

# Relationship between Inflation, Money Supply, Interest Rate and Income Growth (Rgdp) in Nigeria 1980-2010. an Empirical Investigation.

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## Abstract;

This paper attempts to examine the relationship between money supply, interest rate, income growth and inflation rate in Nigeria for the period 1980-2010. The paper employed a cointegration method, VAR, and Granger causality test to examine the relationship among the variables. Based on this approach, the paper found that there is no long run relationship among the variables and granger causality test shows a bidirectional relationship between money supply and inflation, income growth and inflation and interest rate and inflation. The granger causality test also revealed that money supply, interest rate, and income growth all granger cause inflation. Based on these findings, this study recommends appropriate control and management of money supply, interest rate and inflation rate.

**Keywords;** Inflation rate, Money Supply, Interest rate, Income growth, Cointegration, Granger Causality test.

## INTRODUCTION

Managing inflationary pressures continue to be overriding objective of monetary policy for most countries in the world today. Inflation remains one of the major economic variables that can distort economic activities in both developed and less developed countries. Monetary policy has always been seen as a fundamental instrument over the years for the attainment of macroeconomic stability. The adverse effect of inflationary pressure from money supply, interest rate and income growth has been a serious concern for the monetary authorities, economist and policy analyst. Consequently, inflation has been defined as a persistent and appreciable rise in the general price level of prices (Jhingan, 2002). In Nigeria, a major plague that has persisted in the economy is inflationary trends and erosion in the value of money. Inflation has been a real life phenomenon in Nigeria and has continued to worsen day after day.

Regrettably, we are now reaching levels of inflation considered to be epidemic and which pose greater threats to the entire system. Producers are confronted with higher unit cost of production, low capacity utilization and outright shop closure. The higher cost of production has reduced output which affects the unit cost.

The consumer bears the burden of higher prices which diminishes the value of their disposable income. The average propensity to save and invest are continuously on the decline thereby causing serious liquidity crises due to deposit runs which is universally acknowledged as hindrance to impressive economic performance.

However, very few studies have tried to examine the influence of inflation on money supply, interest rate and income growth (GDP) in Nigeria; and the analysis will cover thirty (30) Years duration from 1980-2010.

## 2. THEORETICAL FRAMEWORK AND REVIEW OF LITERATURE.

The monetarists, following from the Quantity Theory of Money (QTM), have propounded that the quantity of money is the main determinant of the price level, or the value of money, such that any change in the quantity of money produces an exactly direct and proportionate change in the price level. The QTM is traceable to Irving Fisher's famous equation of exchange:  $MV=PQ$ , where M stands for the stock of money; V for velocity of circulation of money; Q is the volume of transactions which take place within the given period; while P stands for the general price level in the economy.

Transforming the equation by substituting Y (total amount of goods and services exchanged for money) for Q, the equation of exchange becomes:  $MV=PY$ . The introduction of Y provides the linkage between the monetary and the real side of the economy. In this framework, however, P, V, and Y are endogenously determined within

the system. The variable  $M$  is the policy variable, which is exogenously determined by the monetary authorities. The monetarists emphasize that any change in the quantity of money affects only the price level or the monetary side of the economy, with the real sector of the economy totally insulated. This indicates that changes in the supply of money do not affect the real output of goods and services, but their values or the prices at which they are exchanged only. An essential feature of the monetarists' model is its focus on the long-run supply-side properties of the economy as opposed to short-run dynamics (Dornbush, et al, 1996).

The Keynesian opposed the monetarists' view of direct and proportional relationship between the quantity of money and prices. According to this school, the relationship between changes in the quantity of money and prices is non-proportional and indirect, through the rate of interest. The strength of the Keynesian theory is its integration of monetary theory on the one hand and the theory of output and employment through the rate of interest on the other hand. Thus, when the quantity of money increase, the rate of interest falls, leading to an increase in the volume of investment and aggregate demand, thereby raising output and employment. In other words, the Keynesians see a link between the real and the monetary sectors of the economy an economic phenomenon that describes equilibrium in the goods and money market (IS-LM). Equally important about the Keynesian theory is that they examined the relationship between the quantity of money and prices both under unemployment and full employment situations. Accordingly, so long as there is unemployment, output and employment will change in the same proportion as the quantity of money, but there will be no change in prices. At full employment, however, changes in the quantity of money will induce a proportional change in price. The neo-Keynesian theoretical exposition combines both aggregate demand and aggregate supply. It assumes a Keynesian view on the short-run and a classical view in the long-run. The simplistic approach is to consider changes in public expenditure or the nominal money supply and assume that expected inflation is zero. As a result, aggregate demand increases with real money balances and, therefore, decreases with the price level. The neo-Keynesian theory focuses on productivity, because, declining productivity signals diminishing returns to scale and, consequently, induces inflationary pressures, resulting mainly from over-heating of the economy and widening output gap.

But by and large, the theories outlined above by various schools of thought in economics provide a better understanding of the position of inflation as a macroeconomic variable in the mainstream economic thought and its effect on the overall performance of the economy. Among all the theories, the monetarist theory is adopted because its proposition fairly satisfied the realities of the projected causes of inflationary pressure in Nigeria.

In general the money supply is regarded as the stock of liquid assets held within an economy at a point in time. Although, several monetary aggregates that are alternative measures of the money supply exist. The number and definitions of these aggregates change from time to time in each country. In the Nigeria context the most relevant aggregates are the narrow measure of money, usually called  $M1$  and broad measure of money called  $M2$ . (Ogwuma, 1996). Furthermore, Adeyeye and Fakiyesi (1980) found that there exist some significant relationship between growth in bank credit, growth of money supply and growth of government expenditure and inflation rate while an unclear relationship exist between government revenue and inflation. Fakiyesi (1996), using data from Nigeria and autoregressive distributed lag model (ADL) argued that inflation depends on the growth in broad money, the rate of exchange of the naira visa-vis the dollar, the growth of real income, the level of rainfall, and the level of anticipated inflation, measured based on the previous year's level of inflation. Omoke et, al,(2010), tested the causal long term relationship between budget deficit, money growth and inflation in Nigeria and the result of the study pointed to a close long term relationship between inflation and money supply.

Another important issue arising from the foregoing is the link between inflation on one hand and market interest rate on the other. Perceptual inflation generates expectations about the cause of factored prices and puts on upward bias on market interest rates as lenders seek to protect the real value of their funds. It is important to point out that the long term positive effect of money stock changes on output is generally considered to be tenuous. Thus, the main long term effect of excessive money stock growth appears to be negative, that is a sustained rise in the price level. Long term growth is generally considered to depend on real factors such as resources endowments, technology, and high productivity and inter-temporal choices between present and future consumption.

Widenfeld and Nicolson, (1976) assert that "One of the major arguments which has been used to justify the pursuit of inflationary policies by government is that, inflation results in a more rapid rate of economic growth". Shapiro (1982) notes that "for any economy producing below potential, many economists maintain that inflation of the creeping or crawling variety will have a tonic effect on output and employment." Hager, (1983) recommended inflation as growth promoting. "In principles, it can succeed but only carefully controlled conditions. The extra purchasing power has to be used for capital formation rather than for public consumption of goods and services that are used up in current period. If properly administered, a higher capital stock can, in

future periods raise output. The increase in supply will in turn lead to lower prices for goods if the money stock does not continue to rise. Thus increase in effective demand- supply". The inflation is referred to as "self-liquidating" and growth in economic output has been achieved. Ekanem, (1993) notes that, reduction in the real interest rates increase investment which is relevant to investment decision. During inflation period, interest rates typically do not adjust fully to the expected rate of inflation either because investors under estimate the actual rate of inflation or because they are prevented from adjusting to it because of controls in the capital market or government interest rate policy.

### 3. Methodology

Data used for this study was obtained from CBN statistical bulletin (2010). The study made use of secondary data in the analysis, and includes data on rate of inflation, interest rate, money supply and rate of growth of GDP. In determining the influence of inflation on interest rate, money supply, and rate of growth of GDP, Cointegration test, VAR and granger causality tests are used in estimating the parameters of the model. Inflation rate will be used as proxy to consumer price index; interest rate is proxy by prime lending rate, money supply proxy by M2, while rate of growth of GDP is proxy by real GDP. STATA package is used in carrying out the estimation. Recognizing the fact that most macro-economic data are non-stationary, the analysis is preceded by first undertaking Augmented Dickey Fuller unit root test and Granger causality test. In addition, some pre and post estimation tests such as ADF test, Autocorrelation, and causality test were carried out to ascertain that valid models were applied.

The model specification has to do with the derivation of mathematical and econometric model that would be used as the basis for estimation, and is used to measure the economic relationship existing between economic variables. The mathematical model is specified as follows:

$$Y = F(X_1, X_2, X_3, \dots)$$

From the above functional relationship, where Y stand for dependent variable, and X1,X2,X3 stand for independent variables, therefore the following multiple regression equation can be gotten as:  $Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + U_t$ .....(1)

Where; Y = rate of inflation,  $\beta_0$  = Estimated intercept term (constant),  $\beta_1$ =parameter estimate of the corresponding variable, X1 =money growth (supply of money), X2= income growth (RGDP), X3 = interest rate, t = time series data, U = Estimate of the stochastic error term.

### 4. RESULTS AND DISCUSSION OF FINDINGS

This study commence it empirical analysis by first testing the properties of the time series used in the analysis. As most macroeconomic time series data are non-stationary, since carrying out regression on non-stationary time series data will lead to spurious regression outcomes, we employ the widely used Augmented dickey fuller (ADF) test to ascertain the stationarity of the data. The result in table 1, Established that all the variables are stationary at their level values. Therefore the Null Hypothesis (H0) of stationarity should be accepted and the alternative hypothesis (H1) that they are not stationary should be rejected because all their test statistics that is Mackinnon p values are; 0.0407 for inflation rate and stationary and significant at 5%, Money supply M2; 0.0058 stationary and significant at 1%, RGDP; 0.0000 stationary and significant at 1%, and Interest rate; 0.0443 stationary and significant at 5%. To test this conjecture, we proceed to carry out further analysis of the variables. Therefore our next task is to investigate whether the variables under scrutiny are cointegrated. This is because the existence of cointegration allows us to establish whether or not well defined linear relationship exist among the variables in the long run. To do this we apply the Johansen ML technique because of its superiority over the Engle-Granger two step procedures. The Johansen test for cointegration is a multivariate unit root test which estimates the cointegration rank r in the multivariate case, and which is also able to estimate the parameters of these cointegrating relationships. The result revealed the existence of no cointegrating relationship among the variables, as only one cointegrating vector emerge, which also indicate a sign of no cointegration as the trace statistics and maximum eigen values are not greater than the critical value at 5%. Thus, we conclude that all the variables are not cointegrated and have no long run relationship with each other. Therefore we have to test and run the lag order selection statistics of the VAR. Akaike information criterion (AIC) and Schwarz Bayesian Criterion (SBC) to select the lag length of the VAR system, and this is archived by minimizing the AIC and SBC. Both criterions agree with the use of lag length of 4. Therefore we run the Basic VAR and Granger causality tests. The result as shown in table 4; the granger causality test in the case of inflation rate shows that causality is running from money supply to inflation with significant relationship at even 1% level of significance at lag 1. Also, causality runs from RGDP to inflation and interest rate to inflation. Therefore, considering the money supply, causality is running from inflation to money supply, real GDP to money supply, and interest rate to money supply. That is to say inflation, RGDP, and interest rate all granger cause money supply. Also, considering

the real GDP, the granger causality test revealed that causality is running from inflation to RGDP, money supply to RGDP, and interest rate to RGDP.

Finally, considering the interest rate, the granger causality test revealed that inflation granger cause interest rate, money supply also granger cause interest rate, and RGDP granger cause interest rate. Therefore, bidirectional relationship exists between money supply and inflation, real GDP and inflation, and interest rate and inflation. Also, LM statistics for residual autocorrelation was carried out using the Langrange multiplier test and indicates a Null hypothesis of no autocorrelation at lag order. Since the validity of the diagnostic statistics requires that the error term follow a normal distribution, we proceed further to test the hypothesis that the error term is normally distributed that is normality test using the Jarque-Bera test, Skewness test and Kurtosis test, and all the test revealed that there is no normality problem, that all the eigenvalues lie inside the unit circle VAR satisfies stability condition.

## **5. CONCLUSION AND RECOMMENDATIONS**

This study is conducted to determine the relationship between money supply, interest rate, income growth and inflation rate for the economy of Nigeria for the period 1980-2010. Johansen co-integration test, VAR, and Granger Causality test are used to determine the relationship among the variables. The result indicates that there is no existence of long run relationship among all the variables, i.e money supply, interest rate, income growth, and inflation rate.

For detecting the level of causality among the variables, granger causality test is applied which revealed that causality is running from money supply to inflation, income growth to inflation, and interest rate to inflation. Based on these findings, this study recommends appropriate control and management of money supply, interest rate and inflation rate. Secondly, there is need for the central bank of Nigeria to maintain monetary policy consistent with low inflation and inflation expectations.

**Appendix 1.**

| year | M2    | RGDP  | INF  | INTRATE |
|------|-------|-------|------|---------|
| 1980 | 0     | 0.00  | 10   | 7.5     |
| 1981 | 6.56  | 84.62 | 21.4 | 7.75    |
| 1982 | 10.67 | 2.77  | 7.2  | 10.25   |
| 1983 | 13.34 | 7.59  | 23.2 | 10      |
| 1984 | 10.65 | 1.10  | 40.7 | 12.5    |
| 1985 | 11.06 | 8.69  | 4.7  | 9.25    |
| 1986 | 4.06  | 2.39  | 5.4  | 10.5    |
| 1987 | 18.64 | 0.56  | 10.2 | 17.5    |
| 1988 | 25.91 | 6.85  | 56   | 16.5    |
| 1989 | 3.41  | 7.11  | 50.5 | 26.8    |
| 1990 | 31.46 | 11.51 | 7.5  | 25.5    |
| 1991 | 21.52 | 0.87  | 12.7 | 20.01   |
| 1992 | 32.21 | 2.20  | 44.8 | 29.8    |
| 1993 | 34.96 | 1.26  | 57.2 | 18.32   |
| 1994 | 25.64 | 0.22  | 57   | 21      |
| 1995 | 16.25 | 2.11  | 72.8 | 20.18   |
| 1996 | 13.92 | 4.20  | 29.3 | 19.74   |
| 1997 | 13.82 | 2.74  | 10.7 | 13.54   |
| 1998 | 18.24 | 2.85  | 7.9  | 18.29   |
| 1999 | 24.88 | 0.41  | 6.6  | 21.32   |
| 2000 | 32.46 | 5.16  | 6.9  | 17.98   |
| 2001 | 21.26 | 7.79  | 18.9 | 18.29   |
| 2002 | 17.73 | 17.59 | 12.9 | 24.85   |
| 2003 | 19.42 | 9.28  | 14   | 20.71   |
| 2004 | 12.29 | 9.48  | 15   | 19.18   |
| 2005 | 19.58 | 6.11  | 17.8 | 17.75   |
| 2006 | 30.11 | 5.68  | 8.2  | 17.26   |
| 2007 | 30.94 | 6.05  | 5.4  | 16.49   |
| 2008 | 36.66 | 5.64  | 11.6 | 16.08   |
| 2009 | 14.58 | 6.50  | 12.4 | 18.36   |
| 2010 | 6.46  | 7.29  | 13.7 | 17.59   |

Source; CBN, Statistical bulletin,2010.

**TABLE 1 AUGMENTED DICKEY FULLER UNIT ROOTS TEST**

| Variable | Critical Values    | 1%     | 5%     | 10%    | Order of Integration |
|----------|--------------------|--------|--------|--------|----------------------|
| Inf      | -2.942<br>(0.0407) | -3.716 | -2.986 | -2.624 | Stationary at Level. |
| M2       | -3.597<br>(0.0058) | -3.716 | -2.986 | -2.624 | Stationary at Level. |
| RGDP     | -5.877<br>(0.0000) | -3.716 | -2.986 | -2.986 | Stationary at Level. |
| Intrate  | -2.909<br>(0.0443) | -3.716 | -2.986 | -2.624 | Stationary at Level. |

**TABLE 2, VAR LAG ORDER SELECTION CRITERIA**

| lag | LL       | LR      | df | p     | FPE      | AIC      | HQIC     | SBIC     |
|-----|----------|---------|----|-------|----------|----------|----------|----------|
| 0   | -366.192 |         |    |       | 9.5e+06  | 27.4216  | 27.4787  | 27.6136* |
| 1   | -344.741 | 42.903  | 16 | 0.000 | 6.5e+06  | 27.0178  | 27.3032  | 27.9777  |
| 2   | -332.112 | 25.256  | 16 | 0.065 | 9.1e+06  | 27.2676  | 27.7813  | 28.9954  |
| 3   | -309.711 | 44.803  | 16 | 0.000 | 7.2e+06  | 26.7934  | 27.5355  | 29.2891  |
| 4   | -281.208 | 57.006* | 16 | 0.000 | 4.9e+06* | 25.8673* | 26.8377* | 29.1308  |

\*Indicates Lag order selected by the criterion,LR;Sequential modified LR test statistics,FPE;Final predictor error,AIC;Akaike information criterion,SC;Schwarz information criterion,HQ;Hannan-Quinn information criterion.

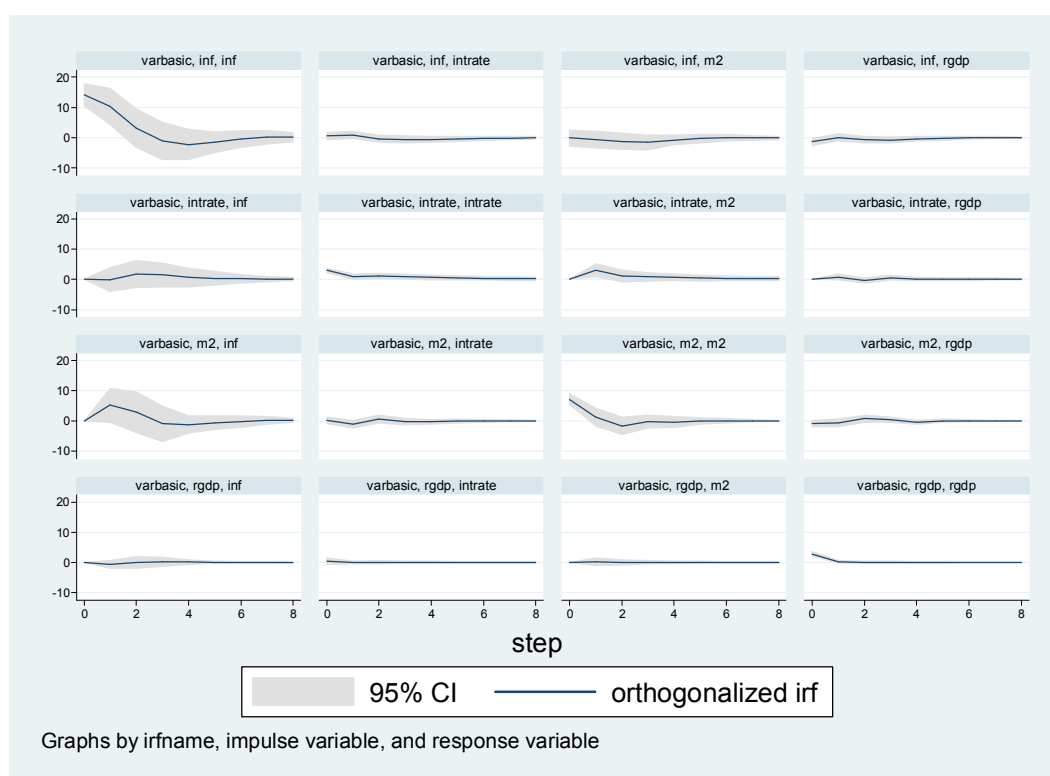
**TABLE 3, SUMMARY OF JOHANSEN COINTEGRATION TEST**

| Rank | Trace statistics | Eigen value | Critical value 5% |
|------|------------------|-------------|-------------------|
| 3    | 2.3240*          | 0.38860     | 3.76              |

**TABLE 4, GRANGER CAUSALITY TEST**

| Null Hypotheses   | Lag | F Statistics | Decision           |
|---|-----|--------------|--------------------|
| M2 does not granger cause inflation.<br>M2 granger cause inflation. | 2   | 0.177        | Reject.<br>Accept. |
| Rgdp does not granger cause inf<br>Rgdp granger cause inf           | 2   | 0.361        | Reject.<br>Accept. |
| Intrate granger cause inf<br>Intrate does not granger cause inf     | 2   | 0.996        | Reject.<br>Accept. |
| Inf does not granger cause M2<br>Inf granger cause M2               | 2   | 0.183        | Reject.<br>Accept. |
| Rgdp does not granger cause M2<br>Rgdp granger cause M2             | 2   | 0.869        | Reject.<br>Accept. |
| Intrate does not granger cause M2<br>Intrate granger cause M2.      | 2   | 0.007        | Reject.<br>Accept. |
| Infl does not granger cause Rgdp<br>Infl granger cause Rgdp         | 2   | 0.312        | Reject.            |
| M2 does not granger cause Rgdp<br>M2 granger cause Rgdp             | 2   | 0.059        | Reject.            |
| Intrate does not granger cause Rgdp<br>Intrate granger cause Rgdp   | 2   | 0.275        | Reject.<br>Accept. |
| Inf does not granger cause intrate<br>Inf granger cause intrate     | 2   | 0.027        | Reject.<br>Accept. |
| M2 does not granger cause intrate<br>M2 granger cause intrate       | 2   | 0.074        | Reject.<br>Accept. |
| Rgdp does not granger cause intrate<br>Rgdp granger cause intrate.  | 2   | 0.814        | Reject.<br>Accept. |

FIGURE1, VAR STABILITY CONDITION



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