

EXPLORING MONETARY POLICY TOOLS AND DOMESTIC PRICE DYNAMICS IN NIGERIA: AN AUTO-REGRESSIVE DISTRIBUTIVE LAG APPROACH

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ABSTRACT

This study investigates the impact of monetary policy tools on domestic price dynamics in Nigeria from 1990 to 2022. Data for the study were obtained from the Central Bank of Nigeria data source and the World Bank's World Development Indicators 2022. Monetary policy rate, broad money supply, cash reserve ratio, Treasury bill rate, and liquidity ratio are adopted to proxy monetary policy tools while commodity price index is employed to capture domestic price dynamics. The study adopted the Augmented Dickey Fuller approach and Auto-Regressive Distributive lag test to ensure the stationary status of the variables and analyse the data. Result from the bounds test showed that monetary policy tools exert a long term influence on domestic price dynamics. Further findings that monetary policy rate has a positive and significant relationship with commodity price index in the previous and second year period while broad money supply exert a negative but significant relationship with commodity price index in the previous and second year period of the short-run. However, Treasury bill rate exhibits a negative but significant effect on commodity price index in the long term as well as the most current year of the long-run. Similarly, liquidity ratio is negative with commodity price index but in the long term while cash reserve ratio is positive but insignificantly related with commodity price index. Hence, it is concluded that monetary policy tools had significant impact on commodity price in Nigeria. Thus, the need for suggesting amongst others that the central bank of Nigeria should consider maintaining the current policy rate or implementing gradual increase. This approach will continue to signal a contentment to price stability.

Keywords: Monetary Policy Tools, Commodity Price, Monetary Policy Rate, Cash Reserve Ratio, Treasury Bill Rate.

Introduction

Monetary policy, a critical tool for economic management, plays a pivotal role in shaping a nation's economic landscape by influencing money supply, interest rates, and overall economic activity. This paper recognizes Monetary policy as actions and strategies implemented by the central bank

to manage a nation's money supply, interest rate, and overall economic activities. It is imperative to note that the primary objectives of monetary policy are to achieve and maintain price stability, control inflation, foster economic growth, and ensure a stable financial system. According to Adesoye, (2012); and CBN (2011)

monetary policy is a combination of measures designed to regulate the value, supply and cost of money in an economy in consonance with the expected level of economic activities. In line with this view, (Mathai, (2012) described monetary policy is the tinkering of the amount of money that circulates in any economy in order to achieve a balance between hitting the target on inflation as well as output.

In Nigeria, the Central Bank of Nigeria (CBN) is tasked with the responsibility of formulating and implementing monetary policy to achieve macroeconomic objectives, particularly price stability. This is especially crucial in Nigeria's context, where the economy faces multifaceted challenges, including high inflation rates, exchange rate volatility, and dependency on oil exports.

Domestic price dynamics, referring to the fluctuations in the price levels of goods and services within the country are significantly influenced by the CBN's monetary policy actions. It is therefore pertinent to note that understanding the interplay between these policy tools and domestic price dynamics is essential for comprehending how effectively the CBN can manage inflation and promote economic stability. For instance, the central bank of Nigeria employs various monetary policy tools to regulate money supply and influence domestic prices. Open Market Operations (OMO), for example, involve the buying and selling of government securities. By selling government bonds, the CBN withdraws liquidity from the banking system, reducing the amount of money available for lending and spending, which can help curb inflation. Conversely, purchasing bonds injects money into the economy, potentially stimulating spending and investment.

Again, the monetary policy Rate (MPR), also known as the benchmark interest rate, directly influences the cost of borrowing. When the CBN raises the MPR, borrowing

costs for businesses and consumers increase, which tends to reduce spending and investment, thus helping to control inflation. Lowering the MPR, on the other hand, makes borrowing cheaper, encouraging spending and investment, which can stimulate economic growth but may also lead to higher inflation if not managed properly. Similarly, the cash reserve ratio (CRR) dictates the proportion of customers' deposits that commercial banks must hold as reserves in the CRR means banks must hold as reserves rather than lend out. An increase in the CRR means banks have less money to lend, which can reduce the money supply in the economy, helping to control inflation. A lower CRR increases the funds available for banks to lend, potentially boosting economic activity but also raising the risk of higher inflation.

Furthermore, the liquidity Ratio (LR) is the minimum percentage of liquid assets banks must maintain. Adjusting this ratio influences the liquidity in the banking system. Raising the LR requires banks to hold more liquid assets, reducing the money available for lending and spending, which can help manage inflation. Lowering the LR can increase liquidity, promoting more lending and spending, but may also contribute to inflationary pressures. For example, in 2019, the CBN aggressively used OMO to manage liquidity and control inflation by issuing OMO bills to mop up excess liquidity, stabilizing the Naira and curbing inflationary pressures. Similarly, in 2020, the CBN reduces the MPR from 13.5% to 12.5% to mitigate the economic impact of the COVID-19 pandemic, aiming to lower borrowing costs and stimulate economic activity. The same year, the CBN increased the CRR from 2.5% to 27.5% to combat rising inflation and excess liquidity in the banking system, reducing the money available for banks to lend and aiding in controlling inflation.

Yet, despite the monetary policy authority (CBN) wielding various policies to

combat mounting price of goods and services, inflation rate keeps on rising. For instance, in 2018, inflation rate stood at 12.1% but declined to 11.4% in 2019. Sadly, inflation rate upsurge to 13.2%, 175 and 18% between 2020, 2021 and 2022 (WDI, 2022). It is against this background that this paper seeks to answer the following questions. How has monetary policy rate influenced domestic price dynamic? Has broad money supply promoted domestic price dynamics? To what extent has cash reserve ratio affected domestic price dynamics? And how has Treasury bill rate enhanced domestic price dynamics? To this end, this paper empirically explores how Monetary policy tools influence domestic price dynamics in Nigeria.

Literature Review

Theoretical Framework

Quantity Theory of Money

The quantity Theory of money, developed by economist Irving Fisher in 1911, posits a direct relationship between the money supply in an economy and the overall price level of goods and services. This theory is encapsulated in the equation of exchange: $(MV = PT)$, where (M) represents the money supply, (V) is the velocity of money (the rate at which money circulates in the economy), (P) denotes the price level, and (T) stands for the volume of transactions or real output. According to Fisher's theory, an increase in the money supply, assuming the velocity of money and the volume of transactions remain constant, leads to a proportional increase in the price level. For instance, if the Central Bank of Nigeria (CBN) increases the money supply to stimulate economic growth without a corresponding increase in real output, this excess money chases the same amount of goods and services, leading to higher prices, i.e., inflation. The velocity of money reflects

how quickly money changes hands in an economy. If the velocity increases while the money supply and real output remain constant, that increased frequency of money changing hands can lead to higher demand for goods and services, pushing up the price level. In Nigeria, factors such as increased consumer confidence or improved financial systems can raise the velocity of money, thereby impacting domestic prices.

The volume of transactions represents the real output or economic activity. If the real output grows, the same amount of money now circulates among a larger quantity of goods and services. In the scenario, even with an increased money supply, if real output grows proportionally, the price level may remain stable. For example, if Nigeria's agricultural sector significantly improves its productivity, the increase in goods and services can offset the inflationary impact of a growing money supply. Consider Nigeria's high inflation rates due to increased money supply from expansive fiscal policies or oil revenue inflows. If the CBN decides to control inflation, it might reduce the money supply by selling government securities through Open Market Operations (OMO). According to Fisher's theory, reducing the money supply while the velocity of money and real output remain relatively stable should lead to a decrease in the price level, thus controlling inflation.

Monetarist Theory

In 1953, Milton Friedman put out the monetarist idea. This theory states changes in the money supply have a direct and proportional impact on price levels in the long-run. This theory is founded on the premise that inflation is always and everywhere a monetary phenomenon, driven primarily by changes in the money supply. In the context of domestic price dynamics in

Nigeria, the application of Friedman's monetarist theory can be understood through several key concepts. Monetarists argue that an increase in the money supply, without a corresponding increase in real output, leads to inflation. For instance, if the Central Bank of Nigeria (CBN) significantly increase the money supply to stimulate economic growth, this can result in too much money chasing too few goods. As a result, the general price level rises, leading to inflation. This relationship is particularly evident in economies like Nigeria's, where supply-side constraints and structural inefficiencies limit the ability to quickly increase output in response to higher demand.

Friedman emphasized the importance of controlling the growth rate of the money supply to manage inflation. He advocated for a steady, predictable increase in the money supply aligned with the natural growth rate of the economy. In Nigeria, where inflation has been a persistent issue, adopting a monetary policy that targets a stable and moderate growth rate of the money supply could help anchor inflation expectations and stabilize prices overtime. However, the application of Friedman's monetarist theory in Nigeria is not without challenges. Structural issues, such as large informal sector, weak financial infrastructure, and external economic shocks (like fluctuations in global oil prices), can promote the relationship between money supply and price levels. Additionally, the need for coordination between monetary policy and fiscal policies is crucial. If the government's fiscal policy is expansionary, leading to large budget deficits and increased public spending, it can undermine the CBN's efforts to control the money supply and stabilize prices.

Empirical Literature

Mwamkonko (2023) examines the relative efficacy of monetary policy transmission channels in Tanzania. The study applied co-integration and error

correction modeling approach to analyze the short-run and long-run comparative effects of five monetary policy transmission mechanisms on economic growth. The study found that growth-effects of monetary policy depends on transmission channels used. The results show that interest rate channel and stock price channel are not effective in Tanzania. The results further show that though the bank credit channel is working, it is weak. Moreover, the results reveal that exchange rate and expected inflation are the dominant transmission channels of monetary policy in Tanzania.

Utilising secondary sourced data Gökhan (2023) the impact on the pricing of agricultural commodities produced by various entities of the US dollar and Turkish lira exchange rates (EXR) and the money supply (M2). The VECM Vector Error Correction Model was used to determine the direction and magnitude of the association among the data. The findings show that in the short term, the causation goes from agricultural price (AP) to M2, but not the other way around. Over time, EXR has a greater impact than M2. In the agricultural pricing equation, the coefficient of error correction is 0.0726, which is statistically significant at the 1% level. All of the system's instability can be corrected, according to it, in around 14 months. This study demonstrates that M2 and the exchange rate (EXR) significantly impact agricultural prices (AP) in the long term. Keeping a careful eye on these macro factors is essential for agricultural price management.

Applying the Autoregressive Distributed Lagged (ARDL) Cointegration Bound test. Quarterly time series data from 2006:1 - 2020:4. Abbas (2023) examines the monetary policy effectiveness and inflation dynamics in Nigeria for inflation, money

supply, monetary policy rate, liquidity ratio, and cash reserve requirement were used in the empirical analysis. The result of the bound test suggests that there exists a long-run cointegration relationship between inflation and the monetary policy variables included in the model. The ARDL short-run estimates show that all the selected monetary policy instruments have a predictable influence on the inflation rate with varying lags. While the long-run estimates indicated that only the monetary policy rate and cash reserve ratio significantly influence the inflation rate. The result of the granger causality test shows a bidirectional causality between broad money supply and inflation rate and a unidirectional causality running from inflation rate to liquidity ratio.

Tonprebofa (2022) explored monetary policy effect on inflation stabilization in Nigeria. Monthly time series data from 2009-2018 were used in estimating the model. The ADF test for the stationarity, the johansen cointegration test and the vector error correction model were utilized in testing the variables. The findings from the unit root test did indicate stationarity at first difference 1(1). The cointegration (Johansen) test indicates that there was a nexus linking inflation and all the regressors adopted in the long term. The result of the VECM for the two estimated models shows a self-equilibrating mechanism of 14 per cent and 32 per cent for the first and second models respectively. The findings further reveal that the variables; liquidity ratio, policy rate (MPR), exchange rate, reserve requirement and treasury bills rate all had an effective impact on the inflation rate and that that effect was very significant.

Using a data-rich framework covering the years 1986-2020, Oneh et al.

(2022) examined the effect of monetary policy on price stability in Nigeria. The researchers were interested in learning which monetary policies have been successful in promoting price stability and how inflation reacts to changes in monetary policy. The study employed Auto-regression Distributed Lag (ARDL) Bound Test for Cointegration of data analysis and Error Correction Model (ECM) estimation. The ADF test revealed that, inflation (INF), exchange rate (EXR) and broad money supply (M2) were stationary at first difference 1(1); while monetary policy rate (MPR) and real interest rate (RIR) were stationary at level 1(0). The results of the ARDL bounds revealed that the null hypothesis of no long-run relationship were all rejected implying that a long-run effect exists among monetary policy variables and price stability. The result of the analysis shows that EXR, M2, and MPR have negative and insignificant on price stability, while RIR has negative and significant on price stability.

In their study covering the years 1986–2018, Bank-Ola et al (2020) analyze how monetary policy affected price stability in Nigeria. Inflation consumer prices was used to gauge price stability, while monetary policy variables included cash reserve ratios, liquidity ratios, exchange rates, money supply, and imports of goods and services. After performing a diagnostic test, the researchers used secondary time series data retrieved from the WDI and the CBN Statistical Bulletin 2018 to construct the Auto-Regressive Distributed Lag (ARDL) model. According to the study's findings, the cash reserve ratio was the only monetary policy tool that significantly and positively impacted price stability. During the time period under consideration, imports of goods and services had a positive but negligible

effect on price instability, but liquidity ratio, exchange rate, and money supply had a negative and small influence.

By means of secondary yearly data from 1981 to 2019, Salihu (2020) examined how successful monetary policy was in managing inflation in Nigeria. The research monitored inflation using the following variables: money supply, rate of Treasury bills, rate of monetary policy, and exchange rate. The paper used the following tests to determine if the variables were related over the long term: the cointegration method, the Granger causality test, and the Augmented Dickey Fuller unit root test. Ordinary Least Square (OLS) was chosen as the best linear unbiased estimator because of its properties. In the first part of the investigation, we used the Augmented Dickey Fuller (ADF) unit root test to examine the relevant variables. We found that, while the variables were stationary at first differences, they were non-stationary at level. The variables were shown to have a long-run association according to the Johansen co-integration test. There was a positive correlation between inflation in Nigeria and the money supply, monetary policy rate, and Treasury bill rates, according to the empirical results of the OLS test. As a result, inflationary pressures increase as the value of a currency declines. The study found that inflation was affected by the money supply, the rate of treasury bills, monetary policy, and the exchange rate during the study period. It suggests that open market operations should not use the annual Treasury bill rate as a proxy for inflation management.

In their 2015 study, Bortey explore the relationship that exists between monetary policy and inflation in Ghana by examining the extent to which inflationary pressures can be attributable to monetary. The study used stylized facts and data on the

Ghanaian economy show that, money supply and inflation has shared a similar trend for most years. Quarterly data ranging from 1990q1 – 2013q4 on money supply, CPI and other determinants of inflation were used in the study. Employing impulse response function and variance decomposition in a VAR and VECM model, the paper found the existence of a long-run relationship between inflation and the other variables, also the variations in inflation is the results of money supply, the nominal exchange rate, and shocks to inflation itself. The empirical findings also show that response of inflation to a shock persists for over two years (six quarters), with the adjustment from disequilibrium fairly slow.

From 1970 to 2014, Babatunde and Kehinde (2016) analyze how monetary policy affected price stability in Nigeria. This research used the statistics bulletin from the Central Bank of Nigeria to compile its data, which was then evaluated using a unit root test, Johansen co-integration test, and ordinary least square regression (OLS) model. The overall price level is represented by the described variable, and the Consumer Price Index (CPI) is used as a surrogate for it. Two explanatory variables were employed: the money supply and the exchange rate. Budget deficits, changes in policy formulation, a lack of a conducive financial market environment, and political instability are some of the monetary policy issues that the study tackled. The research shows that the money supply and exchange rate have an effect on price stability in Nigeria over the long and short term. The 90% coefficient of determination and F-Statistics of 168.30, which exceed the calculated F-Statistics, provide support of this.

The study by Yakubu et al. (2013) looks at how the interplay between fiscal

and monetary policy affects the rise of prices and production in Nigeria. Policy factors like as money supply and government income seem to have a stronger beneficial influence on pricing and economic development in Nigeria, according to innovation assessments. However, this effect is long-lasting and lags behind other variables. While fiscal and monetary policy factors do impact economic activity, our analysis shows that for most periods, economic activity is driven mostly by its own dynamics. This paper's calculations imply that fiscal and monetary policy have a larger influence on inflation and real GDP in Nigeria. Although certain policy factors are seen to be more helpful to social and economic development than others, it is clear that the effect of policies much depends on the policy variables chosen.

So, the research analyzed Irvin Fisher quantity theory of money, and Milton Friedman's monetarist theory. Both the Quantity Theory of money (QTM) by Irving Fisher and the Monetarist theory by Milton Friedman are based on the equation of exchange, which states that the money supply multiplied by the velocity of money equals the total spending in an economy. Irving Fisher's Quantity theory assumes that the quantity of money is stable, meaning that changes in the money supply only affect nominal variables, not real variables. It focuses primarily on the long run and suggests that changes in the money supply primarily affects prices, with a neutral effect on real variables like output or employment.

In contrast, Milton Friedman's Monetarist Theory builds on the Quantity Theory but adds the belief that the Central Bank has direct control over the money supply. Friedman argued for a stable and predictable growth rate of the money supply,

advocating for a rule-based approach to monetary policy. He also emphasized the role of expectations in determining velocity, suggesting that changes in expectations about inflation can influence the velocity of money.

As a result, there is a conflict between the quantity theory monetarist postulates on the controllability of the money supply and the role of expectations. Monetarists believe that Central Bank can directly control the money supply and that expectations play a crucial role in determining velocity. In contrast, Fisher's theory assumes a more passive role for monetary authorities and does not explicitly incorporate expectations into its framework. Evidently, there is a void.

Based on its empirical evaluation of many prior investigations, the current investigation found inconsistent and sometimes contradictory findings. Examples of previous research that found monetary policy factors to have a positive and substantial effect on prices are Salihu (2022) and Babatunde (2016). The opposite is true according to the research of Mwamkonko (2023); Bank-ola et al (2020); Oneh et al. (2022), who found that all monetary policy variables—including the money supply, the exchange rate, and the real monetary policy rate—had a negative and insignificant impact on prices. Gorham (2023). Notably, previous research only examined interest rates, money supply, money reserve ratios, and Treasury bill rates as proxies for monetary policy; none of the studies took a more comprehensive approach by considering all of these variables together. Furthermore, it was discovered that not a single one of these studies used the commodity price index as a stand-in for the dependent variable "commodity price." This finding implies a lack of coverage in the literature.

Methodology

Secondary data for this article came from the World Bank's development indicators and the Central Bank of Nigeria's (CBN) statistics bulletin; the research methodology used was ex-post facto. In the context of this study, this data source is deemed trustworthy and reliable. There will be thirty-two (32) years of data, spanning the years 1990 to 2022. To represent monetary policy tools, we used the following proxies: monetary policy rate (MPR), cash reserve ratio (CRR), broad money supply (MS), Treasury bill rate (TBR), and liquidity ratio (LR). To capture commodity pricing, we used the commodity price index (CPI).

Model Specification

This study's model is an adaptation of Gökhan's (2023) work on the impact of monetary policy indicators on crop prices. The one they used was;

$$AP = f(\text{EXR}, \text{M2}) \quad (1)$$

Where:

AP = Agricultural Commodity Price, EXR = Exchange Rate, M2 = Money supply

Thus, the researcher adjusted the model to include more factors in order to accomplish the goal of this study. The Monetary Policy Rate (MPR), Cash Reserve Ratio (CRR), Treasury Bill (TBR), and Liquidity Ratio (LR) are all part of this set. Monetary policy is represented by including these three factors. The following is a statement of the new enlarged model:

$$\text{CPI} = f(\text{MPR}, \text{CRR}, \text{MS}, \text{TBR}, \text{LR}) \quad (2)$$

$$\text{CPI} = \beta_0 + \beta_1\text{MPR} + \beta_2\text{CRR} + \beta_3\text{MS} + \beta_4\text{TBR} + \beta_5\text{LR} \quad (3)$$

$$\text{CPI}_t = \beta_0 + \beta_1\text{MPR}_t + \beta_2\text{CRR}_t + \beta_3\text{MS}_t + \beta_4\text{TBR}_t + \beta_5\text{LR}_t \mu_t \quad (4)$$

Where:

CPI = Commodity Price, MPR = Monetary Policy Rate, CRR = Cash Reserve Ratio,

MS = Broad Money Supply, TBL = Treasury bill Rate, LR = Liquidity Ratio, μ = Error term, β_0 = Constant and β_1 to β_5 = Parameter Estimates.

The expectations are: β_1 , and $\beta_2 > 0$, β_3 , β_4 and $\beta_5 < 0$, suggesting that, the sign of β_1 , and β_2 are by theory expected to have a positive relationship with commodity price index, since increase in MPR, and CRR will limit financial institution from creating funds thereby leading to cost of capital which will in turn increase commodity price, while β_3 , β_4 and β_5 are expected to have a negative relationship with commodity price.

Description of Variables in the Model

i. Commodity Price Index (CPI): The commodity price index, which is a measure of the average changes in the prices paid or received by producers and consumers for a basket of commodities over time, is a good indicator of commodity prices. Consequently, the index of commodity prices is employed as a stand-in for the dependent variable.

ii. Monetary Policy Rate (MPR): This refers to the interest rate set by the central bank as part of its monetary policy to influence the economy. In another word, it is the rate at which banks can borrow money from the central bank. This implies that as interest rate increases, borrowing becomes more expensive, which can reduce consumer and business spending. This decrease in demand will put downward pressure on commodity prices. Thus, the purpose of this study was to test the hypothesis that monetary policy rates and commodity price indices are negatively related. A yearly percentage is the unit of measurement for monetary policy rate. Economic theory predicts a negative correlation between monetary policy rates and commodity price indices, according to the research. Therefore, β_1 is less than 0.

iii. Cash Reserve Ratio (CRR): This instrument of monetary policy allows the central bank to regulate the needed level of liquidity among deposit money institutions relative to their total deposits. Importantly, if the cash reserve ratio were to rise, banks would have less cash on hand, which would reduce liquidity in the financial system and dampen investment and consumer spending. The researchers in this study thus presupposed that the cash reserve ratio and the commodity price index were positively related. The ratio of cash on hand to total assets is a yearly percentage. The study's theoretical foundations in economics lead it to conclude that a positive correlation exists between the cash reserve ratio and the commodity price index. Therefore, β_2 is greater than zero.

iv. Broad Money Supply (MS): The whole amount of currency in circulation, or the wide money supply, is an important measure of economic health. Coins and notes, other kinds of demand deposits, savings accounts, and other assets that may be turned into cash fast are all part of this category. Increasing the money supply has the potential to stimulate the economy as a whole. Thus, the commodity price index and the broad money supply are anticipated to have an inverse relationship. The monetary base is

quantified in billions of Naira each year. Three, less than zero.

v. Treasury Bill (TBL): Typically having a maturity of one year or less, they are government-issued debt securities. Treasury bills will become more appealing to investors looking for low-risk returns if the rate is increased. For this reason, the commodity price index and Treasury bill are likely to move in the opposite direction. ($\beta_4 < 0$).

vi. Liquidly Ratio (LR): This represent a financial metric that measures a company's ability to pay off its short debts with its short-term assets. This implies that as banks holds more cash or highly liquid assets, they may have less capital available for leading, leading to decreased investment and consumption. This situation will put downward pressure on commodity prices. Therefore, this paper hypothesises a negative relationship between liquidity ratio and commodity price index ($\beta_5 < 0$).

Empirical Data Analysis

Unit Root Test

In order to minimize false regression, the research used the Augmented Dickey Fuller (ADF) unit root test to determine the order of integration of the variables under consideration. This helped in selecting the proper technique.

Table 1: Unit Root Test Using Augmented Dickey Fuller (ADF)

| Variables | Levels | | First Difference | | Order of Integration | P-value |
|-----------|----------------|-------------------|------------------|-------------------|----------------------|---------|
| | ADF Statistics | 5% Critical Value | ADF Statistics | 5% Critical Value | | |
| LCPI | -3.859777 | -2.957110 | | | 1(0) | 0.0060 |
| LMPR | -2.753035 | -2.957110 | -6.889077 | -2.960411 | 1(1) | 0.0000 |
| LMS | -1.852821 | -2.957110 | -4.656258 | -2.963972 | 1(1) | 0.0008 |
| LCRR | -4.490728 | -2.957110 | | | 1(0) | 0.0012 |
| LTBR | -2.782900 | -2.957110 | -5.869186 | -2.960411 | 1(1) | 0.0000 |
| LLR | -2.759132 | -2.957110 | -6.322406 | -2.960411 | 1(1) | 0.0000 |

Source: Author Computation 2024* Level of significance at 5%

This study employs the Augmented Dickey-Fuller (ADF) unit root tests to check the order of integration of the variables and the results are presented in Table 1. The results of Augmented Dickey-Fuller (ADF) showed that the variables are integrated in different order or a combination of I(0) and I(1) series. The ADF result revealed that

LMPR, LMS, LTBR and LLR are stationary at levels I(0) while, LCPI, and LCRR, are stationary after first differencing I(1). This condition makes the Autoregressive Distributive Lag (ARDL) Bounds test approach to co-integration appropriate for investigating the long-run relationship among these variables.

Table 2: ARDL Bound Test

| Test Statistics | Value | K | |
|-----------------|----------|------|--|
| F-statistics | 5.531600 | 5 | |
| Significance | I (0) | I(1) | |
| 10% | 2.26 | 3.35 | |
| 5% | 3.62 | 3.79 | |
| 2.5% | 2.96 | 4.18 | |
| 1% | 3.41 | 4.68 | |

Source: Authors Computation 2024

Table 2 shows that the variables are related to one another over the long term, as the F-statistic of 5.531600 is greater than the critical values for both the lower and upper bounds. We conclude that there must be a

long-term association and reject the alternative hypothesis. This indicates that the commodity price in Nigeria is related to monetary policy tools over the long term.

Table 3: ARDL Long-run Result (LCPI)

| Variable | Coefficient | Std. Error | t-Statistic | Prob |
|----------|-------------|------------|-------------|--------|
| LMPR | 10.36310 | 11.97439 | 0.864604 | 0.4124 |
| LMS | 0.849697 | 0.237127 | 3.583297 | 0.0024 |
| LCRR | 0.437166 | 0.399439 | 1.094451 | 0.3056 |
| LTBR | -0.812663 | 0.279053 | -2.912217 | 0.0083 |
| LLR | -0.055344 | 0.020056 | -2.759487 | 0.0093 |

Source: Authors computation 2024

As shown in table 3 of the Autoregressive Distributive Lag (ARDL) Long term result, there was a positive link (+10.36310) between the logarithm of monetary policy rate (LMPR) and the log value of the commodity price index (LCPI), which is a proxy for commodity pricing in Nigeria. If the log value of monetary policy rate (LMPR) were to increase by one unit, the log value of the commodity price index (LCPI) would climb by about 10.4 units. The p-value of 0.4124 suggests that the

correlation between the log value of monetary policy rate and the log value of the commodity price index is not statistically significant. This agrees with economic theory which predicts that, a rise in the monetary policy rate is likely to cause the logarithm of the commodity price index to rise.

As a surrogate for Nigerian domestic prices, the log value of the commodity price index (LCPI) showed a positive association (+0.849697) with the long-run ARDL result

of the log of broad money supply (LMS). There is a statistically significant correlation between the logarithm of broad money supply and the logarithm of its commodity price index ($p = 0.0024$).

In addition, the cash reserve ratio (CRR) showed a positive correlation (+0.437166) with the commodity price index (LCPI), which is a stand-in for commodity pricing in Nigeria. If the cash reserve ratio (CRR) in Nigeria grow by one unit, the log value of the commodity price index (LCPI) would increase by almost 0.43%. Cash reserve ratio has a statistically insignificant effect on the log value of the commodity price index, nevertheless, with a probability value of 0.3056.

In addition, the value of the commodity price index (LCPI) as a proxy for commodity pricing in Nigeria had a negative correlation of (-0.812663) with the

value of the Treasury bill rate (TBR). Thus, the log value of the LCPI in Nigeria would decrease by about 0.81% for every unit rise in the value of the Treasury bill rate (TBR). But with a probability of 0.0083, the effect of the Treasury bill rate on the log value of the commodity price index is statistically significant.

Last but not least, the value of the commodity price index (LCPI) as a surrogate for commodity pricing showed a negative association (-0.055344) with the log value of the liquidity ratio (LLR). So, for every one unit increase in the log value of liquidity ratio (LLR), the log value of the commodity price index (LCPI) in Nigeria would rise by almost 0.06%. There is a statistically significant relationship between the logarithm of liquidity ratio and the logarithm of the commodity price index, according to the probability value of 0.0093.

Table 4: ARDL Short-run Result (LCPI)

| Variable | Coefficient | Std. Error | t-Statistic | Prob |
|--|-------------|------------|-------------|--------|
| C | 0.340229 | 0.056300 | 6.043129 | 0.0003 |
| D(LMPR) | 0.604556 | 0.073660 | 8.219904 | 0.0000 |
| D(LMPR(-1)) | -0.741951 | 0.128730 | -5.763624 | 0.0004 |
| D(LMPR(-2)) | -0.257930 | 0.075656 | -3.409251 | 0.0092 |
| D(LMS) | 0.044216 | 0.097081 | 0.455451 | 0.6609 |
| D(LMS(-1)) | -0.077428 | 0.132432 | -0.584659 | 0.5749 |
| D(LMS(-2)) | 0.120458 | 0.119260 | 1.010049 | 0.3420 |
| D(LCRR) | 0.027968 | 0.027323 | 1.023612 | 0.3360 |
| D(LCRR(-1)) | 0.001716 | 0.024841 | 0.069098 | 0.9466 |
| D(LCRR(-2)) | 0.069728 | 0.037241 | 1.872338 | 0.0981 |
| D(LTBR) | -0.217867 | 0.040614 | -5.364322 | 0.0007 |
| D(LTBR(-1)) | 0.334095 | 0.095981 | 3.480852 | 0.0083 |
| D(LTBR(-2)) | 0.086927 | 0.056305 | 1.543851 | 0.1612 |
| D(LLR) | -0.052151 | 0.062600 | -0.832290 | 0.4294 |
| D(LLR(-1)) | 0.784695 | 0.092856 | 8.450684 | 0.0000 |
| D(LLR(-2)) | 0.415999 | 0.064730 | 6.426703 | 0.0002 |
| Ecm (-1) | -0.183504 | 0.024987 | -7.343916 | 0.0001 |
| Adj R ² = 0.869747, F-stat = 13.10276 (0.000016), DW = 2.339119 | | | | |

Source: Authors computation 2024.

The coefficient estimate for the error correction term, ECM (-1) has a negative

value and is significant at the 0.05 level. It suggests that the model will reach long-run

equilibrium at a rate of 18% every year. This means that a yearly adjustment speed of 18% may fix the mistake from the previous year.

The independent variables (MPR, MS, CRR, TBR & LR) explain 87% of the total variance in the dependent variable (CPI), according to the corrected R-Square (R²) value. As a whole, the model is noteworthy since the F-statistic is significant at the 5% level of significance. Without serial correlation, the model would not work, according to the Durbin-Watson statistics of 2.339119, which is close to 2.

Table 4 displays the model's short-run outcome. A negative monetary policy rate (MPR) of (-0.741951, and -0.257930) was seen in the the preceding, and the second year periods when the log value of the commodity price index (LCPI) was used as a surrogate for commodity price in Nigeria. This means that the log value of the commodity price index (LCPI), which is a proxy for domestic price, would decline by approximately 0.74%, and 0.25% for every unit increase in the log value of monetary policy rate (MPR) in Nigeria. Monetary policy rate and commodity price index log value do correlate statistically ($p=0.0004$, and 0.0092 , respectively). Economic theory do not predict this outcome. The log value of the commodity price index is likely to slow down in response to an increase in monetary policy rate.

As a substitute for commodity prices in Nigeria over the current year, the log value of the commodity price index (LCPI) is positive (+0.044216) when applied to the logarithm of broad money supply (LMS). This means that the log value of the commodity price index (LCPI), which is a proxy for domestic pricing, would rise by about 0.04% for every unit rise in the log value of the broad money supply (LMS) in

Nigeria. The correlation between the logarithm of the broad money supply and the logarithm of the commodity price index is statistically insignificant ($p=0.6609$). Economic theory predicts this outcome. As the money supply expands, the log value of the commodity price index is anticipated to increase.

Using the log value of the commodity price index (LCPI) as a stand-in for domestic prices in Nigeria over the current, previous and second year, the cash reserve ratio (CRR) also has a positive value of (+0.027968, +0.001716 and +0.069728). If the cash reserve ratio (CRR) in Nigeria increases by one unit, the log value of the commodity price index (LCPI), which is a proxy for commodity pricing, would upsurge by about 0.002%, 0.002% and 0.07%. Based on the p-value of 0.3360, 0.9466 and 0.0981, it can be concluded that the cash reserve ratio is significantly related to the log value of the commodity price index. Economic theory does not support this outcome. The predicted outcome is that the log value of the commodity price index will rise in response to an increase in the cash reserve ratio.

Similarly, using the log value of the commodity price index (LCPI) as a stand-in for commodity prices in Nigeria in the most recent year, the value of the Treasury bill rate (TBR) is negative (-0.217867). If the Treasury bill rate (TBR) in Nigeria were to rise by one unit, the log value of the commodity price index (LCPI), which is a proxy for commodity pricing, would fall by about 0.022%. The correlation between the yield on Treasury bills and the logarithm of the commodity price index is statistically significant ($p = 0.0007$). Economic theory predicts this outcome. The predicted outcome of a rise in the rate of interest on

Treasury bills is that the log value of the commodity price index will fall.

Last but not least, as a surrogate for commodity prices in Nigeria during the previous and second year period, the log value value of the liquidity (LLR) is positive (+0.784695 and +0.415999) using the log value of the commodity price index (LCPI). This means that the log value of the commodity price index (LCPI), which is a proxy for domestic pricing, would rise by

about 0.78% and 0.042 for every unit increase in the log value of the liquidity ratio (LLR) in Nigeria. A statistically significant association between the log value of liquidity ratio and the log value of the commodity price index is shown by the p-value of 0.0000 and 0.0002. Economic theory predicts this outcome. The predicted outcome of a rise in the liquidity ratio on commodity rice is that the log value of the commodity price index will fall.

Diagnostic Test

Table 5: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results

| | F-Statistic | Prob-Value |
|---|-------------|------------|
| Ramsey Reset Test | 0.451380 | 0.5232 |
| Breusch-Godfrey Serial Correlation LM Test | 0.442738 | 0.6617 |
| Breusch-Pagan-Godfrey Heteroskedasticity Test | 0.432351 | 0.9408 |

Source: Authors computation 2024

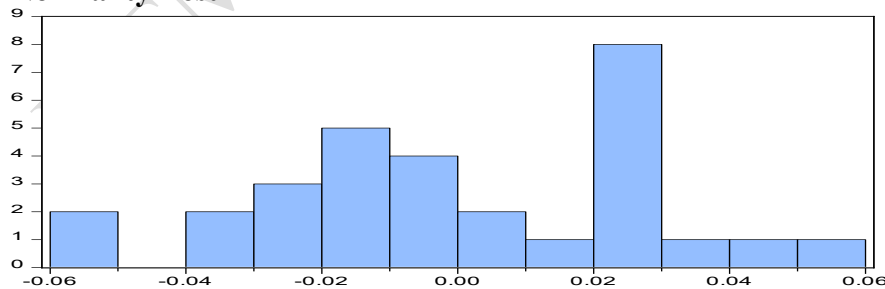
From the diagnostic test results in Table 5, we can see that the Ramsey Reset test for linearity found an f-statistic of 0.451380 and a computed p-value of 0.5232, both of which are greater than the 5% (0.05) critical value. Consequently, we can reject the null hypothesis and conclude that the model is correctly specified.

The f-statistic is 0.442738 and the Chi-Square probability value is 0.6617, according to the Serial or Autocorrelation Test utilizing the Breusch-Godfrey Serial Correlation LM Test. This proves that there

is no serial correlation in the model, as the probability value of around 7% (0.6617) is higher than the crucial value of 5% (0.05).

An f-statistic of 0.432351 and a Chi-Square probability value of 0.9408 were produced by the heteroscedasticity test that used the Breusch-Pagan-Godfrey test. With a probability Chi-square value more than 5% ($P > 0.05$), the results point to the absence of heteroskedasticity in the model. Thus, residuals are homoscedastic, meaning they have a constant variance, an ideal property for regression.

Normality Test



| Series: Residuals | |
|-------------------|-----------|
| Sample 1993 2022 | |
| Observations 30 | |
| Mean | -5.45e-16 |
| Median | -0.006903 |
| Maximum | 0.057385 |
| Minimum | -0.058996 |
| Std. Dev. | 0.029067 |
| Skewness | -0.092780 |
| Kurtosis | 2.410249 |
| Jarque-Bera | 0.477798 |
| Probability | 0.787494 |

The residuals are normally distributed, as shown in the figure above,

which summarizes the normalcy test. The Jarque-Bara value is 0.477798, and the

associated probability value is 0.787494, both of which are more than the 0.05 threshold of significance.

Discussion of Findings

(i) Monetary Policy Rate and Commodity Price Index in Nigeria

In the preceding and succeeding year's time period of the short-run, the results of the regression analysis using the Auto-Regressive Distributive Lag (ARDL) method showed that the monetary policy rate (MPR) has a negative association with the commodity price index (CPI). It agrees with economic theory that monetary policy rate (MPR) and the commodity price index (CPI) have a negative relationship. The general public foretells that when monetary policy rate (MPR) rises, it will lead to higher borrowing costs, which can reduce consumer spending and business investment. This in turn will result to decrease in commodity prices. But the result's p-value shows that monetary policy rate (MPR) has a statistically significant effect on the CPI. Therefore, the analysis concludes that the null hypothesis that the MPR and CPI are not significantly related is incorrect. The results of this study are in line with those of earlier research by Abbas (2023); Tonpreboba (2022); and Salihu (2020).

(ii) Broad Money Supply and Commodity Price Index in Nigeria

From what we can see, in the long term, there is a strong correlation between the broad money supply (MS) and the commodity price index (CPI). Economic theory predicts a positive correlation between the MS and the CPI (commodity price index). A rise in the broad money supply (MS) will lead to higher demand for commodities due to increased spending power. With more money circulating in the economy, consumers and business may have greater purchasing ability, leading to increased demand for goods and services which will in turn put upward pressure on commodity price. Wide-ranging money supply (MS) does have a statistically significant

effect on the commodity price index (CPI), according to the p-value of the outcome. Since the research found a substantial connection between broad money supply (MS) and commodity price index (CPI), the null hypothesis that there is no relationship between the two is rejected. Previous research by Salihu (2020) instill confidence on the results of this investigation.

(iii) Cash Reserve Ratio and Commodity Price Index in Nigeria

An unfavorable association between cash reserve ratio (CRR) and commodity price index (CPI) was inferred using regression analysis. It defies economic theory that cash reserve ratio (CRR) has a negative connection with the commodity price index (CPI). Since deposit money banks have less cash on hand, an increase in the cash reserve ratio (CRR) is likely to cause interest rates to rise, making borrowing more expensive and, in turn, driving up the cost of goods and services in the country. Cash reserve ratio (CRR) has a statistically insignificant effect on commodity price index (CPI), according to the p-value of the finding. Therefore, the analysis concludes that the null hypothesis that the cash reserve ratio (CRR) and commodity price index (CPI) do not have a significant link is true. Earlier studies by Bank-ola et al (2020) inspire trust on the results of this investigation.

(iv) Treasury Bill Rate and Commodity Price Index in Nigeria

Also, in the long-run and the most recent year's worth of data, we see that the connection between the Treasury bill rate (TBR) and the commodity price index (CPI) is negative. Economists' predictions about a negative correlation between the TBR and the CPI are spot on. The anticipated slowdown in the growing costs of goods and services in the nation is a result of a rise in the Treasury bill rate (TRB). The result's p-value, however, suggests that the Treasury bill rate (TBR) has a statistically significant effect on the CPI. Accordingly, the study's

results disprove the null hypothesis that the correlation between the TBR and CPI is not statistically significant. Prior research by Yakubu et al (2013) engender confidence on the results of this investigation.

(v) Liquidity Ratio and Commodity Price Index in Nigeria

Finally, the estimated model's results showed that a negative liquidity ratio (LR) has a long-term drawback on the commodity price index (CPI). Economic theory predicts a negative correlation between the liquidity ratio (LR) and the commodity price index (CPI). Changes in liquidity ratio signal broader economic conditions that could impact commodity markets such as shift in monetary policy or banking regulations. This means that an increase in liquidity ratio will potentially reduce lending and spending, which could lead to lower demand for goods and service. According to the p-value of the finding. It follows that the investigation does not support the null hypothesis that the correlation between the LR and the CPI is not statistically significant. Research by Tonprebofa (2022) corroborate the results of this research.

Conclusions and Recommendations

According to the study's conclusions, commodity prices are significantly affected by changes in monetary policy tools including monetary policy rates, money supply, Treasury bill rates, liquidity rates etc. Regression analysis on the link between monetary policy rate and commodity prices found that, in the previous and second years' worth of data, monetary policy rate is negative but significantly correlated with commodity prices, whereas broad money supply is positively and significantly correlated with commodity prices in the long-term. For the longterm and present short-term timeframe, it was also determined that the rate of Treasury bills had a negative and statistically significant correlation with

commodity prices. Similarly, liquidity indicated a negative but significant impact with commodity prices in the long-term. Lastly, according to the regression results, there is a positive but negligible association between the cash reserve ratio and commodity prices in the long run and in the short run compared to the previous year.

Recommendations

- i. Central Bank of Nigeria (CBN) should consider maintaining the current policy rate or implementing gradual increase. This approach will continue to signal a contentment to price stability.
- ii. The monetary policy authority (CBN) should consider tightening monetary policy by reducing the growth rate of the broad money supply. This can be achieved through higher policy interest rates, which will make borrowing more expensive and reduce the money supply.
- iii. Central bank of Nigeria (CBN) should re-evaluate the effectiveness of using cash reserve ratio as a primary tool for controlling inflation. Focus on their more impactful monetary policy tools.
- iv. Federal government through the Central bank of Nigeria (CBN), should consider increasing the Treasury bill rates as a tool to control inflation. Higher rate on treasury bills can attract investment into government securities, reducing excess liquidity in the economy, helping to curb inflationary pressure.
- v. Finally, federal ministry of finance should ensure close coordination between fiscal and monetary policies to support the Central banks efforts in managing inflation.

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