# Commodity Terms of Trade and Their Effects on Money Supply In Nigeria

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***Abstract:*** **This work modelled commodity terms of trade and their effects on money supply in Nigeria. The Kwaitkowski-Phillips-Schmidt-Shin (KPSS) root test was used to determine whether the commodity trade variables were stationary after first and second differencing was done. Two co-integrated models were built based on commodity trade stationarity. The first Model, containing the variables, Mineral Products, Allied Industries Products, Leather Products, Textiles Products, Wood Products, Precious Metals Products, Base Metals and Miscellaneous Manufactured Articles, was stationary after the first difference. The second Model containing the variables, Animal Products, Vegetable Products, Paper Making Material Products, Machinery and Chemical Appliances, Vehicles and Parts Products, Beverages, Plastic and Rubber and Cement Products, was stationary after the second difference. The results show that there exists a long run relationship between money supply and commodity terms of trade since the parameters the commodity trade variables were significant at 1%, 5% and 10% levels.**

***Keywords:*** **Differencing, Stationarity, Co-Integrated Models, Money Supply; Commodity Trade Variables.**

## I. INTRODUCTION

Time series modelling involves collection and study of historical data or past observations of a time series with a view to developing an appropriate model which describes the inherent structure of the series. This model is then used to generate future values for the series, i.e. to make forecasts. Time series forecasting thus, can be described as the act of predicting the future by understanding the past. Time series modelling is a dynamic research area which has attracted attentions of researchers over the last few decades (Sarkar, 1986).

Forecasting money supply is an important principle that enhances technological capabilities, strong institutional and economic reforms to increase production capacity and commodity terms of trade of an economy. Money comes in various forms namely:

1. Commodity Money: - this is a medium of exchange where the value is defined by the intrinsic value of the material it is made of in itself i.e. gold, silver etc.
2. Fiat Money: - this type of money gets its value from the government. The government declares it a legal tender and thus, it is accepted as a means of payment.
3. Fiduciary Money: - this type of money is not backed-up by government as a legal tender but, depends on confidence of the people for its acceptance. There is no legal backing for its acceptance. These include bank cheques, bit coins, and bank drafts.
4. Commercial Bank Money: - these are best described as claims against financial institutions that can be used to purchase goods and services, it represents a portion of the currency that is made debt generated by the commercial banks, and these can be withdrawn at any time by bank cheques, automatic teller machine cards or online banking without prior notice to the banks (Bloch and Sapsford, 1998).

These forms of money all make up the money system. This research, however, concentrated on money supply in the economy.

The supply of money means the total amount or value of money (paper notes, coins and demand deposits of bank) in circulation which is held by the public at any particular point in time. This does not include other forms of wealth such as investments, home equity or assets. It does not include credit such as loans (people use this to increase their standard of living but it does not form part of the money supply). Briefly put, money supply is the stock of money in circulation (Sanda, 2013). The central bank of Nigeria (CBN) measures money supply with the notation M1 and M2:

1. M1 is the most liquid form of money. It includes the currency in circulation, demand deposits and moneys in checking accounts (this is termed narrow money by the Central Bank of Nigeria).
2. M2 (broad money) includes all the money in M1 (narrow money) in addition to the savings and time deposits, as well as foreign denominated deposits. M2 is called broad money and it measures the total volume of money supply in the economy.

Money supply is the amount of M2 in the economy. The supply of money is determined by the Central Bank through the monetary policy. Monetary Policy refers to the specific actions taken by the Central Bank to regulate the value, supply and cost of money in the economy with a view to achieving Government's macroeconomic objectives (CBN, 2018a). Governments, usually have four main economic aims:

1. To achieve price stability (low and stable inflation);
2. Maintain a high level of individual that are employed and low level of unemployment; Encourage economic growth;
3. Encourage trade and secure a favorable balance of payments.

There are other objectives which are increasingly becoming important for governments. These include equitable distribution of income and wealth (a fair share of the national 'cake', more equitable than would be in the case of an entirely free market), increasing productivity (more output per unit of labor per hour or output per unit of factor inputs per hour), thermal Equilibrium – equilibrium in the Balance of payments without the use of artificial constraints (i.e., exports roughly equal imports in the long run).

An economy has to make do with a set amount of money as excessive money supply can lead to inflation or rise in prices. A failed monetary policy can be detrimental to the economy and the society at large. Failed monetary policy can result in unpleasant consequences such as hyperinflation, stagflation, recession, high unemployment rate, shortage of imported goods, inability to export goods, and even total monetary collapse which may give rise to the adoption of a much less efficient barter economy. Governments and central banks take both regulatory and free market approaches to monetary policy (William and Michael, 1991).

Terms of Trade (TOT), can be defined as the ratio of export prices to import prices, It can be also be interpreted as the amount of import goods an economy can purchase per unit of export goods (Bloch and Sapsford 1998). That is:

$$\text{TOT} = \frac{\text{EXPORT PRICE INDEX}}{\text{IMPORT PRICE INDEX}} \times 100 \qquad (1.1)$$

Equation (1.1) implies that when a country's TOT is less than 100% the country is importing more than it is exporting and when the value is greater than 100% the country is exporting more than it is importing. Commodity terms of trade refers to the terms of trade for commodities only, excluding services.

The relationship between commodity terms of trade and money supply has been broadly debated over time. This study intends to debunk the myth that money supply is independent.

Nigerian being a developing country/economy is characterized by significant debt burden, structural imbalance and uncertainties. An insight into determinants of money supply as it relates to commodity terms of trade has become pertinent. Most scholars of economics are of the view that the problem of Nigeria's economic growth and thus, money supply has not been well understood, and had been improperly managed. For example, an increase in the money supply will lead to an increase in the amount of money that people and firms will hold and they will spend more. Therefore, aggregate demand will increase. The reverse will be true when money supply decreases. That is, a decrease in the money supply will lead to a decrease in the amount of money that people and firms will hold and as a result, they will spend less. This will cause aggregate demand to decrease. This work, focused on relation and causality of money supply and commodity terms of trade, seeks to know if there are specific commodities that affect/increase/reduce money supply? Foremost in the heart of every data analyst or statistician is identifying trends, patterns, relationships, and predicting accurately events, occurrences and impact. It is against this backdrop that this work examined Nigeria's Economic growth determinants as well as the direction of causality that exists between money supply to the economy and several variables called commodity terms of trade.

The aim of this study is to find the relationship and causality between money supply and commodity terms of trade. The objectives are:

1. To identify if there is a relationship between the commodity terms of trade
2. Determine if the commodity trade variables are stationary after first and second differenced
3. To identify if a relationship exists between money supply and commodity terms of trade
4. To determine the significant variables and to what extent each variable relies on the other.

*Definition of Terms*

*A. Co-Integration test*

Non-stationary time series (or unit root variables) cannot be analysed using the classical methods e.g., ordinary least squares. They have to be analysed with different methods. One of these methods is called co-integration (Johansen and Juselius 1990). Co-integration tests analyse non-stationary time series processes that have variances and means that vary over time. Co-integration methods allow one to estimate the long-run parameters or equilibrium in systems with unit root variables (Rao, 2007). Test for co-integration identify stable and long run relationships between variables. There are several tests for co-integration e.g., Engle-Granger two-step method, Johansen test and Philips-Ouliaris Co-integration test (CBN, 2018b). The Engle-Granger test is a single-equation method used to determine whether there is a co-integrating relationship between two variables (Engle and Granger, 1987).

Stationarity means that the time series has a constant mean ($\mu$) and finite (bounded) variance, $\delta^2$. A nonstationary time series cannot be used for estimation of model to be used for forecasting. In this case one should investigate if the variables have long-run relationship (co-integration), if they are co-integrated, a regression in which nonstationary variables are employed would not suffer from losing any valuable long term information. A time series is considered strictly stationary if the probability distribution of its values does not change over time (Brooks, 2014). The main idea behind co-integration is that variables have a tendency to move together in the long run – there is an equilibrium relationship between them. Short-term deviations from the equilibrium are possible, but in the long-run the variables will return back to equilibrium relation due to the error or equilibrium correction model (Granger and Newbold, 1974; Engle and Granger, 1987).

*B. Unit Root*

This test determines if the time series variable is non-stationary using unit root. It is a statistical hypothesis test of stationarity that is designed for determining whether differencing is required. The hypothesis is stated as $H_0$: Presence of unit root against $H_1$: stationarity, trend

stationarity or explosive root. The main test for unit root that is valid for large sample is the augmented Dickey-Fuller test:

a) Augmented Dickey-Fuller (ADF) test: tests the null hypothesis $H_0$ that a unit root is present in the time series sample, this test is used for large and the more complicated set of time series models. In the ADF test the more negative the number is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence (Dickey and Fuller, 1979; Schwert, 1989).
b) Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests are used for testing a null hypothesis that an observable time series is stationary around a deterministic trend (i.e. trend-stationary) against the alternative of a unit root. Contrary to most unit root tests, the presence of a unit root is not the null hypothesis but the alternative. Additionally, in the KPSS test, the absence of a unit root is not a proof of stationarity but, by design, of trend-stationarity. This is an important distinction since it is possible for a time series to be non-stationary, have no unit root yet be trend-stationary. In both unit root and trend-stationary processes, the mean can be growing or decreasing over time; however, in the presence of a shock, trend-stationary processes are mean-reverting (i.e. transitory, the time series will converge again towards the growing mean, which was not affected by the shock) while unit-root processes have a permanent impact on the mean (i.e. no convergence over time) (Gerald, 2015; Francis, 2000, Erik and Pär, 2007).

*C. First Order Difference and Transformation*

These are used to stabilize data; Differencing can help stabilize the mean of a time series by removing changes in the level of a time series, and so eliminate trend and seasonality. To difference the time series, $Z_t$, we create the new series

$$Y_i = Z_i - Z_{i-1} \quad (1.2)$$

The differenced data will contain one point less than the original data. This procedure can be repeated (i.e., performing the 2nd, 3rd, etc. differencing) until stationarity is achieved. In summary, differencing is one way to make a non-stationary time series, stationary. It is done by computing the differences between consecutive observations. If the time series is not stationary, it can be transformed in order to achieve stationarity with one of the following techniques. For non-constant variance, taking the logarithm or square root of the series may stabilize the variance. For negative data, one can add a suitable constant to make the entire data positive before applying the transformation. This constant can then be subtracted from the model to obtain predicted (i.e., the fitted) values and forecasts for future points.

## II. REVIEWED WORKS ON COMMODITY VARIABLES AND MONEY SUPPLY

Money supply, simply put, refers to the amount of money available for spending in the economy. Money supply is an important factor not only for acceleration of the process of economic development but also for the achievement of price stability in the economy (Williams and Michael, 2008). A healthy money supply requires that there should be neither inflation nor deflation. Inflation is the greatest problem of a developing economy like Nigeria. Monetary policies are monetary management techniques put in place by government through the central bank to control money stock/supply in order to influence broad macro-economic objectives which include price stability, high level of employment, sustainable economic growth and balance of payment equilibrium (CBN, 2018a). Over the years, the major goals of monetary policy have often been the two later objectives namely: Inflation targeting and exchange rate policy. These objectives have dominated the Central Bank of Nigerian's monetary policy focus based on the assumption that these are essential tools of achieving macroeconomic stability (Ajayi, 1999).

We believe that the CBN and others concerned with monetary policy need to reconsider their stance on effects of commodity terms of trade on money supply. That is the main thrust of this study. Most of the studies we reviewed have some methodological and conceptual problems that undermine their accuracy and thus, their efficacy for effective policy purposes. For instance, non-application of unit root test to reduce or possibly eliminate spurious regression due to non-stationary properties of time-series, and the use of cross-country analysis that precludes Nigeria's specifics, may all lead to biased inferences. Recognizing the above gaps and challenges highlighted in the literatures, there is need to re-examine the problem of economic growth in Nigeria holistically, using modern analytical econometric techniques. Establishing, in concrete terms, the effects of commodity terms of trade on money supply would go a long way in addressing the problems of effective money supply planning and economic growth in Nigeria.

Uwakaeme (2015) examined the major economic growth determinants as well as the direction of causality that exists between economic growth and some selected economic growth indicators in Nigeria using the Johansen co-integration. The results showed that a positive and long run relationship exists between economic growth and some selected growth indicators such as industrial productivity index. Inflation as it refers to money supply and excessive fiscal deficit has a negative/inverse effect on the economy (ibid). The author also believed that Nigeria has been unable to harness foreign direct investment to its fullest potential, given the unstable environment which is characterized by high price due to inflation, fragile financial systems amongst others. One of the main factors is the volatility of exports commodities which prices are also volatile. Prior to Nigeria's political independence, agriculture was the mainstay of the economy, the present heavy reliance on primary commodity has induced adverse terms of trade shocks leading to huge current account deficits and exchange rate volatility and consequently a weak external sector for Nigeria (ibid).

The trend in the current account amplifies the degree of import dependence of the Nigerian economy. If the Central bank increases money supply, then the money supply curve shifts to the right. The monetary policy influences the market interest rate which in turn, affects the level of planned investment. Conversely, if the quantity of money is stable or at least predictable, the changes in the money supply will have a predictable effect on nominal income (Uwakaeme, 2015). Suppose the Central bank, dreading an impending recession on the business-cycle horizon, decides to undertake expansionary monetary policy and injects more money into the system. With extra money circulating in the economy, the purchasing power is enhanced as there would be more money for household, business, government and foreign expenditures. Everyone is willing and able to buy more real products at the existing price level. Consumption expenditures, investment expenditures, government purchases, and even, net exports will increase leading to an increase in aggregate demand. If a country's terms of trade improve, it means that for every unit of exported goods sold it can buy more units of imported goods. Potentially, a rise in the terms of trade creates a benefit in terms of how many goods need to be exported to buy a given amount of imported goods. It can also have a beneficial effect on domestic cost-push inflation as an improvement indicates falling import prices relative to export prices and likewise, a worsening term of trade indicates that a country has to export more to purchase a given quantity of imported goods.

## III. DATA AND METHODS

Monthly data of trade (commodities), extracted from the Central Bank of Nigeria and National Bureau of Statistics Bulletins, were converted to yearly data and expressed in Millions of Naira. Also, data of Money supplied by the Central Bank of Nigeria spanning same time period of January 2001 to December 2017 were obtained and expressed in Billions of Naira (See Appendix). Time series plots of the data were obtained and differencing procedure done for stationarity. The plots of the differenced series were also obtained. Engle-Granger Co-integration test and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) unit root test were employed for the analysis of the data. After the first and second difference, two co-integrated models were built based on stationarity of the time series of the commodity trade variables.

### *3.1 Model Specification*

A stationary data has the property that the mean, variance and autocorrelation structure does not change over time. That is, it is without trend, and has a constant variance over time, a constant autocorrelation structure over time and no periodic fluctuations [Dickey *et al.* (1986); Dolado *et al.* (1990)]. Differencing is used to stabilize data. It can help stabilize the mean of a time series by removing changes in the level of the time series thus, eliminating trend and seasonality.

$$\nabla \mathrm{Y}_t = (1-\mathrm{B})\mathrm{Y}_t = \mathrm{Y}_t - \mathrm{Y}_{t-1} \quad \text{(First Difference)} \quad (3.1)$$

where, $\nabla = 1 - \mathrm{B}$ is Backward Shift (or Backward Difference Operator ) and $\mathrm{BY}_t = \mathrm{Y}_{t-1}$

Occasionally the differenced data will not appear stationary and it may be necessary to difference the data a second time

$$\begin{aligned} \nabla^2 \mathrm{Y}_t &= (1-\mathrm{B})^2 \mathrm{Y}_t \\ &= (1-2\mathrm{B}+\mathrm{B}^2)\mathrm{Y}_t \quad \text{(Second Difference)} \\ &= \mathrm{Y}_t - 2\mathrm{Y}_{t-1} + \mathrm{Y}_{t-2} \end{aligned} \quad (3.2)$$

Generally, $\nabla^d \mathrm{Y}_t = (1-\mathrm{B})^d \mathrm{Y}_t$ (3.3)

where, $d$ is the order of difference and $\nabla^d$ removes a polynomial of order $d$.

Confirming the order of integration is an important step for all Time Series analysis as the possibility of getting misleading results, if non-stationary variables are included, is high.

We tested for unit root to determine stationarity and we used the Kwaitkowski-Phillips-Schmidt-Shin (KPSS) root test also to determine stationarity. The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test figures out if a time series is stationary around a mean or linear trend, or is non-stationary due to a unit root [Phillips, (1987); Phillips and Perron, (1988); Phillips and Xiao (1998)]. As already mentioned, a stationary time series is one where the mean and variance are constant over time. Therefore, we tested the hypothesis:

$H_0$: The time series generated by the data is stationary

$H_1$: The time series generated by the data is not stationary

The KPSS test is based on linear regression. It breaks up a series into three parts: a deterministic trend ($\beta_t$), a random walk ($r_t$), and a stationary error ($\varepsilon_t$), with the regression equation:

$$X_t = r_t + \beta_t + \varepsilon_t \quad (3.4)$$

If the data is stationary, it will have a fixed element for an intercept (or the series will be stationary around a fixed level), the test uses Ordinary Least Square (OLS) to find the equation which differs slightly depending on whether you want to test for level stationarity or trend stationarity (Kwiatkowski, *et al.* 1992**).** The Time Series model is

$$Y_t = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + \cdots + B_pX_p + e_i \quad (3.5)$$

where $t = 1 \ldots N$

$\mathrm{Y_t}$ is the dependent variable, endogenous variable.

$X_t$ are the explanatory variables.

$B_t$ are the Unknown coefficients.

$e_t$ is the Error term.

N is the sample size and p is the number of independent variables (p=16).

## IV. RESULTS

Although only statistical tests can provide proof, a graphical representation can also give some indication about the time series properties of the commodity terms of trade indices. Figure 1 shows the time series plot of the commodity terms of trade for each commodity considered. There was strong indication that the plots in Figure 1 were non-stationarity thus, necessitating differencing of the commodities trade variables in order to achieve stationarity. Tables 1A and 1B shows the correlation between the commodity terms of trade variables, highlighting commodities with strong correlation with each other. Table 1A displayed the simple correlation coefficients between these commodity terms of trade variables while Table 1B highlighted the points of strong correlation (in red and blue colours) between the variables. Figure 2 shows the time series plots of the first differences for each commodity.

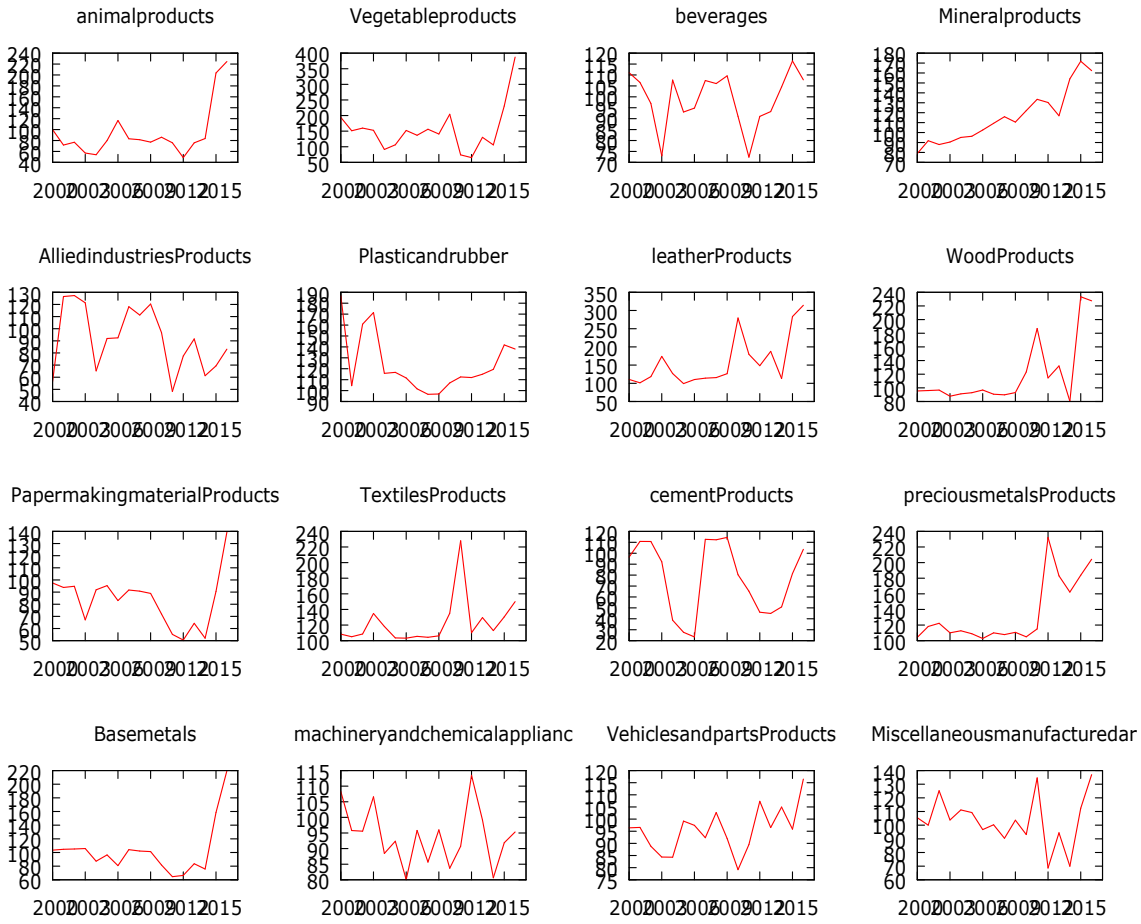


Figure 1: Commodity Terms of Trade Indices Time Series Plots

From Figure 2, it was observed that the under listed commodities appeared to have achieved stationarity after first difference:

- Machinery and Chemical Appliances (MCA)
- Vehicle Parts Products (VPP)
- Vegetable Products (VP)
- Plastic and Rubber Products (PRP)
- Wood Products (WP)
- Textile Products (TP)
- Precious Metals (PM)
- Miscellaneous Manufactured Articles (MMA)

Hence, second differencing was done. Figure 3 shows the plot of the second differences for each commodity.

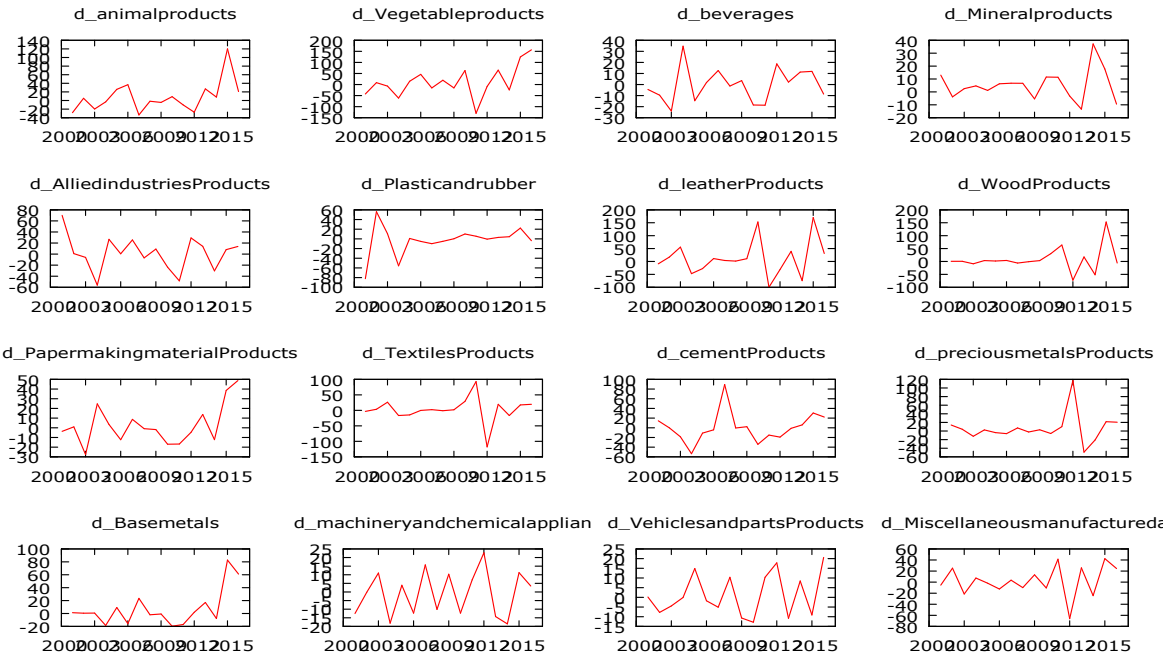


Figure 2: First Differences of the Commodity Terms of Trade Indices Time Series Plots

From Figure 3, it was observed that the under listed commodities appeared to have achieved stationarity after the second difference:

- Beverages (B)
- Base Metals (BM)
- Cement Products (CP)
- Leather Products (LP)
- Allied Industries Products (AIP)
- Animal Products (AP)
- Mineral Products (MP)
- Paper Making Material Products (PMMP)

The KPSS unit-root test, without the time trend component, was used to test level stationarity before differencing. The results are displayed in Table 2.

Table 1A - Correlation coefficient of the commodity trade of terms

| animalproducts | Vegetableproducts | beverages | Mineralproducts | AlliedindustriesProducts | Plasticandrubber | leatherProducts | WoodProducts | PapermakingmaterialProducts | TextilesProducts | cementProducts | preciousmetalsProducts | Basemetals | machineryandchemicalapplianc | VehiclesandpartsProducts | Miscellaneousmanufacturedarti | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **0.8507** | 0.4338 | **0.6455** | -0.2246 | 0.2198 | **0.6885** | **0.7944** | **0.6149** | 0.1604 | 0.1656 | 0.3886 | **0.8626** | -0.1712 | 0.4667 | 0.4428 | animalproducts |
| | 1 | 0.379 | 0.3655 | 0.0732 | 0.3314 | **0.6867** | **0.5798** | **0.752** | 0.046 | 0.4392 | 0.2262 | **0.9068** | -0.0348 | 0.3371 | 0.4496 | Vegetableproducts |
| | | 1 | 0.1701 | 0.0044 | -0.0653 | -0.0274 | 0.0547 | **0.5682** | -0.5558 | 0.3109 | 0.1134 | 0.4521 | -0.141 | 0.3311 | -0.0711 | beverages |
| | | | 1 | -0.4277 | -0.2021 | 0.6748 | 0.7424 | -0.0453 | 0.3826 | -0.0705 | 0.6791 | 0.4175 | -0.2555 | 0.4766 | -0.0029 | Mineralproducts |
| | | | | 1 | -0.1504 | -0.2192 | -0.4057 | 0.225 | -0.4635 | 0.5327 | -0.304 | 0.0802 | 0.0829 | -0.2016 | -0.0417 | AlliedindustriesProducts |
| | | | | | 1 | 0.1309 | 0.1116 | 0.1918 | 0.0375 | 0.1711 | 0.0197 | 0.3092 | 0.4677 | -0.0703 | 0.3174 | animalproducts |
| | | | | | | 1 | **0.8317** | 0.2076 | 0.4867 | 0.1058 | 0.4688 | 0.599 | -0.0304 | 0.0654 | 0.341 | Vegetableproducts |
| | | | | | | | 1 | 0.2689 | **0.6215** | 0.0544 | **0.5319** | **0.6317** | -0.0042 | 0.282 | 0.5427 | beverages |
| | | | | | | | | 1 | -0.2175 | 0.429 | -0.0847 | **0.8118** | -0.0356 | 0.2829 | 0.587 | Mineralproducts |
| | | | | | | | | | 1 | -0.0563 | 0.0906 | 0.0292 | -0.0487 | -0.1427 | 0.5352 | AlliedindustriesProducts |
| | | | | | | | | | | 1 | -0.1829 | 0.4359 | 0.2213 | -0.0536 | 0.2725 | Plasticandrubber |
| | | | | | | | | | | | 1 | 0.3323 | 0.341 | 0.6439 | -0.1839 | leatherProducts |
| | | | | | | | | | | | | 1 | 0.0719 | 0.4392 | 0.5314 | WoodProducts |
| | | | | | | | | | | | | | 1 | 0.1065 | -0.0158 | PapermakingmaterialProducts |
| | | | | | | | | | | | | | | 1 | -0.1328 | TextilesProducts |
| | | | | | | | | | | | | | | | 1 | Miscellaneousmanufacturedarti |

Table 1B: Correlation coefficient of the commodity terms of trade (one decimal place) with red/light blue colour shows correlation points

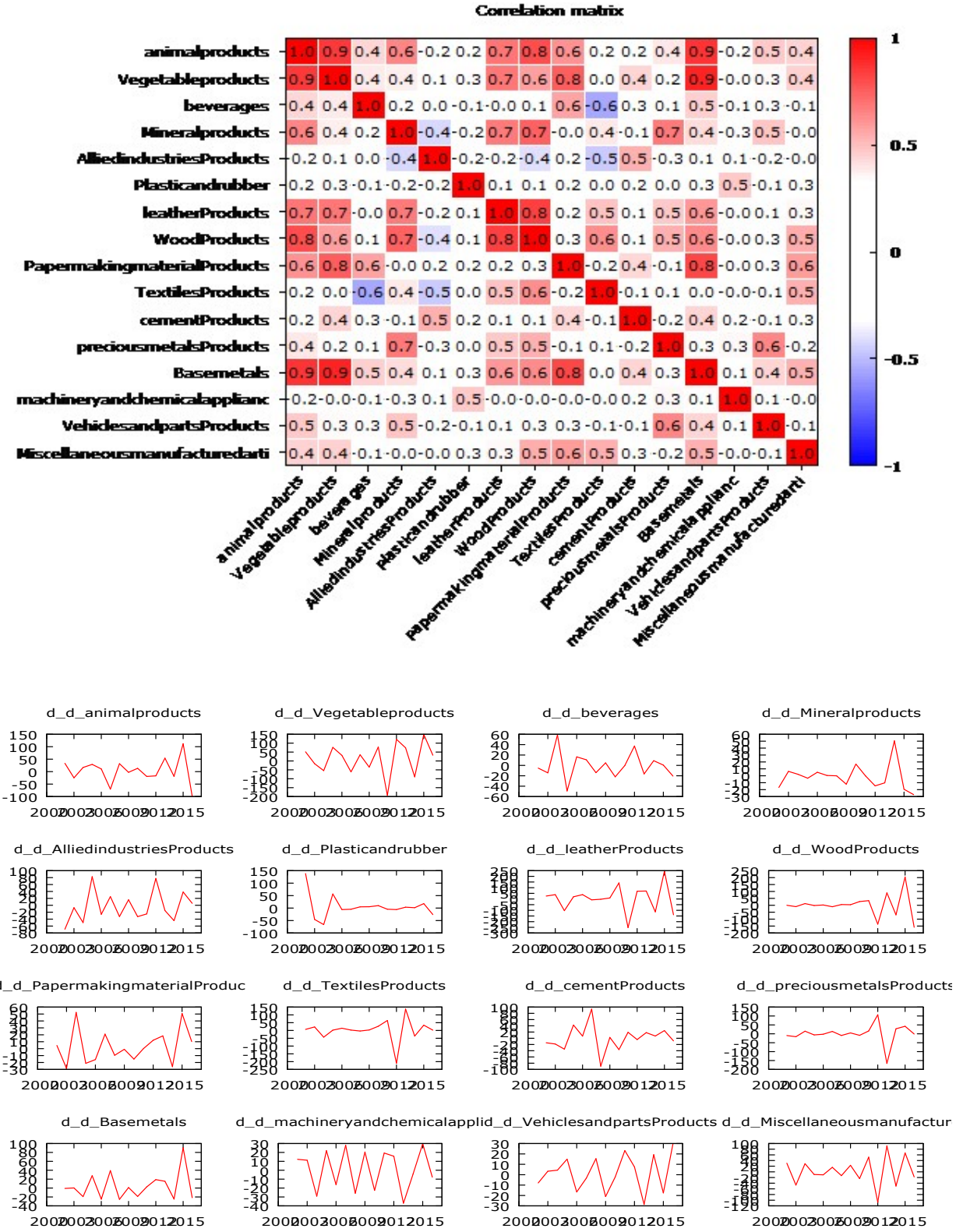


Figure 3: Second Differences of the Commodity Terms of Trade Indices Time Series Plots

Table 2: KPSS Test on the Commodity Terms of trade

| Variable(Commodity Terms of Trade) Statistics | Test Statistic (without trend) | P-Value |
|---|---|---|
| Animal Products | *0.371056* | *0.094* |
| Vegetable Products | 0.288015 | 0.100 |
| Beverages | 0.299387 | 0.100 |
| Mineral Products | *0.379907* | *0.090* |
| Allied Industries Products | 0.294283 | 0.100 |
| Plastic and Rubber | 0.235709 | 0.100 |
| Leather Products | *0.365482* | *0.097* |
| Wood Products | 0.358185 | 0.100 |
| Paper Making Material Products | 0.237321 | 0.100 |
| Textiles Products | 0.319500 | 0.100 |
| Cement Products | 0.383402 | 0.100 |
| Precious Metals Products | 0.337830 | 0.100 |
| Base Metals | 0.278569 | 0.100 |
| Machinery and Chemical Appliances | 0.301274 | 0.100 |
| Vehicles and Parts Products | 0.354041 | 0.100 |
| Miscellaneous Manufactured Articles | 0.216266 | 0.100 |
| 10% 5% 1% *Critical values:* 0.359 0.463 0.686 | | |

Table 2 showed that three series were stationary at 10% level of significance. However, first difference of all the independent variables was done and the results shown in Table 3.

Table 3: KPSS Test on the Commodity Terms of Trade after First Difference

| Variable(Commodity Trade of Terms) Statistics First Differences | Test Statistic (without trend) | P-Value | Stationary? |
|---|---|---|---|
| Animal Products | 0.408978** | 0.076 | No |
| Vegetable Products | 0.406776** | 0.077 | No |
| Beverages | 0.387053** | 0.087 | No |
| *Mineral Products* | *0.279028*** | *0.100* | *Yes* |
| *Allied Industries Products* | *0.270542*** | *0.100* | *Yes* |
| Plastic and Rubber | 0.363839** | 0.098 | No |
| *Leather Products* | *0.331552*** | *0.100* | *Yes* |
| *Wood Products* | *0.351312*** | *0.100* | *Yes* |
| Paper Making Material Products | 0.367025** | 0.096 | No |
| *Textiles Products* | *0.279581*** | *0.100* | *Yes* |
| Cement Products | 0.40881** | 0.076 | No |
| *Precious Metals Products* | *0.279906*** | *0.100* | *Yes* |
| *Base Metals* | *0.355124*** | *0.100* | *Yes* |
| Machinery and Chemical Appliances | 0.368246** | 0.096 | No |
| Vehicles and Parts Products | 0.366858** | 0.097 | No |
| *Miscellaneous Manufactured Articles* | *0.32439**** | *0.100* | *Yes* |

10% 5% 1%

*Critical values*: 0.360 0.463 0.682

Using 5% level of significance, the independent variables that achieved stationarity after first difference are:

1. Mineral Products
2. Allied Industries Products
3. Leather Products
4. Textiles Products
5. Wood Products
6. Precious Metals Products
7. Base Metals
8. Miscellaneous *Manufactured Articles*

These variables were used subsequently, to build Model 4.1.

Again, we difference the independent variables that did not achieve stationarity in Table 4.

Table 4: KPSS Test on Commodity terms of trade after second difference

| Variable(Commodity Trade of Terms) Statistics Second Differences | Test Statistic (without trend) | P-Value | Stationary? |
|---|---|---|---|
| Animal Products | 0.233942*** | 0.100 | Yes |
| Vegetable Products | 0.270163*** | 0.100 | Yes |
| Beverages | 0.441595** | 0.060 | |
| Plastic and Rubber | 0.384891** | 0.088 | |
| Paper Making Material Products | 0.32788*** | 0.100 | Yes |
| Cement Products | 0.392554** | 0.084 | |
| Machinery and Chemical Appliances | 0.266195*** | 0.100 | Yes |
| Vehicles and Parts Products | 0.310141*** | 0.100 | Yes |

10% 5% 1%

*Critical values:* 0.361 0.463 0.678

Similarly, using 5% level of significance, the independent variables that achieved stationarity after second difference are:

1. Animal Products
2. Vegetable Products
3. Paper Making Material Products
4. Machinery and Chemical Appliances
5. Vehicles and Parts Products
6. Beverages
7. Plastic and Rubber
8. Cement Products

These variables were used to build model 4.2.

In line with the Time Series Modelling, unit root is basically required to establish whether the time series is stationary and if non-stationary the number of times the variables have to be differenced to arrive at stationarity. Thus, the null hypothesis is accepted at several levels indicating that some variables are stationary after 1st difference and others after 2nd difference. Let,

$$Y_{t1} = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + e_i \quad (4.1)$$

$$Y_{t1} = B_0 + B_1Z_1 + B_2Z_2 + B_3Z_3 + B_4Z_4 + B_5Z_5 + B_6Z_6 + B_7Z_7 + B_8Z_8 + e_i \quad (4.2)$$

where, $Y_{t1}$ is Money Supply (MS)

$X_1$ = Mineral Products

$X_2$ = Allied Industry Product

$X_3$ = Leather Products

$X_4$ = Textile Products

$X_5$ = Wood Products

$X_6$ = Precious Metals Products

$X_7$ = Base Metals

$X_8$ = Miscellaneous Manufactured Articles

$Z_1$ = Animal Products

$Z_2$ = Vegetable Products

$Z_3$ = Paper Making Material Products

$Z_4$ = Machinery and Chemical Appliances

$Z_5$ = Vehicles and Parts Products

$Z_6$ = Beverages

$Z_7$ = Plastic and Rubber

$Z_8$ = Cement Products

$B_0$ = Constant, $B_1$,$B_2$,$B_3$,$B_4$,$B_5$,$B_6$,$B_7$,$B_8$ and $B_9$ are parameter estimates and $e_i$ = error term

The constant, $B_0$ and the parameters, $B_1$,$B_2$,$B_3$,$B_4$,$B_5$,$B_6$,$B_7$,$B_8$ and $B_9$ for regression equations 4.1 and 4.2 were determined and the results are shown in Tables 5 and 6 respectively.

*Table 5:* Result of Co-integrating regression - OLS, of effect of Commodity Terms of Trade on Money Supply (using First Difference Variables)

| Variables | Coefficient | std. error | t-ratio | p-value | |
|---|---|---|---|---|---|
| *Constant* | *23185.0* | *9333.83* | *−2.484* | *0.0379* | ** |
| *Mineral products* | *201.766* | *50.8016* | *3.972* | *0.0041* | *** |
| Allied industries~ | 0.279582 | 29.1312 | 0.009597 | 0.9926 | |
| Leather Products | 19.6950 | 18.0906 | 1.089 | 0.3080 | |
| Wood Products | −36.0217 | 44.0433 | −0.8179 | 0.4371 | |
| Textiles Products | 23.3669 | 44.2773 | 0.5277 | 0.6120 | |
| *Precious metalsPr~* | *46.0350* | *23.5524* | *1.955* | *0.0864* | * |
| Basemetals | −4.29923 | 39.2525 | −0.1095 | 0.9155 | |
| Miscellaneousman~ | 9.27599 | 92.7098 | 0.1001 | 0.9228 | |

*Footnote:* *=sig. at 10%;**=sig. at 5%;***=sig. at 1%. Dependent variable: Money Supply (MS)

Mean dependent variable - 8657.200

S.D. dependent variable - 6932.017

Sum squared residual - 42771492

S.E. of regression - 2312.236

R-squared - 0.944369

Adjusted R-squared 0.888738

Log-likelihood - −149.3964

Akaike criterion - 316.7928

Schwarz criterion - 324.2917

Hannan-Quinn - 317.5382

Rho - −0.007435

Durbin-Watson - 1.944966

*Model 4.1* then becomes $Y_{t1} = 23185.0 + 201.766X_1 + 0.279582X_2 + 19.6950X_3 - 36.0217X_4 + 23.3669X_5 + 46.0350X_6 - 4.29923X_7 + 9.27599X_8 + e_i$

Table 6: Result of Co-integrating regression - OLS, of effect of Commodity Terms of Trade on Money Supply (using Second Difference variables)

| Variables | Coefficient | std. error | t-ratio | p-value | |
|---|---|---|---|---|---|
| Constant | −795.410 | 16050.5 | −0.04956 | 0.9617 | |
| Animal products | 94.3394 | 50.5261 | 1.867 | 0.0988 | * |
| Vegetable products | 49.8698 | 38.3521 | 1.300 | 0.2297 | |
| Beverages | 44.4849 | 111.008 | 0.4007 | 0.6991 | |
| Plastic and rubber | −98.9149 | 50.8818 | −1.944 | 0.0878 | * |
| Paper making mater~ | −292.584 | 81.1018 | −3.608 | 0.0069 | *** |
| Cement Products | −2.70026 | 42.7985 | −0.06309 | 0.9512 | |
| Machinery and chem~ | 104.629 | 148.534 | 0.7044 | 0.5012 | |
| Vehicles and parts~ | 162.283 | 144.238 | 1.125 | 0.2932 | |

Footnote**:** *=sig. at 10%;*=sig. at 10%;***=sig. at 1%. Dependent variable: MS

Mean dependent variable - 8657.200

S.D. dependent variable - 6932.017

Sum squared residual - 1.31e+08

S.E. of regression - 4040.065

R-squared - 0.830165

Adjusted R-squared - 0.660330

Log-likelihood - −158.8832

Akaike criterion - 335.7663

Schwarz criterion - 343.2653

Hannan-Quinn - 336.5117

Rho - −0.025296

Durbin-Watson - 1.948518

*Model 4.2* then becomes $Y_{t2} = -795.410 + 94.3394Z_1 + 49.8698Z_2 + 44.4849Z_3 - 98.9149Z_4 - 292.584Z_5 - 2.70026Z_6 + 104.629Z_7 + 162.283Z_8 + e_i$

## V. DISCUSSION

This work examined the existence of a relationship between commodity terms of trade and money supply and to what extent the independent variables in the relationship rely one another (correlation). Generally, the correlation coefficient has values from -1 to +1. A coefficient closer to ±1 indicates a relatively strong correlation between the variables. Some coefficient values from Table 1B show strong, positive correlation between the commodity terms of trade variables. For example, Base metals (BM) and Vegetable products (VP), with correlation value of 0.91 is the strongest positive correlation while, Allied Industry Products and Miscellaneous manufactured articles, with correlation value of -0.0417 is the weakest correlation among these commodity variables and it is a negative correlation. However, all of the markets indicate mutual interdependence.

Before starting co-integration, we pretested the commodity terms of trade for stationarity using the KPSS test. After confirming that they were stationary, co-integration between money supply and commodity terms of trade was done. The results indicated co-integration and significant relationship between mineral products, precious metals and Money Supply (Model 4.2). The results also indicated co-integration and significant relationship between animal products, plastic and rubber, paper making material products and Money Supply (Model 4.2). It is clear from these results that a long run relationship exists between money supply and mineral products, precious metals, animal products, plastic and rubber and paper making material products, since their parameters were significant at 1%, 5% and 10% levels.

## VI. CONCLUSION AND RECOMMENDATION

On the basis of the above results, it was concluded that a long run relationship exists between money supply and commodity terms of trade. We therefore, recommended that government should come up with policies and create enabling environment that will encourage entrepreneurs in the private sector to start-up businesses in sectors of the economy especially, Agricultural and Mining sectors that has enormous prospects as shown by the results of this study.

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APPENDIX

The Data for Commodity terms of trade and money supply

| Year | animal products | Vegetable products | Beverages | Mineral products | Allied industries Products | Plastic and rubber | leather Products | Wood Products | Paper making material Products | Textiles Products | cement Products | precious metals Products | Base metals | machinery and chemical appliances | Vehicles and parts Products | Miscella-neous manufac-tured articles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 99.95117 | 194.1014 | 111.0416 | 78.82758 | 56.46628 | 186.7375111 | 110.5742 | 95.45794 | 97.51938 | 108.33 | 96.41729 | 104.2247 | 103.4598 | 108.2875 | 96.40677 | 105.4561 |
| 2002 | 71.68197 | 151.2482 | 106.5842 | 91.80899 | 126.4796 | 104.5031001 | 101.3741 | 96.0755 | 93.83257 | 104.9992 | 110.8147 | 118.1435 | 104.6977 | 95.78563 | 96.57654 | 100.0078 |
| 2003 | 76.82831 | 159.7079 | 96.95877 | 87.94038 | 127.3084 | 160.7991548 | 118.3572 | 96.74295 | 94.77659 | 108.5318 | 110.7354 | 122.2778 | 105.1177 | 95.56393 | 88.80728 | 125.2362 |
| 2004 | 57.05558 | 152.6644 | 72.99457 | 90.46751 | 121.3267 | 171.4350273 | 173.9275 | 87.75567 | 67.13282 | 134.7975 | 92.19156 | 110.0544 | 105.7921 | 106.5838 | 84.37719 | 103.777 |
| 2005 | 53.91054 | 91.26368 | 107.6712 | 95.12017 | 65.23005 | 115.7998009 | 126.7895 | 91.18507 | 91.85401 | 118.1398 | 38.69992 | 112.6236 | 87.24087 | 88.44734 | 84.3004 | 111.1535 |
| 2006 | 79.88113 | 106.1362 | 93.02846 | 96.27628 | 91.93832 | 116.6918746 | 99.12971 | 92.86915 | 95.31463 | 103.4827 | 27.64926 | 108.8866 | 96.48611 | 92.36054 | 99.18917 | 109.2469 |
| 2007 | 116.6358 | 152.1845 | 94.83123 | 102.5586 | 92.48539 | 111.5232478 | 110.3278 | 96.85052 | 83.00047 | 103.237 | 23.40968 | 102.7851 | 80.72818 | 80.07341 | 97.42491 | 96.77967 |
| 2008 | 83.12899 | 136.7028 | 107.4554 | 109.2906 | 118.1184 | 101.603597 | 114.0902 | 90.64726 | 91.69843 | 105.5014 | 112.7514 | 109.9767 | 104.1409 | 95.81742 | 92.33418 | 100.2927 |
| 2009 | 81.44908 | 156.0915 | 106.0827 | 115.9796 | 111.2433 | 96.55566211 | 115.6073 | 89.7577 | 90.78269 | 104.2826 | 112.2898 | 107.7574 | 102.1566 | 85.67819 | 102.7012 | 90.41041 |
| 2010 | 77.06302 | 140.7842 | 109.5912 | 110.5551 | 120.356 | 96.8564174 | 126.4128 | 93.055 | 88.92027 | 106.1626 | 114.5284 | 110.6303 | 101.33 | 95.99462 | 92.02091 | 103.6395 |
| 2011 | 86.04557 | 204.1196 | 91.08318 | 122.0904 | 96.76284 | 106.9866257 | 279.3913 | 123.2307 | 71.96413 | 135.1128 | 80.34479 | 104.9065 | 81.66274 | 83.69588 | 79.15695 | 93.14577 |
| 2012 | 75.79207 | 73.88947 | 72.37724 | 133.4684 | 48.3102 | 112.4741537 | 179.6305 | 187.0094 | 55.19009 | 227.9809 | 65.27914 | 115.0406 | 64.59637 | 90.73991 | 89.51391 | 134.6117 |
| 2013 | 48.63432 | 65.10874 | 91.04958 | 130.2946 | 77.50427 | 111.9322384 | 148.3787 | 114.5153 | 50.50316 | 110.1187 | 46.04621 | 232.1925 | 66.42689 | 113.486 | 107.3435 | 68.61453 |
| 2014 | 75.70387 | 130.1854 | 93.24071 | 116.9207 | 91.58594 | 114.9602649 | 187.6256 | 132.112 | 64.26826 | 129.5511 | 44.89214 | 183.0706 | 83.48721 | 99.19307 | 96.51397 | 94.4131 |
| 2015 | 83.62868 | 105.7974 | 104.5194 | 154.1027 | 61.25184 | 119.46926 | 113.1556 | 80.50745 | 52.00876 | 112.8957 | 50.86041 | 162.2079 | 75.75264 | 80.6517 | 104.9584 | 69.93827 |
| 2016 | 203.6929 | 230.4316 | 116.4206 | 171.8249 | 69.33267 | 141.803737 | 283.352 | 233.3959 | 90.55522 | 130.456 | 81.41086 | 183.8091 | 158.5448 | 91.86954 | 95.85692 | 112.413 |
| 2017 | 224.6048 | 387.3209 | 107.7884 | 162.3507 | 83.12874 | 138.040557 | 314.2792 | 227.4519 | 139.318 | 150.0119 | 103.5559 | 204.314 | 219.5887 | 95.33136 | 116.4751 | 136.9908 |

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MONEY SUPPLY | 878.46 | 1,269.32 | 1,505.96 | 1,952.92 | 2,131.82 | 2,637.91 | 3,797.91 | 5,127.40 | 8,008.20 | 9,411.11 | 11,034.94 | 12,172.49 |
| YEAR | 2013 | 2014 | 2015 | 2016 | 2017 | | | | | | | |
| MONEY SUPPLY | 13,895.39 | 15,160.29 | 17,679.29 | 18,901.30 | 21,607.68 | | | | | | | |

Sources: Central Bank of Nigeria and National Bureau of Statistics