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A Co-Integration Approach to Assess the Impact of Nigeria Monetary Policy on Economic Growth

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ABSTRACT

This research examines the impact of Nigeria's monetary policy on her economic growth by developing a model that is able to investigate how monetary policy of the government has affected economic growth through the adoption of multi-variable regression analysis. GDP representing economic growth which was used as the dependent variable against the explanatory variables which is Monetary Policy Variables: money supply, exchange rate, interest rate, and inflation rate. The time series data is the market-controlled period covering 1960-2020. The study determined the relationship between monetary policy instruments and GDP, and it also determined the adequacy of the model. The study adopted a co-integration approach and also conducted a unit root test. The study showed that monetary policy variables included in the model has combined significant impact on GDP in Nigeria. In addition, the core finding of this study showed that exchange rate and money supply have positive and statistically significant relationship with GDP in Nigeria. However, inflation rate has negative impact on GDP and a non-statistically significant relationship with GDP, interest rate has positive and statistically insignificant relationship with GDP. The results from the study proved that monetary policy have a significant relationship with GDP. In conclusion, based on the outcome of the Study. The study recommended among others that the regulatory authority (CBN) is advised to reduce interest rates and increase money supply such that both loans and funds will be easily accessed by manufacturing/industrial outlets to enhance manufacturing output in the Nigeria economy.

1. Introduction

Monetary policy is said to be a set of tools used by a nation's central bank to control the overall money supply and promote economic growth and employ strategies such as revising interest rates and changing bank reserve requirement. (Federal Reserve Bank 2022). Adegboyo *et al.* (2021) investigate the impact of fiscal, monetary and trade policies on Nigerian economic growth from 1985 to 2020. The study adopts endogenous growth model (AK model) as its theoretical framework. Nigeria, as an economy heavily dependent on imports, experiences sluggish growth, fluctuating business cycles and economic instability. This supports the view expressed by (Busari *et al.,* 2002) that monetary policies are more effective in targeting inflation than in stimulating growth. These conditions often lead to rising unemployment rates, inflation, a decrease in productivity and an imbalance in the balance of payments. Government has in one way or the other regulated and controlled the economy to maximize the welfare of the citizens by way of ensuring that the resources are efficiently allocated and used (Nwoko *et al.,* 2016). Similarly, to other developing countries, the Nigerian government implements three types of public policies to achieve the goals of income distribution and resource allocation. These public policy tools include monetary policy, fiscal policy, and income policy. The reason for focusing on monetary policy is due to its significant impact on both fiscal and income policy measures (Nouri & Samimi, 2011; Udude, 2014). Sulaiman and Migiro, (2014) studied the effect of fiscal and monetary policy on economic growth in Nigeria. The Autoregressive Distributed Lag Model (ARDL) was adopted as the estimation technique.

Lawal *et al.* (2017) conducted a study to assess the influence of the interplay between monetary and fiscal policies on the behaviour of the Nigerian stock market (ASI), as well as the effect of the volatility of this interplay on the market. The study utilized monthly data and applied both the ARDL and EGARCH models.

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Ufoeze *et al.* (2018) conducted a study to investigate the effect of monetary policy on economic growth in Nigeria. The study used the natural logarithm of the GDP as the dependent variable and explanatory variables such as monetary policy rate, money supply, exchange rate, lending rate, and investment.

Economic growth is the process by which a nation's wealth increases over time. Although the term is often used in discussions of short-term economic performance, in the context of economic theory it generally refers to an increase in wealth over an extended period (Mark, 2021). Growth can best be described as a process of transformation. Whether one examines an economy that is already modern and industrialized or an economy at an earlier stage of development, one finds that the process of growth is uneven and unbalanced (Cornwall, 2023).

The primary goal of this study is to assess the efficacy of the monetary policy implemented by the Central Bank of Nigeria (CBN) over the years.

2. Methodology

This research work employs the *ex-post facto* research design which is the type of research involving events that have already taken place and for which data already exists, and the research is merely engaged in data gathering. This type of design is a common and ideal method in conducting research in business and social sciences.

2.1 Model specification and validity

In analysing the determinant of economic development via monetary policies in Nigeria between 1960 and 2020, the study will be using co-integration approach to adopt and modify the model.

$$GDP_t = F(MS_t, INFL_t, INTR_t, EXCH_t) \quad (1)$$

$$GDP_t = \beta_0 + \beta_1 MS_t + \beta_2 INFL_t + \beta_3 INTR_t + \beta_4 EXCH_t + U_t \quad (2)$$

where:

GDP_t = Gross domestic product at the current time

MS_t = Money supply at the current time

$INFL_t$ = Inflation rate at the current time

$INTR_t$ =Interest rate at the current time

$EXCH_t$ = Exchange rate at the current time

β_0 =Intercept

$\beta_1, \beta_2, \beta_3$ and β_4 are the coefficient of the independent variables

U_t is the white noise error term

This model is transformed to log-linear econometric format to obtain the coefficient of the elasticity of the variables, while reducing the effect of any outliner variable. In the log-linear regression, the coefficients are easy to interpret as the problems of different units have been solved and the interpretation becomes easy in elasticity terms. Findings with log linear are sensitive to functional form.

Thus, the mathematical format of the model is as follows

$$\log GDP_t = \alpha_0 + \alpha_1 \log MS_t + \alpha_2 \log INFL_t + \alpha_3 \log INTR_t + \alpha_4 \log EXCH_t + U_t \quad (3)$$

A priori Expectations of $\beta_1, \beta_2 > 0$ and $\beta_2, \beta_3 < 0$

The study follows the arguments set out in the standard Mundell-Fleming-Dornbush model, which assumes *a priori,* that expansionary monetary policy reduces interest rates, depreciates the real exchange rate and increases prices (i.e., inflation, money supply, and the level of real output.)

Based on the expansionary assumption, the expected *a priori* is that:

- β_0 is to take care of the constant variable;

- β_1 is the coefficient of money supply (MS), which is expected to be greater than zero ($\beta_1 > 0$), because it is positively related to the gross domestic product in Nigeria;
- β_2 is the coefficient of inflation rate (INFL), which is expected to be less than zero ($\beta_2 < 0$) due to its negative relationship with the gross domestic product in Nigeria;
- β_3 is the coefficient of interest rate (INTR), which is expected to be less than zero ($\beta_3 < 0$) due to its negative relationship with the gross domestic product in Nigeria;
- β_4 is the coefficient of the exchange rate (EXCH), which is expected to be greater than zero ($\beta_4 > 0$) due to its positive relationship with the gross domestic product in Nigeria;

3. Results and Discussion

3.1 Descriptive statistics of the study variables

Table 1: Descriptive Statistics of the variables

Statistics	*INTR*	*GDP*	*EXCH*	*INFL*	*MS*
Mean	-1.26118	4.87E+10	66.30426	15.82364	4.99461E+12
Standard Error	1.974977	7.59E+09	12.0749	1.955036	1.23935E+12
Median	1.57	4.05E+10	8.04	11.71	57553630000
Standard Deviation	14.10416	5.93E+10	94.30796	15.26932	9.67965E+12
Sample Variance	198.9272	3.51E+21	8893.991	233.152	9.36956E+25
Kurtosis	8.118831	29.69383	1.45646	4.105254	3.319890549
Skewness	-2.28286	4.815078	1.470493	2.036842	2.056100644
Range	84.04	4.28E+11	358.26	76.5655	3.86271E+13
Minimum	-65.86	4.2E+09	0.55	-3.73	276000000
Maximum	18.18	4.32E+11	358.81	72.8355	3.86274E+13
Sum	-64.32	2.97E+12	4044.56	965.242	3.04671E+14
Count	51	61	61	61	61

Source: Authors compilation using R studio

The descriptive statistics of the study variables as shown in table 1 indicated that Money Supply had an average of 4.99E+12, the inflation rate had an average of 15.823, Exchange rate had an average of 66.30, GDP had an average of 4.87E+10, while the Interest rate had an average of -1.26. The standard deviation showed that Money Supply was the most volatile variable in the time series. This is followed by GDP, exchange rate, inflation rate and interest rate. The skewness statistic from the table above revealed that all the variables were positively skewed except interest rate which was negatively skewed. The kurtosis statistics showed that the exchange rate is platykurtic because it is less than three (3) suggesting that the distribution is flat relative to normal distribution while inflation rate, interest rate, GDP and money supply were leptokurtic, implying that the distribution peaked relative to normal distribution.

3.2 Correlation analysis

Table 2 Correlation Analysis of the Variables

	INTR	*GDP*	*EXCH*	*INFL*	*MS*
INTR	1				
GDP	-0.06021	1			
EXCH	0.399645	0.374041	1		
INFL	-0.44834	0.066632	-0.10532	1	
MS	0.346667	0.387854	0.924154	-0.11456	1

Source: Authors compilation using R studio

It is important to know that correlation helps to measure the strength of a linear association between variables. As shown in table 2 above; gross domestic product (a proxy for economic growth) is positively correlated with money supply, inflation rate, and exchange rate. While it has a negative correlation with only interest rate. The correlation of a variable to itself is seen to be a perfect one (+1). Changes in all other variables except interest rate will cause a shift in the gross domestic product by 37.40%, 6.66%, and 38.78% respectively.

3.3 Diagnostics test

This study embarked on diagnostic tests to ensure that the data and model used in this research work conforms to the basic assumptions of the classical linear regression which will ensure that the output of this process is not error prone and is reliable.

3.4 Test for stationarity

Stationarity test requires that the variables in the time series model must be stationary at a given level and p-value must be significant at that level. Stationarity is attained where the test statistic is most negative and greater than the critical value of the chosen level of significance.

Table 3: Augmented dickey-fuller (ADF)

Series	*ADF Test Statistic*	*5% Critical Value*	*Order*	*Remark*
EXCH	0.9515	-3.4865	I(0)	Not Stationary
GDP	-1.4560	-3.4865	I(0)	Not Stationary
INFL	-4.1290	-3.4865	I(0)	Stationary
INTR	-5.9999	-3.4865	I(0)	Stationary
MS	4.8584	-3.4865	I(0)	Stationary

Source: Authors compilation using R studio

Table 3 shows the ADF test at levels. The variables (inflation rate, interest rate, money supply) were stationary at level since by comparison, their critical values were less than in absolute values than their augmented dickey fuller (ADF) test statistics at 5% level of significance. Consequently, the variables (exchange rate, GDP) were not stationary at the level since by comparison, their critical values were greater than in absolute values than their augmented dickey fuller (ADF) test statistics at the 5% level of significance.

Table 4: Augmented dickey-fuller unit root test at first difference (trend and intercept)

Series	*ADF Test Statistic*	*5% Critical Value*	*Order*	*Remark*
EXCH	-5.7324	-3.4878	I(1)	Stationary
GDP	-2.4631	-3.4878	I(1)	Not Stationary
INFL	-8.0228	-3.4878	I(1)	Stationary
INTR	-4.7018	-3.4878	I(1)	Stationary
MS	3.1158	-3.4878	I(1)	Not Stationary

Source: Authors compilation using R studio

Table 4 shows the ADF test after first difference (trend and intercept). The variables (exchange rate, inflation rate, interest rate) were stationary at first difference since by comparison, their critical values were less than in absolute

values than their test statistics at 5% level of significance. Consequently, the variables (Money supply, GDP) were not stationary at first difference since by comparison, their critical values were greater than in absolute values than their augmented dickey fuller (ADF) test statistics at 5% level of significance.

Table 5: ADFs at second difference (trend and intercept)

Series	*ADF Test Statistic*	*5% Critical Value*	*Order*	*Remark*
EXCH	-7.6195	-3.4921	I(2)	Stationary
GDP	-5.1199	-3.4921	I(2)	Stationary
INFL	-7.2469	-3.4921	I(2)	Stationary
INTR	-4.5644	-3.4921	I(2)	Stationary
MS	-1.6086	-3.4921	I(2)	Not Stationary

Source: Authors compilation using R studio

Table 5 shows the Augmented dickey-fuller unit root test at first difference (trend and intercept). The variables (exchange rate, GDP, inflation rate, interest rate) were stationary at second difference since by comparison, their critical values were less than in absolute values than their augmented dickey fuller (ADF) test statistics at 5% level of significance. Consequently, the variable (Money supply) is not stationary at second difference since by comparison, their critical values were greater than in absolute values than their augmented dickey fuller (ADF) test statistics at 5% level of significance.

3.5 Co-integration test results

Co-integration is an essential part of financial modelling analysis used in Finance to model long-run equilibrium relationship (Brooks, 2014) and this is supported by Woolridge (2006). Soumare and Tchana (2015) used co-integration method to establish and test for long-run equilibrium relationship and thus form the basis for the adoption of co-integration method to test for the existence of long-run equilibrium relationship before proceeding with the regression analysis.

Table 6: Co-integration Test for Long-run Relationship between Monetary Policy and GDP

Hypothesized No. of CE(s)	*Eigen Value*	*Trace Statistic*	*0.05 Critical Value*	*Prob***	*Max-Eigen Statistic*	*0.05 Critical Value*	*Prob***
None*	0.711394	141.0501	117.7082	0.0008	55.92113	44.49720	0.0020
At most 1	0.565449	85.12896	88.80380	0.0894	37.50494	38.33101	0.0620
At most 2	0.376652	47.62403	63.87610	0.5234	21.26928	32.11832	0.5509
At most 3	0.297724	26.35474	42.91525	0.7178	15.90429	25.82321	0.5532
At most 4	0.126357	10.45045	25.87211	0.9044	6.078777	19.38704	0.9524
At most 5	0.092579	4.371675	12.51798	0.6879	4.371675	12.51798	0.6879

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Authors compilation using E-View

The results of the multivariate co-integration tests were validated using the Johansen (1991, 1995) approach. The Johansen's framework provides a number of co-integrating equations and estimates of all co-integrating vectors

in the multivariate case. The Johansen co-integration test result is presented in Tables 6. The result in table 6 of the trace and maximum eigen-value tests show the existence of one (1) co-integrating vector (p-value of 0.0008 for trace test and 0.0020 for maximum eigen-value) between EXCH, GDP, INTR, INFL and MS at the 5% level of significance. This thus confirms the existence of long-run equilibrium (co-integrating) effect of EXCH, INTR and INFL on GDP. Thus, concluding that there is long-run relationship between monetary policy and economic growth in Nigeria.

Table 7: Autoregressive Distributed Lag (ARDL) modelling the short-run relationship between the GDP and monetary policy variables

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	-1.425e+10	2.392e+10	-0.596	0.55388
L(GDP, 1)	7.648e-01	2.325e-01	3.290	0.00184
INTR_RATE	-1.318e+09	6.167e+08	-2.138	0.03743
L(INTR_RATE, 1)	-5.737e+08	6.297e+08	-0.911	0.36664
EXCH_RATE	1.021e+09	4.749e+08	2.150	0.03641
L(EXCH_RATE, 1)	-7.736e+08	5.130e+08	-1.508	0.13784
INFL_RATE	-3.975e+08	6.205e+08	-0.641	0.52475
L(INFL_RATE, 1)	7.979e+07	6.073e+08	0.131	0.89600
MONEY_SUPPLY	2.030e+08	4.519e+08	0.449	0.65524
L(MONEY_SUPPLY, 1)	2.193e+08	4.650e+08	0.472	0.63923

Residual standard error: 4.978e+10 on 50 degrees of freedom
Multiple R-squared: 0.4061, Adjusted R-squared: 0.2992
F-statistic: 3.798 on 9 and 50 DF, p-value: 0.001044
Since the p-value= 0.001044 is less than 0.05, thus conclude that, there is a short-run relationship between GDP and monetary policy variables.

3.6 Test of hypothesis

Restatement of hypothesis

H_0 : There is no significant relationship between monetary policy and Gross Domestic Product in Nigeria.

H_1 : There is a significant relationship between monetary policy and Gross Domestic Product in Nigeria

Table 8: Test of the Direction and Significance of the Relationship between Monetary Policy and GDP

Variables	***Coefficients***	***Standard Error***	***t Stat***	***P-value***
Intercept	5.74E+10	8.33E+09	6.8881	1.49E-08
EXCH	29207145	1.13E+08	0.2577	0.039775
INFL	-4.6E+08	3.06E+08	-1.5060	0.138927
MS	0.00046	0.001078	-0.4260	0.026721
INTR	7.2E+08	3.56E+08	-2.0151	0.049891
R Square	0.329577			
Adjusted R Square	0.293870			
Standard Error	2.97E+10			
F-Statistics	20.70892			
P-Value	0.035909			

From Table 8, the coefficient of determination R^2 shows that about 32.9% of the changes in economic growth (proxy for GDP) can be explained by monetary policy (Interest rate, Inflation rate, Exchange rate and Money supply). This implies that monetary policy can be effectively used to control Nigerian economy. Additionally, the F-statistics (20.70892) has probability less than 5%, which indicate that monetary policy variables included in the model has combined significant effect on economic growth in Nigeria. However, the contributions and significance of the individual coefficients of the model is used to test for hypotheses for this study using the t-test. Each of the hypotheses is tested with the coefficient and the t-values.

H_0 : Exchange rate has no significant effect on GDP in Nigeria

H_1 : Exchange rate has a significant effect on GDP in Nigeria

The coefficient of the EXCH is 29207145, which means that monetary policy rate has positive relationship with GDP. The t value is 0.257775 with probability value of 0.039775. Since the p value is less than 5%, we reject the null hypothesis and conclude that Exchange rate has a significant effect on GDP in Nigeria.

H_0 : Inflation rate has no significant effect on GDP in Nigeria.

H_1 : Inflation rate has a significant effect on GDP in Nigeria.

The coefficient of the INFL is -4.6E+08, which means that inflation rate has a negative relationship with GDP. The t value is -1.5065 with probability value of 0.138927. Since the p value is greater than 5%, we do not reject the null hypothesis and conclude that Inflation rate has no significant effect on GDP in Nigeria.

H_0 : Money Supply has no significant effect on GDP in Nigeria.

H_1 : Money Supply has a significant effect on GDP in Nigeria.

The coefficient of the MS is 0.00046, which means that the money supply has negative relationship with GDP. The t value is -0.4260 with probability value of 0.02672. Since the p value is less than 5%, we reject the null hypothesis and conclude that money supply has significant effect on GDP in Nigeria.

H_0 : Interest rate has no significant effect on GDP in Nigeria.

H_1 : Interest rate has a significant effect on GDP in Nigeria.

The coefficient of the INTR is 7.2E+08, which means that the interest rate has positive relationship with GDP. The t value is -2.0151 with probability value of 0.04989. Since the p value is less than 5%, we reject the null hypothesis and conclude that interest rate has significant effect on GDP in Nigeria.

4. Conclusion

This research determined the impact of monetary policy on economic growth in Nigeria by developing a model that is able to investigate how monetary policy of the government has affected economic growth through the use of multi-variable regression analysis. We proxied the variables of monetary policy instruments to include: Money Supply (MS), Exchange Rate (EXCH), Interest Rate (INTR), and Inflation rate (INFL). Economic growth was represented by Gross Domestic Product (income) at constant prices. Monetary policies determine the exchange rate of banks and their interest rates on loans, influence inflation rate and generally the total money supply in the economy which in turn play significant roles on the direction of economic activities and development generally.

Time Plots of the Study Variables

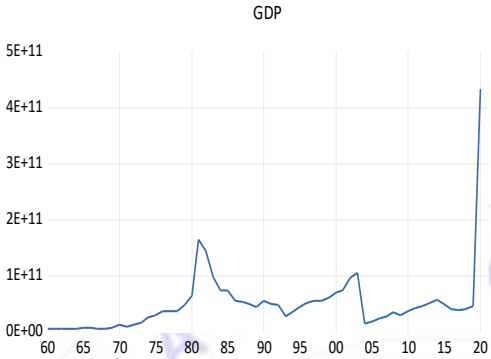

Figure 3.1: Time plot of GDP from 1960-2020

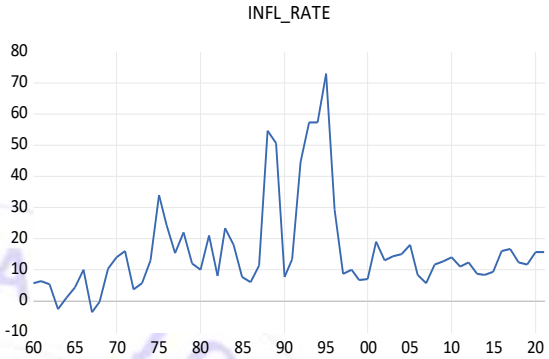

Figure 3.2: Time plot of Inflation Rate from 1960-2020

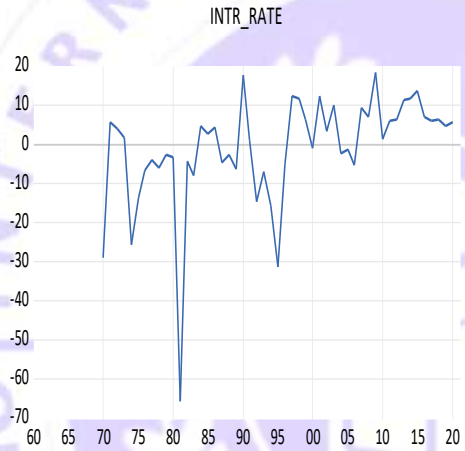

Figure 3.3: Time plot of Interest Rate from 1960-2020

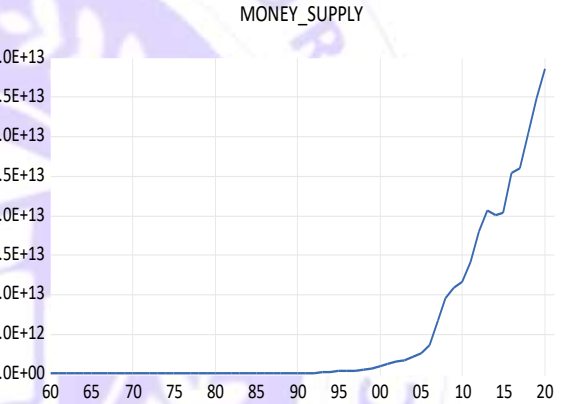

Figure 3.4: Time plot of Money Supply from 1960-2020

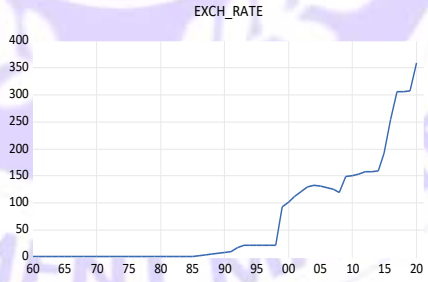

Figure 3.5: Time plot of Exchange Rate from 1960-2020

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