

The Dynamics of Nigeria's Money Supply on Domestic Output

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Abstract:

This study looked at how Nigeria's domestic output growth is impacted by the dynamics of the money supply. The study's goals was to identify the long- and short-term relationships between the narrow money supply ($M(1)$), and the real gross domestic product (RGDP), the long- and short-term relationships between the broad money supply ($M(2)$) and the real gross domestic product, and the causal links between the RGDP, the $M(1)$ and the $M(2)$. To get the data needed for the investigation, a secondary source of data collection was used. The Augmented Dickey-Fuller (ADF) test, the Johansen-Juselius Co-integration test, the Vector Error Correction Model (VECM), and the Granger Causality test were the tools used for data analysis. It was found that all the variables were integrated of the first difference and stationary over the observed period. The Johansen-Juselius co-integration test was found to be suitable for determining the long term relationship amongst the variables since all the variables were integrated of the first difference. Also, it was found that two co-integration equations exist for the model. Hence, the vector error correction model VEC Model was estimated to account for the long term dynamics. The two co-integration models obtained in the study ECM(1) & ECM(2) were found to have negative significant coefficients which imply that there exists a long-run causality running from $M(1)$ and $M(2)$ to RGDP for the two co-integration equations with the speed of adjustment to the equilibrium of 2.0854 and 0.7679 respectively. Also, the existence of a short-run causality running from $M(1)$ to RGDP was found while there is no evidence of a short-run causality running from $M(2)$ to RGDP.

Keywords:

Co-integration, Error Correction, Money Supply, RGDP

1. Introduction

The main concerns of economists, researchers and policymakers are to study the causal links between money and other macroeconomic aggregates, such as income,

prices, interest rates and exchange rates. This relationship is very important because it demonstrates the relevance and effectiveness of the monetary policy, especially in a small open economy such as Nigeria with double-digit inflation and epilepsy. Different schools of economics have postulated different relationships between money and macroeconomic aggregates. Keynesians, monetarists, new classics, and young Keynesians agree that monetary turmoil has a positive effect on output, but they do not agree on the nature of these positive effects and how they are transmitted. While Keynesians postulated that a positive monetary shock from interest rates and investment would increase both economic activity and price levels, monetarists disagree with the long-term positive effect of monetary shocks, according to the classical argument. The new classical economists spread the effects of monetary shocks based on the expected expansion of the money supply. They believed that only an unexpected expansion of the money supply would lead to an increase in production.

The young Keynesians postulated, at least in the short term, the neutrality of the money supply because of tight prices and wages; and market failures and failures [11]. A study Olatunji et al. [11] argues that the real business cycle postulated that a monetary shock does not have a positive effect on output, but only raises interest rates and price levels. According to this theory, the money supply is endogenous and the output is exogenous, and it is mainly determined by technology. The current macroeconomic paradigm means that the dynamic causal link between money and macroeconomic aggregates (eg output, price levels) is unclear and unresolved.

A country's real gross domestic product, which refers to real production, is essentially a measure of the health and size of its economy. The indicator of economic health is the value of the country's total output of goods and services at market prices, excluding net income abroad. It is important to note that an increase in a country's real output (GDP) is synonymous with the changes taking place in its economy. However, these changes, which can be an economic success, depend to a large extent on the effectiveness of the monetary policy framework, and some insight into the near future is needed to achieve this. As a result, decision-makers need to develop forecasts to help them make decisions. Monetary policy has an important role to play in achieving the key economic goals of sustainable growth, full employment, price stability and a healthy balance of payments. However, in pursuing these goals, the central bank has always set intermediate targets for monetary policy. These are targets for the use of interest rates, money supply, bank lending and exchange rates to achieve key monetary management objectives and are seen as channels through which monetary policy is transmitted to the macro-economy to achieve the ultimate objective [16].

The study by Schneider et al. [14] looked at the long-run relationship between macroeconomic variables in Germany between the first quarter of 1991 and the fourth quarter of 2005. These long-term relationships are based on production, arbitrage, solvency and portfolio balance sheet conditions, as well as stock flows and accounting identities. The underlying economic theory provides five long-term relationships or equilibrium conditions between the nine variables of the macro model. The long-term relationship is embedded in an unbounded VECM model with nine variables. The calculated VECM model identifies five long-term relationships within the theoretical constraints of long-term coefficients. Using quarterly data series from January 1995 to December 2008, the study by Pal and Mittal [13] studied the long-run link between the Indian capital market and important macroeconomic factors. Stock market indexes, market capitalization, the value of sold shares, and macro-

variables like inflation, interest rates, and money supply are all factors that the capital market was evaluated for. The study by Muhammed and Irshad [17] looked at an overview of the Indian capital market by examining the growth process of capital markets, the structure of their evolution and the operation through stock exchanges in India. The study also looked at the development of the regulatory mechanism for the Indian capital markets. The study shows that during India's first and second five- year plans, public sector companies were healthier than private companies, but their shares were not listed and capital markets were not well organized. However, in the Indian context, the study by Mishra et al. [6] considered key market parameters such as market size, market liquidity, market turnover, market volatility and the efficiency of the Indian capital market between 2002 and 2009 to analyze and assess India's two leading equities markets, the Bombay Stock Exchange and NSE India. The use of time series econometrics indicates greater volatility and weak inefficiencies in the Indian stock market. However, the market has great potential for more market size, more liquidity and a reasonable level of market turnover.

A study conducted by Akinboyo and Olowofeso [2] examined the nature of the long-run relationship between economic growth, the exchange rate, and other variables considered using the boundary checks of the Cointegration approach and autoregressive distributed delay models (ARDL). A stability test and a residual diagnostic test were performed to verify that the assumptions of the classical linear regression model were followed. The test results did not show the instability of the variables used, as the residual variance generally remained stable within the critical 5 per cent range. The ARDL limit test showed a Cointegration relationship between the variables with an F- statistic of 7.544, which exceeds the $I(0)$ and $I(1)$ limits at significant levels of 2.06 and 3.24.5%, respectively. The study recommends developing a more forward-looking strategy in the medium to long term to stimulate long- term domestic growth and reduce over- reliance on imports. In retrospect, there is empirical evidence in Nigeria that there is a relationship between money in circulation and real GDP growth. There is no consensus among economists as to whether government intervention through monetary policy will improve Nigeria's economic growth [8]. However, the Nigerian government, in cooperation with its monetary authority, continues to pursue a policy of economic growth and thus uses monetary policy, regardless of its various transmission channels, to manipulate economic fluctuations to date. These transmission channels are how monetary policy affects real performance and macroeconomic activity and are considered essential for economic growth. Although empirical studies like those by Srithilat and Sun [15] have shown that monetary policy is effective in addressing macroeconomic variables, other authors, like those by Lashkary and Kashani [5], have argued that changes in the money supply only affect the nominal size of GDP and have no bearing on real economic variables; rather, they can only increase inflation. The widespread consensus regarding the connection between the money supply and economic growth in Nigeria has not, however, been compelling in the field of macroeconomic policy research. The relevance of this study's exploration into the interconnections between the $M(1)$, $M(2)$, and growth output cannot be overstated. Using quarterly data from 1981 to 2018, Ogunmuyiwa and Ekone [10] investigated the effect of the money supply on economic development in Nigeria. The data were analyzed using the Granger causation test and the Johansen- Juselius co-integration test. The findings indicated a long-term favourable connection between Nigeria's economic development and the money supply. Using quarterly data from

1980 to 2020, Olugbenga et al. [12] conducted another study to examine the impact of Nigeria's money supply on economic development. The Autoregressive Distributed Lag (ARDL) model and the causation test were used in the research. The findings demonstrated a favourable short-run and long-run connection between Nigeria's money supply and economic development. Using quarterly statistics from 1981 to 2020, Adeoye et al. [1] investigated the effect of the money supply on economic development in Nigeria. The Granger causality test and the Vector Error Correction Model (VECM) were used in the research to evaluate the data. While the short-run relationship was found to be negligible, the findings indicated a favourable long-run relationship between money supply and economic development in Nigeria.

2. Material and Methods

2.1. Research Design

A study design can be defined as a set of methods and procedures used to collect and analyze measurements of variables identified in research problems. Research plans are useful in research because they help the researcher to form a logical picture of the structure of the data source and the subsequent analysis [9]. The study design used in this study was an expost facto study design. Ex post facto research design is a category of research plans in which an investigation begins after the fact has occurred without the intervention of the researcher.

2.2. Source of Data Collection

Secondary data from the Central Bank of Nigeria's (CBN) Statistical Bulletin covering the years 2010 to 2020 was used for this analysis. The information includes RGDP data from 2010 to 2020 as well as quarterly reports on the $M(1)$ and $M(2)$.

2.3. Method of Data Analysis

In practice, most macroeconomic variables indexed by the time parameter are usually non-stationary. When the mean and variance of a time series data set do not change throughout the observation period, the distribution is said to be stationary. However, the value of the covariance between two periods only depends on the difference between the periods and not on the time point at which the covariance is being considered [3]. The procedure can be thought of as transitory if either one or both of the aforementioned conditions are not met. You can use the Extended Dickey-Fuller (ADF) test, the Phillips- Peron test, or the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to determine whether the time series data are stationary. The steady state of the data collected for this investigation is used for the ADF test.

The unit root test can be performed under the null hypothesis $p = 0$ against the alternative hypothesis of $p < 0$. The decision rule is to compare the calculated ADF statistics with the critical values from Fuller's table. If the test statistic is greater than the critical value, the null hypothesis is not rejected, and this indicates that the series is not stationary or not integrated on the order of zero. The p -value of the test can also be compared to the significance level to determine whether the series is stationary or non-stationary. Note that if a variable is stationary without differentiation, it is said to be integrated of order zero, while if a variable is stationary only after the first difference, it is said to be integrated of order one [3].

The short-run or long-run relationship of the series is often examined using the Cointegration test based on the order of integration of the variables as derived using the ADF approach previously explained. A stationary linear combination of integrated variables is what Cointegration refers to. Cointegration implies both a shared stochastic trend and long-run equilibrium. It can be highly helpful in distinguishing between short- and long-term relationships between variables and also contribute to increasing the accuracy of long-term forecasts. If variables of interest have a unit root that is integrated in the same order, then either the Engle-Granger technique or the Johansen-Juselius approach can be utilized to analyze the long-run connection [3]. However, Engle-Granger, when the variables are integrated of different order the appropriate method to employ is the autoregressive distributed lag (ARDL) approach.

Given a VAR(p) of I(1) X's (ignoring the deterministic trends),

$$X_t = \varphi + \Phi_1 X_{t-1} + \dots + \Phi_p X_{t-p} + \varepsilon_t \quad (1)$$

There always exists an error correction representation of the form (trick $X_t = X_{t-1} + \Delta X_t$) (Elem- Uche et al., 2019).

$$\Delta X_t = \varphi + \Pi X_{t-1} + \sum_{i=1}^{p-1} \Phi_i^* \Delta X_{t-i} + \varepsilon_t \quad (2)$$

Where, φ represent the model coefficient, Π and Φ^* are functions of the Φ 's.

The ΠX_{t-1} is referred to as the error correction mechanism. The error correction mechanism is the speed of adjustment which assesses the rate at which the dependent variable ΔX_t adjust to the change in the independent variables. In the present study the dependent variable is the RGDP while M(1) and M(2) are the independent variables.

Testing causality between variables is very important, and this is because, in most cases, correlation does not imply causality. There is also always the possibility of ignoring common factors in practice. The causal link between variables can disappear when the common causes that were previously ignored are taken into account.

3. Results and Discussion

The result presented in Table 1 found the mean value of RGDP as ₦17,616,845, M(1) as ₦25,368,754, and M(2) as ₦59,694,188. The Standard Deviation was found to be ₦5,154,430 for RGDP, ₦7,528,565 for M(1), and ₦20,216,127 for M(2). The result revealed that M2 has the higher mean and standard deviation followed by M1 and the least was found to be RGDP. Also, the Skewness was obtained for RGDP as ₦2.73 Million, M1 as ₦0.49 Million, and M2 as ₦0.57. This result revealed that RGDP has the higher Skewness followed by M2 and the least was found to be M1.

Table 1. Descriptive Analysis of RGDP M1 and M2.

S/N	Variable	Mean	Standard Deviation	Median	Skewness
1.	RGDP	17616845	5154430	16334719	2.73
2.	M(1)	25368754	7528565	21876869	0.49
3.	M(2)	59694188	20216127	56782642	0.57

Source: Eview 9.0

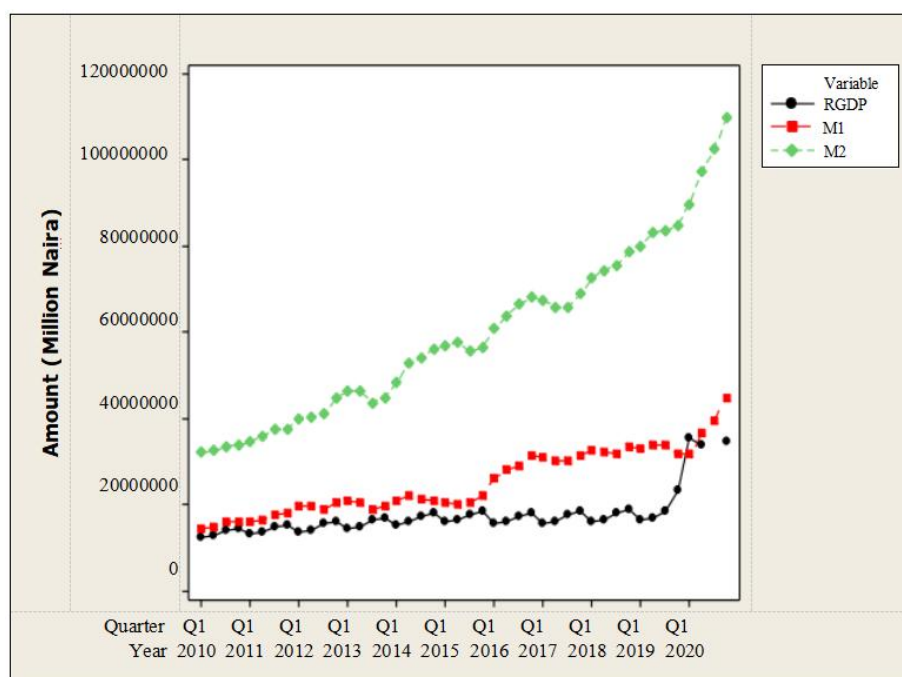


Figure 1. The Quarterly graph of RGDP, M(1) & M(2) from 2010-2020.

The result presented in Figure 1 shows that the trend of M(2) was greater than M(1) and RGDP across the period covered in the study. Also, it was found that the trend of M(1) was greater than RGDP from 2010 to 2019 Quarter 4 where the two series intercepted. This result implies that the value of RGDP was able to intercept with the volume of narrow money supply M(1) in 2019 Quarter 4.

The result of the unit root test on the variables using the Augmented Dickey-Fuller test statistic obtained in table 2 found that the all the series considered (RGDP, M(1) and M(2)) has no unit root and stationary overtime at the first difference since the test statistic value has more negative values (-6.2285, - 3.7361 and -3.5759 respectively) than the critical value (-3.1913) at 5% significant level. This result implies that the series are integrated of order 1 (I(1)) and stationary over the study period. Thus, Table 2 shows that the variables have the same order of integration I(1) (i.e. is stationary at first differencing).

All the variables as presented in Table 2 were found to be non-stationary at zero difference I(0) but after first differencing I(1), they all became stationary. The differencing was applied to avoid having a spurious regression. Since the differenced variables were stationary, there could be co-integration between the variables. This test enables one to know if some of the variables in the model are cointegrated and as well shows if there is long term relationship existing between the set of the variables. The number of the lag used in the co-integration test is based on the information criterion used in the underlying model. The co-integration trace test of RGDP, M(1), and M(2) was presented in Table 3.

Table 2. Result of Augmented Dickey-Fuller unit root test for the variables between the variables. This test enables one to know if some of the variables in the model are cointegrated and as well shows if there is long term relationship existing between the set of the variables. The number of the lag used in the co-integration test is based on the information criterion used in the underlying model. The co-integration trace test of RGDP, M(1), and M(2) was presented in Table 3.

Table 2. Result of Augmented Dickey-Fuller unit root test for the variables.

Variables	Level		1st Difference		Order of integration
	No Trend	With Trend	No Trend	With Trend	
RGDP	-0.0946	-1.1748	-6.0802	-6.2285	I(1)
M1	0.7745	-1.9019	-3.4696	-3.6493	I(1)
M2	1.8910	3.1379 Critical values	-2.9739	-3.5759	I(1)
5%	-2.931404	-3.189732	-2.933158	-3.191277	

Source: Eview 9.0

Table 3. Summary Result of Cointegration trace test.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.460183	39.09345	29.79707	0.0032
At most 1 *	0.320249	15.66550	15.49471	0.0471
At most 2	0.025881	0.996416	3.841466	0.3182

Source: Eview 9.0

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The result of the co-integration test presented in Table 3 shows that the null hypothesis of no co- integration was rejected since the trace test indicated two (2) cointegrating equation at the 5% since all the p-values (0.0032 & 0.0471 for None & At most 1 respectively) were all less than 0.05. This indicates a long term relationship or co- integration could exist among the variables (RGDP, M1 and M2). Based on this evidence, the vector error correction model VEC Model was estimated to account for the long term dynamics (relationship).

Table 4. Summary result of the Long term relationship.

	Coefficient	Std. Error	t-Statistic	Prob.
ECM(1)	-2.085435 -	0.637827	-3.269593 -	0.0030
ECM(2)	0.767937	0.248446	3.090962	0.0047
D(RGDP(-1))	1.989268	0.613736	3.241243	0.0033
D(RGDP(-2))	0.784862	0.485555	1.616423	0.1181
D(RGDP(-3))	0.471060 -	0.384346	1.225616 -	0.2313
D(M1(-1))	1.024443	0.432177	2.370427	0.0255
D(M1(-2))	1.204064	0.461111	2.611223	0.0148
D(M1(-3))	0.472189	0.575659	0.820258	0.4195
D(M2(-1))	0.144658 -	0.302508	0.478196 -	0.6365
D(M2(-2))	0.475635 -	0.311526	1.526789 -	0.1389
D(M2(-3))	0.621160	0.401015	1.548970	0.1335
C	21279.07	627022.2	0.033937	0.9732

The outcome of the co-integration test in Table 3 demonstrates that the variables have a long-term association. The log-likelihood ratio was used to select the cointegrating equation. We chose the equation with the lowest log-likelihood ratio when the log-likelihood ratio is positively signed, and the equation with the highest log-likelihood ratio at the absolute term when it is negatively signed. The lowest log probability ratio was selected because it was found that all cointegrating equations had a positive sign. The result presented in Table 4 showed that ECM(1) & ECM(2) have negative significant coefficients of - 2.0854 and -0.7679 respectively, with corresponding p-values of 0.003 and 0.0047 which were less than critical value of 5%.

This result implies that there exists a long run causality running from M(1) and M(2) to RGDP for the two co-integration equations with speed of adjustment to equilibrium of 2.0854 and 0.7679 respectively. The Walds test will be employed to determine whether a short run exist amongst the variables.

Table 5. Summary result of the Short term relationship.

Wald Test:			
Test Statistic	Chi-square Value	df	Probability
M(1)	12.84394	3	0.0050
M(2)	6.661369	3	0.0835

The result presented in Table 5 found a Chi-square value of 12.84 and 6.66 respectively with corresponding p-values of 0.005 and 0.084. This result indicates that there exists a short run causality running from M(1) to RGDP since p-value of 0.005 was less than 5% critical value but no short run causality running from M(2) to RGDP since p-value of 0.084 was greater than 5% critical value.

4. Conclusions

The vector error correction model was used in this study to investigate the causation and long and short-term relationship between the RGDP, the narrow money supply (M1), and the wide money supply (M2) in Nigeria. All of the variables were discovered to be integrated of the first difference and stationary throughout the observed time. Since all the variables were integrated of the first difference, the Johansen- Juselius co-integration approach was determined to be suitable for finding the long-term relationship between the variables. The results of the co-integration test suggest that the variables may have a long- term link or co-integration (RGDP, M1 and M2). This outcome was consistent with the study by Srithilat and Sun [15], who found that a small money supply (M1) and other factors have a long-term adverse impact on real GDP per capita. Additionally, it was discovered that the model has two co-integration equations. To account for the long-term dynamics, the vector error correction model, or VEC Model, was estimated.

It was discovered that the two co-integration models obtained in the study, ECM(1) & ECM(2), had negative significant coefficients, which suggests that there is a long-run causality running from M(1) and M(2) to RGDP for the two co-integration equations with the speed of adjustment to the equilibrium of 2.0854 and 0.7679, respectively. Additionally, it was discovered that there was a short-run causality that runs from M(1) to RGDP, but there is no proof that one runs from M(2) to RGDP. This outcome was consistent with the findings of Srithilat and Sun [15], who discovered that there is a short-term causal relationship between the limited money supply and real GDP per capita based on the outcome of the error correction model in their study. On the basis of the study's findings, the following suggestions were made: (1). In the near future, a variety of economic measures should be implemented in order to boost Nigeria's economic production (RGDP), and (2). Monetary policy transmission through the credit channel and exchange rate channel should be further strengthened by tightening creditworthiness standards, strengthening accounting standards, bankruptcy laws, corporate governance, and credit rights, and improving bank credit assessment capabilities. This is necessary for M(1) and M(2)to have the anticipated effects on Nigeria's economic output.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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