NIGERIAN MONETARY POLICY (1991-2021): MONEY SUPPLY RATE AND INFLATION RATE

ABSTRACT
Monetary policy can be so dicey or delicate that it requires great tact from the monetary authority. *Contractionary monetary policy, when pushed too far, drags the economy to recession while extreme expansionary monetary policy sinks the economy to liquidity trap. Central banks are in charge and are expected to favorably run the monetary policy by adjusting interest rates, influencing local lending rates, buying foreign currency, printing money, and use of other tools to modulate currency exchange rates, manage inflation, etcetera, with a sole target of creating a healthy economy. This study looks into the effect of money supply rate, exchange rate and interest rate on inflation rate in Nigerian economy between 1991 and 2021. With secondary data, the variables are found to be of mixed order of integration and, therefore, the ARDL model is our parameter estimator. Our model is found to be stable and our empirical investigation reveals that both money supply rate and interest rate in Nigeria have no significant effect on Nigeria's inflation rate while exchange rate has a significant inverse effect on Nigeria's inflation rate – the less favorable the exchange rate, the more biting the inflation. The study concludes with a recommendation that Nigerian authorities should take giant strides to fix the insecurity problems of the country in order to create safe environment that can attract both local investments and foreign direct investments which will, among other benefits, favour Nigeria in exchange rate.*

KEYWORDS: monetary policy, inflation rate, money supply rate, exchange rate and interest rate

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1. INTRODUCTION

Monetary policy is the measure adopted by the monetary authority of a nation to put in check either the interest rate payable for very short-term borrowing (borrowing by banks from each other to meet their short-term needs) or the money supply, often as an attempt to reduce inflation or the interest rate, to ensure price stability and general trust of the value and stability of the nation's currency.

According to Wikipedia, monetary policy is a modification of the supply of money, i.e. "printing" more money, or decreasing the money supply by changing interest rates or removing excess reserves. This is in contrast to fiscal policy, which relies on taxation, government spending, and government borrowing as methods for a government to manage business cycle phenomena such as recessions.

Monetary policy targets to stabilize gross domestic product, to achieve and maintain low unemployment, and to maintain predictable exchange rates with other currencies.

Monetary policy can be expansionary or contractionary. An expansionary policy maintains short-term interest rates at a lower than usual rate or increases the total supply of money in the economy more rapidly than usual. It is traditionally used to try to reduce unemployment during a recession by decreasing interest rates in the hope that less expensive credit will entice businesses into borrowing more money and thereby expanding. This would increase aggregate demand, which would increase short-term growth as measured by increase of GDP.

Expansionary monetary policy usually diminishes the exchange rate by increasing the amount of currency in circulation In this case, foreign purchasers will be able to purchase more with their currency in the country with the devalued currency. Contractionary policy, on the flip side, maintains short-term interest rates greater than usual, slows the rate of growth of the money supply, or even decreases it to slow short-term economic growth and lessen inflation. Contractionary policy can result in increased unemployment and depressed borrowing and spending by consumers and businesses, which can eventually result in an economic recession if implemented too vigorously.

The Central Bank of Nigeria (CBN), just as other central banks, always targets to maintain favorable general price stability in the economy using monetary policy dynamic instruments which include money supply, exchange rate and interest rate. When increase in money supply does not increase the interest rate and income and hence does not stimulate economic growth, we have an unhealthy economy called liquidity trap. On the flip side, contractionary measure pushed too far can plunge the economy into recession.

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Inflation rate is the rate of increase in prices over a given period of time. An exchange rate is the value of a nation's currency in terms of the currency of another nation. Interest rate is the proportion of a loan that is charged as interest to the borrower, typically expressed as an annual percentage of the loan outstanding. The money supply refers to the amount of cash or currency circulating in an economy over a given period of time.

The exchange Rate is one of the intermediate policy variables through which monetary policy is transmitted to the larger economy through its impact on the value of domestic currency, domestic inflation (the pass-through effect), the external sector, macroeconomic credibility, capital flows, and financial stability.

Undoubtedly, there is interconnectivity between the monetary policy instruments. It is, however, not inappropriate to wonder and inquire about the sort of relationships that exist between inflation rate and money supply rate, exchange rate and interest rate in Nigerian economy. Are they direct relationships or inverse? Are they significant or not? Against this backdrop, we have set out to empirically examine the effect of monetary policy on inflation rate in Nigeria. Specifically, the objectives of this study are

(i) to ascertain the extent to which money supply rate causes inflation in Nigeria.

(ii) to assess the extent to which the interest rate causes the inflation rate in Nigeria.

(iii) to determine the extent to which exchange rate causes inflation rate in Nigeria.

The following research questions have been mapped out:

i. To what extent does money supply rate have effect on inflation rate in Nigeria.?

ii. To what extent does interest rate have effect on the inflation rate in Nigeria?

iii. To what extent does exchange rate have effect on the inflation rate in Nigeria?

The following hypotheses, therefore, are to be tested in this study:

i. $\boldsymbol{H_0^1}$: money supply rate in Nigeria has no significant effect on inflation rate in Nigeria.

ii $\boldsymbol{H_0^2}$: interest rate in Nigeria has no significant effect on inflation rate in Nigeria.

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iii H_0^3: exchange rate to Nigeria's economy has no significant effect on inflation rate in Nigeria

For the significance of the study, it is expected that the findings of this study will be useful to policy makers in adopting suitable monetary policy measures to regulate inflation in Nigeria. In addition, the results of this study will add to the existing literature of monetary policy and inflation control in Nigeria; a good reference material for researchers.

For the scope of the study, the empirical investigation involves the following variables – Nigeria's inflation rate, money supply rate, exchange rate and interest rate from 1991 to 2021.

2. LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Monetary Policy

Monetary policy refers to the credit control measures adopted by the central bank of a country. According to Samiksha S. (2001), monetary policy is a policy employing central bank's control of the supply of money as an instrument for achieving the objectives of general economic policy.

G.K. Shaw defines monetary policy as any conscious action undertaken by the monetary authorities to change the quantity, availability or cost of money.

Samiksha S. (2001) outlined the objectives of monetary policy as follows: Full Employment, Price Stability, Economic Growth and Balance of Payments.

Samiksha S. (2001) classified instruments of monetary policy as two types: first, quantitative (known to be general or indirect) and second, qualitative (known to be selective or direct). Both types of the instruments affect the level of aggregate demand through the supply of money, cost of money and availability of credit. Of the two types of instruments, the first category includes bank rate variations, open market operations and changing reserve requirements. They are meant to regulate the overall level of credit in the economy through commercial banks. The selective credit controls aim at controlling specific types of credit. They include changing margin requirements and regulation of consumer credit.

2.1.2 Definition of Terms

Bank Rate: The minimum lending rate of the central bank at which it rediscounts first class bills of exchange and government securities held by the commercial banks. When the central bank finds that inflationary pressures have started emerging within the economy, it raises the bank rate. Borrowing from the central bank becomes costly and commercial banks borrow less from it. The commercial banks, in turn, raise their lending rates to the business community and borrowers borrow less from the commercial banks. There is contraction of credit and prices are checked from rising further. On the contrary, when prices are depressed, the central bank lowers the bank rate. It is cheap to borrow from the central bank on the part of commercial banks. The latter also lower their lending rates. Businessmen are encouraged to borrow more. Investment is encouraged. Output, employment, income and demand start rising and the downward movement of prices is checked.

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Open Market Operations: The operations refer to sale and purchase of securities in the money market by the central bank. When prices are rising and there is need to control them, the central bank sells securities. The reserves of commercial banks are reduced and they are not in a position to lend more to the business community. Further investment is discouraged and the rise in prices is checked. On the flipside, when recessionary forces start in the economy, the central bank buys securities. The reserves of commercial banks are raised. They lend more. Investment, output, employment, income and demand rise and fall in price is checked.

Reserve Ratio: This is a certain percentage of each commercial bank's total deposits required by law to be kept, in its vaults, in the form of a reserve fund and also a certain percentage with the central bank. When prices are rising, the central bank raises the reserve ratio. Banks are required to keep more with the central bank. Their reserves are reduced and they lend less. The volume of investment, output and employment are adversely affected. On the flipside, when the reserve ratio is lowered, the reserves of commercial banks are raised. They lend more and the economic activity is favorably affected.

Selective Credit Controls: Credit controls used to influence specific types of credit for particular purposes. They usually take the form of changing margin requirements to control speculative activities within the economy. When there is brisk speculative activity in the economy or in particular sectors in certain commodities and prices start rising, the central bank raises the margin requirement on them. The result is that the borrowers are given less money in loans against specified securities. In case of recession in a particular sector, the central bank encourages borrowing by lowering margin requirements.

2.2 Theoretical Review

2.2.1 Quantity Theory of Money by Fisher

According to Kirti Shailesh (2021), quantity theory of money states that money supply and price level in an economy are in direct proportion to one another. When there is a change in the supply of money, there is a proportional change in the price level and vice-versa. Fisher supported this definition the following equation:

$$\boldsymbol{M \times V = P \times T}$$

where, $\boldsymbol{M}$ = Money supply, $\boldsymbol{V}$ = Velocity of money, $\boldsymbol{P}$ = Price level, $\boldsymbol{T}$ = volume of the transactions

The theory is accepted by most economists per se. However, Keynesian economists and economists from the Monetarist School of Economics have criticized the theory. According to them, the theory fails in the short run when the prices are sticky. Moreover, it has been proved that velocity of money doesn't remain constant over time. Despite all this, the theory is very well respected and is heavily used to control inflation in the market. Friedman says that his quantity theory is a theory of demand for money and not a theory of output, income or prices

2.2.2 Quantity Theory of Money by Friedman

According to Kirti Shailesh (2021), Friedman in his essay, "The Quantity Theory of Money—A Restatement" published in 1956 beautifully restated the old quantity theory of money. In his restatement, Friedman says that "money does matter". For a better understanding and appreciation of Friedman's modern quantity theory, it is necessary to state the major assumptions and beliefs of Friedman.

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First of all, Friedman says that his quantity theory is a theory of demand for money and not a theory of output, income or prices.

Secondly, Friedman distinguishes between two types of demand for money. In the first type, money is demanded for transaction purposes. It serves as a medium of exchange. This view of money is the same as the old quantity theory. But in the second type, money is demanded because it is considered as an asset. Money is more basic than the medium of exchange. It is a temporary abode of purchasing power and hence an asset or a part of wealth. Friedman treats the demand for money as a part of the wealth theory.

Thirdly, Friedman treats the demand for money just like the demand for any durable consumer good. He says that the demand for money depends on three factors**:**

(a) The total wealth to be held in various forms

(b) The price or return from these various assets and

(c) Tastes and preferences of the asset holders.

Friedman considers five different forms in which wealth can be held, namely, money (M), bonds (B), equities (E), physical non-human goods (G) and human capital (H). In a broad sense, total wealth consists of all types of "income". By "income" Friedman means "aggregate nominal permanent income" which is the average expected yield from wealth during its life time.

The wealth holders distribute their total wealth among its various forms so as to maximise utility from them. They distribute the assets in such a way that the rate at which they can substitute one form of wealth for another is equal to the rate at which they are willing to do.

Accordingly, the cost of holding various assets except human capital can be measured by the rate of interest on various assets and the expected change in their prices. Thus Friedman says there are four factors which determine the demand for money. They are: price level, real income, rate of interest and rate of increase in the price level.

The demand for money is unitarily elastic. The relationship between the demand for money and real income (output of goods and services) is also direct. But it is not proportional as in the case of price. Thus, while changes in the price level cause direct and proportional changes in the demand for money, changes in real income create direct but more than proportional changes in the demand for money.

The rate of interest and the rate of increase in the price level constitute the cost of holding cash balances. If money is kept in the form of cash, it does not earn any income. But if the same money is lent out, it could earn some income in the form of interest to the owner.

The interest is the cost of holding cash. At higher interest rate the demand for money would be less. On the other hand, a lower rate of interest creates an increase in the demand for money. Thus there is an inverse relationship between the rate of interest and the demand for money.

The rate of increase in the price level also influences the demand for money. There is an inverse relationship between the rate of increase in the price level and the demand for money. When the price level increases at a high rate, the cost of holding money will increase.

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The people would like to hold smaller cash balances. The demand for money will decline. On the other hand when the price level increases at a low rate, the cost of holding money will decline and the demand for money increases.

Fourthly, Friedman believes that each form of wealth has its own characteristics and a different yield or return. In a broad sense money includes currency, demand deposits and time deposits which yield interest. Money also yields real return in the form of convenience, security etc., to the holder which is measured in terms of price (P). When the price level falls, the rate of return on money is positive because the value of money increases. When the price level rises, the value of money falls and the rate of return is negative. Thus P is an important variable in the demand function of Friedman.

The rate of return on bonds, equities and physical assets consists of currently paid interest rate and changes in their prices. As far as human wealth is concerned it is very difficult to measure the conversion of human into non-human wealth due to institutional constraints. But there is some possibility of substituting human wealth for non-human wealth.

Freidman calls the ratio of non-human wealth to human wealth or ratio of wealth to income as W. According to Friedman, income elasticity of demand for money is greater than unity. Besides, there are certain variables like the tastes and preferences of the wealth holders which also affect the demand functions. These variables are represented by m.

On the basis of the above assumptions and formulations, Friedman has derived a demand function for an individual wealth holder. It may be symbolically expressed as

$$M = f\left[p, r_b - \frac{1}{r_b}.\frac{dr_b}{dt}; r_e + \frac{1}{p}.\frac{dp}{dt} - \frac{1}{r_e}\frac{dr_e}{dt}; \frac{1}{p}.\frac{dp}{dt}; w; y; m\right] \ldots(1)$$

Where M is the total demand for money, P is the general price level,

r_b is the market interest rate on bonds, r_e is the market interest rate on equities,

$\frac{1}{p} \cdot \frac{dp}{dt}$ is the nominal return from physical goods, w is the ratio of non-human to human wealth,

Y is the money income available to the wealth holder, m is the variables affecting tastes and preferences on the wealth holders.

By assuming r_b and r_e to be stable, Friedman replaces the variables representing the return on bonds and equities

$$\left[r_b, \frac{1}{r_b}.\frac{dr_b}{dt}\right] + \left[r_e + \frac{1}{p}.\frac{dp}{dt}\frac{1}{r_b}.\frac{dr_e}{dt}\right]$$

in equation 1 by simply r_b and r_e. As a result of this replacement, the demand function can be written as

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$$M = f\left(P, r_b; r_e; \frac{1}{P}.\frac{dp}{dt} w; y; \mu\right) \quad ...(2)$$

Further Friedman says that when there are changes in price and money income, there will be a proportionate change in the demand for money. This means that equation 2 must be regarded as homogenous of the first degree in P and Y, so that equation 2 becomes as

$$IM = f\left(\lambda P, r_b; r_e; \frac{1}{P}.\frac{dp}{dt} w; \lambda y; \mu\right) \quad ...(3)$$

putting $\lambda = \frac{1}{P}$

equation 3 can be written as

$$\frac{M}{P} = f\left(r_b; r_e \frac{1}{P}.\frac{dp}{dt}; w\frac{\gamma}{P}; \mu\right) \quad ...(4)$$

In this form, the equation 4 expresses the demand for real cash balances as a function of "real" variable.

Putting $\lambda = \frac{1}{Y}$ equation 3 can be written as

$$\frac{M}{Y} = f\left(r_b; r_e \frac{1}{P}.\frac{dp}{dt}; w; \frac{P}{y}; \mu\right) \quad ...(5)$$

or

$$M = f\left(r_b; r_e \frac{1}{P}.\frac{dp}{dt}; w; \frac{P}{y}; \mu\right) Y \quad ...(6)$$

In Friedman's modern quantity theory of money, the supply of money is independent of demand for money. Due to the actions of the monetary authorities, the supply of money changes, whereas the demand for money remains more or less stable. It means that the amount of money which people want to have as cash or bank deposits is more or less fixed to their permanent income.

If the central bank purchases securities, people who sell securities to the central bank receive money and this leads to an increase in their cash holdings. The people will spend this excess money partly on consumer goods and partly by purchasing assets. This spending will reduce their cash balances and at the same time there is a rise in the national income.

On the other hand, when the central bank sells securities, the money holding of the people reduces, in relation to their permanent income. Therefore, they will try to increase their cash partly by reducing their consumption and partly by selling their assets. This will reduce national income. Thus, in both cases the demand for money remains stable.

If the demand for money is given, it is possible to predict the effects of changes in the supply of money on expenditure and income. If the economy is at less than full employment level, an increase in the supply of money raises the expenditure, output and employment levels. But this is possible only in the short run.

2.3 Empirical Review

Babalola et al (2015) studied the effect of inflation and interest rate on economic growth using secondary data sourced from World Bank databank and Central Bank of Nigeria. The study adopted ordinary least square (OLS) method of analysis. The long run relationship between the variables was analyzed using the Johansen integration test. The Augmented Dickey Fuller test performed showed that only inflation is not stationary at first difference. The direction of causality and trend analysis was also performed on variables. It was found that Inflation and Interest rate has a negative effect on Economic growth but neither Inflation nor Interest rate granger causes economic growth. Babalola et al recommended that policy makers should focus on maintaining inflation at a low rate (single digit) and ensuring interest rate stability.

Ikechukwu et al (2016), in their study of the Efficacy of Nigeria Monetary Policy: A Comparative Analysis. assessed the efficacy of the Nigeria's monetary policy against the backdrop of single digit inflation monetary policy target of the regulatory authorities. Two related questions were constructed to guide the study. Relying on both the Keynesian and Structuralist analyses, data were harvested on inflationary performance for 24 years on Nigeria economy from the World Bank data base and assessed it against achievement of the targeted single digit inflation. Thereafter Nigeria inflationary performance was compared with that of South Africa another leading African economy. Ikechukwu et al reported that inflationary pressure on the South African economy was lower than that of Nigeria, even when both countries faced high inflation episodes during the early decade of 1990s. Their findings revealed that factors beyond the purview of monetary policy constrained the realization of single digit inflation and that the factors included the existence of various and uncontrolled sources of liquidity in the country, government fiscal operation, which included financing of deficit budget and monetization of deficits and the existence of large informal credit markets. Based on this, they recommended concerted improvement of public infrastructure, the perfection of cashless economy program, effective prosecution of war against corruption, and the creation of a single treasury account to help close leakages especially those linked to revenue accruable to government through MDAs and remittance to States and MDAs.

Mukhtar et al (2017) examined the effect of money supply on Economic Growth in Nigeria using annual time series data for the period 1981 – 2015. Johansen co-integration approach was used to check the long run relationship among the variables while Vector Error Correction Model (VECM) was used to measure the short run dynamics and the pairwise Granger causality test was used to check the direction of the causality between the variables. The empirical result confirmed long run relationship among the variables where money supply and interest rate showed positive significant impact while real
exchange rate had negative significant impact on the economy. However, in the short run lagged value of money supply had negative significant effect but lagged value of exchange rate showed negative significant effect while lagged value of GDP and lagged value of interest rate did not have any significant effect on the economy. The causality test revealed bidirectional causality between money supply and GDP, unidirectional causality running from exchange rate to money supply and interest rate to money supply while there is no causality between exchange rate and GDP, interest rate and GDP, and also interest rate and exchange rate. In the conclusion, the study recommended
expansionary monetary policy for achieving economic growth in Nigeria in addition to greater emphasis on the improvement of monetary policies and institutions for ensuring effective and efficient monetary system in Nigeria.

Dinh Doan Van (2020) in his study of supply and inflation impact on economic growth applied the economic theories of Fisher, Friedman to analyse, econometrically, the relationship between money supply and inflation. Vietnam's and China's research data were collected in the period of 2012-2016. His study found out that the

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continuous increase in the money supply caused inflation in the long-term, but the continuous increase in the money supply growth did not cause inflation in a short time; this was analyzed based on the theory of monetary quantity. The study showed that money supply and inflation were closely related, and the money supply directly affected economic growth. Dinh Doan Van (2020) therefore that government should have the relevant monetary policy to grow the economy and proposals to make monetary policy, control inflation levels and stimulate economic growth.

3. RESEARCH METHODOLOGY

3.1 Research Design:

The study is basically an empirical Investigation of the effect of money supply rate, exchange rate and interest rate on inflation rate in Nigerian economy between 1991 and 2021 using secondary data

3.2 Model Specification

The lag structure is chosen by default. The ARDL model is our parameter estimator and we go with the structural form $ARDL\ (p, q_1, q_2, q_3)$ where p, q_1, q_2, q_3 are the optimal lag structures of inflation rate (Inf), Exchange rate (Exch), Interest rate (Int) and money supply rate (MSR) respectively.

The model is specified as follows:

$$\Delta Inf_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta(Inf)_{t-i} + \sum_{j=0}^{q_1} \alpha_j \Delta(Exch)_{t-j} + \sum_{k=0}^{q_2} \delta_k \Delta(Int)_{t-k} + \sum_{l=0}^{q_3} \omega_l \Delta(MSR)_{t-L} + \varphi_1(Inf)_{t-1} + \varphi_2(Exch)_{t-1} + \varphi_3(Int)_{t-1} + \varphi_4(MSR)_{t-1} + \mu_t.$$

Where:

$\sum_{i=1}^{p} \beta_1 \Delta(Inf)_{t-i} + \sum_{j=0}^{q_1} \alpha_j \Delta(Exch)_{t-j} + \sum_{k=0}^{q_2} \delta_k \Delta(Int)_{t-k} + \sum_{l=0}^{q_3} \omega_l \Delta(MSR)_{t-L}$ is the short-run specification

and $\varphi_1(Inf)_{t-1} + \varphi_2(Exch)_{t-1} + \varphi_3(Int)_{t-1} + \varphi_4(MSR)_{t-1}$ is the short-run specification.

μ_t is the disturbance term or the white noise term. Δ = the difference operator, β_0, β_1, α_j, δ_k, ω_l and $\varphi_i (i = 1, 2, 3, 4)$ are the parameters.

3.3 Source of Data: Annual time series data from 1991 to 2021 are used in this study and the following websites are the sources of the data: https://www.worlddata.info, www.globalhungerindex.org, https://www.theglobaleconomy.com/download-data.php and https://www.ceicdata.com/en/indicator/nigeria/money-supply-m2

3.4 Model Estimation/Method of Data Analysis

The empirical investigation will take the following steps:

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- Examination of the stationarity of the variables using the Unit Root Test
- ARDL Cointegration Tests: The Bounds Test, Long-run relationship and Short-run relationship tests.
- Examination of the causal relationships among the variables using the Granger Causality Test and
- Diagnostic Tests.

4. RESULTS AND DISCUSSIONS

4.1 MULTICOLLINEARITY TEST

Variance Inflation Factors
Date: 03/05/22 Time: 18:50
Sample: 1989 2019
Included observations: 31

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	418.8070	62.88214	NA
EXCH	0.002241	4.690781	1.266752
INT	0.793140	48.29820	1.293001
MSR	1.58E-08	1.088624	1.053075

Chart 1: Multicollinearity Test results

Since the Centered VIF coefficients are less than 10 for all the explanatory variables, we conclude that no severe multicollinearity exists in the model.

4.2 SUMMARY OF THE RESULTS OF THE UNIT ROOT TEST

Series	5%Critical value @ Level	ADF t-Statistics @ Level	5%Critical value @ 1st Difference	ADF t-Statistics @1st Difference	Order of Integration
Inf	−2.963972	−2.920806	−2.967767	−6.169967	$I(1)$
MSR	−2.963972	−5.477982	-	-	$I(0)$
Int	−2.963972	−2.836599	−2.967767	−7.230789	$I(1)$
Exch	−2.963972	−1.022490	−2.967767	−5.292419	$I(1)$

Table .1: Unit Root Test from Eviews 9.

The result of the unit root test above shows that Money Supply Rate (MSR) is stationary at level while Inflation rate (Inf), Interest rate (Int), and Exchange rate (Exch) are all stationary at first difference. We have a mixed order of integration. ARDL Bounds test is therefore needed to investigate the cointegration or long-run relationship of the variables.

4.3 ARDL COINTEGRATION TESTS

4.3.1 Bounds Test

ARDL Bounds Test
Date: 02/26/22 Time: 11:10
Sample: 1991 2019

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Included observations: 29
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	9.937558	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Table 2: Bounds Test from Eviews 9

From the table, F-statistic value (9.937558) is greater than the upper bound 5% critical value. We therefore reject the null hypothesis which states that "No long-run relationships exist". Thus, we uphold that long-run relationships exist amongst the variables.

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4.3.2 ARDL Short-run Cointegration and Long Run Coefficients Test

ARDL Cointegrating And Long Run Form
Dependent Variable: INF
Selected Model: ARDL(3, 4, 4, 0)
Date: 02/26/22 Time: 11:48
Sample: 1989 2019
Included observations: 27

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	0.497749	0.170098	2.926244	0.0127
D(INF(-2))	0.565810	0.177226	3.192584	0.0077
D(EXCH)	-0.369458	0.104346	-3.540707	0.0041
D(EXCH(-1))	-0.044525	0.108538	-0.410229	0.6889
D(EXCH(-2))	0.116954	0.109849	1.064679	0.3080
D(EXCH(-3))	-0.213350	0.079904	-2.670086	0.0204
D(INT)	0.533586	0.625232	0.853420	0.4101
D(INT(-1))	-2.567128	0.621811	-4.128473	0.0014
D(INT(-2))	0.272430	0.847667	0.321388	0.7534
D(INT(-3))	1.986098	0.766139	2.592347	0.0236
D(MSR)	-0.000049	0.000053	-0.921616	0.3749
CointEq(-1)	-1.101567	0.223812	-4.921830	0.0004

Cointeq = INF - (-0.2129*EXCH -0.3465*INT -0.0000*MSR + 53.2063)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.

EXCH	-0.212926	0.034040	-6.255178	0.0000
INT	-0.346507	0.872330	-0.397221	0.6982
MSR	-0.000044	0.000050	-0.880767	0.3957
C	53.206266	20.241851	2.628528	0.0220

Table 3, Source: Eviews9 output.

Table 3 shows that in the short-run, inflation rate lag 1 is statistically significant and in direct relationship with the current inflation rate. 1% increase in inflation rate lag 1 brings about 0.497749% increase in the current inflation rate. The current exchange rate is statistically significant and in inverse relationship with the current inflation rate. 1% increase in exchange rate will bring about 0.369458% decrease in the inflation rate. Interest rate lag 1 is significant and in inverse relationship with the current inflation rate. 1% increase in interest rate lag 1 brings about 2.567128% decrease in the current inflation rate.

Money Supply Rate is not statistically significant. It means that Money Supply Rate has no significant impact on inflation rate in Nigeria.

The long-run cointegrating equation is

$$\text{Inf} = 53.2063 - 0.2129(\text{Exch}) - 0.3465(\text{Int}) - 0.0000(MSR)$$

In the long-run, both the exchange rate and the interest rate are in inverse relationship with the inflation rate. However, while this inverse effect of the exchange rate on the inflation rate is statistically significant, that of interest rate is not. 1% increase in exchange rate will bring about 0.2129% decrease in the inflation rate. Our result shows that no significant relationship exists between the money supply rate and the inflation rate.

The error correction term ECT (-1) is significant, properly signed and the speed of adjustment towards long-run equilibrium is -1.101567. This means that approximately 110% of the error is corrected in each period. This high speed of adjustment implies that all deviations/errors will be corrected within one year to bring the system to long-run equilibrium

4.4 GRANGER CAUSALITY TEST

Pairwise Granger Causality Tests
Date: 02/26/22 Time: 19:19
Sample: 1989 2019
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
EXCH does not Granger Cause INF	27	3.09660	0.0419
INF does not Granger Cause EXCH		4.52560	0.0105
INT does not Granger Cause INF	27	5.20032	0.0058
INF does not Granger Cause INT		3.42468	0.0300
MSR does not Granger Cause INF	27	0.08066	0.9873
INF does not Granger Cause MSR		0.06103	0.9925
INT does not Granger Cause EXCH	27	1.37421	0.2822

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EXCH does not Granger Cause INT		1.18794	0.3497
MSR does not Granger Cause EXCH	27	0.00856	0.9998
EXCH does not Granger Cause MSR		0.90106	0.4839
MSR does not Granger Cause INT	27	0.24235	0.9105
INT does not Granger Cause MSR		0.49352	0.7406

Table 4, Source: Eviews9 output

The Granger Causality test results above examines causal relationship amongst the variables. As usual, only two variables are considered at a time and the two variables are both dependent and in turn independent. The test gives us the direction of causality among these variables, and three types of causal relationship exist. Viz: Bidirectional causality, Unidirectional causality and No causal relationship.

In our test results above, we observed that at 5% level of significance, there is bidirectional relationship between exchange rate and inflation. Bidirectional relationship also exists between interest rate and inflation. No other causal relationship exists between any other pair of variables.

4.5 DIAGNOSTIC TESTS

4.5.1 Breusch-Godfrey Serial Correlation LM Test: Here, we test for autocorrelation. This is to find out if our model is free from serial correlation.

H_0: There is no autocorrelation.

F-statistic	0.760324	Prob. F(1,11)	0.4019
Obs*R-squared	1.745593	Prob. Chi-Square(1)	0.1864

Table 5, Source: Eviews9 output

The result in the table shows that Prob. Chi-Square of 0.1864, which is not significant at 5% level of significance. We cannot therefore reject the null hypothesis. Thus, our model has no significant trace of autocorrelation.

4.5.2: Breusch-Pagan-Godfrey Heteroskedasticity Test:

H_0: There is no Heteroskedasticity

F-statistic	0.789476	Prob. F(14,12)	0.6671
Obs*R-squared	12.94522	Prob. Chi-Square(14)	0.5308
Scaled explained SS	2.379361	Prob. Chi-Square(14)	0.9998

Table 6, Source: Eviews9 output

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The result shows that Prob. Chi-Square corresponding to Obs*R-squared is 0.5308, which is not significant at 5% level of significance. Thus, we cannot reject the null hypothesis. We therefore conclude that our model has no significant trace of heteroskedasticity.

4.5.3: ARCH Heteroskedasticity Test: To examine if our model is free from ARCH effect

H_O: There is no ARCH effect

F-statistic	0.333175	Prob. F(4,18)	0.8520
Obs*R-squared	1.585507	Prob. Chi-Square(4)	0.8114

Table 7, Heteroskedasticity Test: ARCH

The result in the table shows that Prob. Chi-Square corresponding to Obs*R-squared is 0.8114, which is not significant at 5% level of significance. Therefore, we cannot reject the null hypothesis. Thus, we conclude that our model is free from ARCH effect.

4.5.4: Jarque – Bera Test: To find out if the residuals of our model are normally distributed

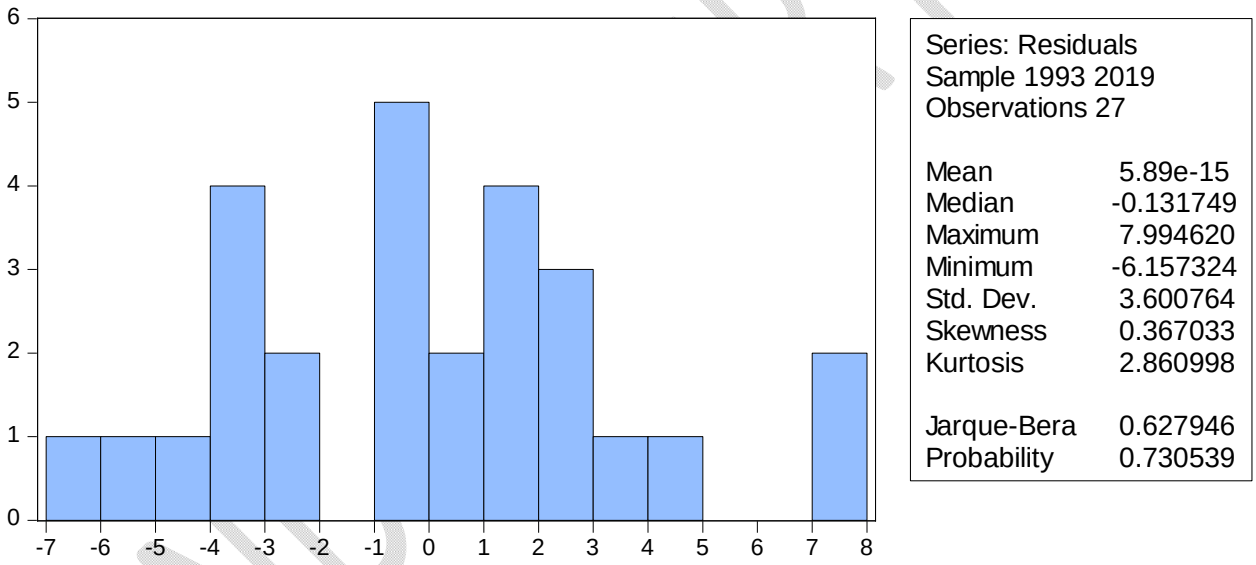

Fig 1, Source: Eviews9 output.

With the prob value greater than 5%, our conclusion is that the residuals of our model are normally distributed.

4.5.5: CUSUM stability Test

Our model is further subjected to CUSUM and CUSUM of squares stability tests and the figures below are the results. CUSUM means cumulative sum. It is used to investigate whether or not the coefficients (parameters) of our model are changing systematically (stable)

Null Hypothesis: parameters are stable.

Acceptance of the null hypothesis is desirable.

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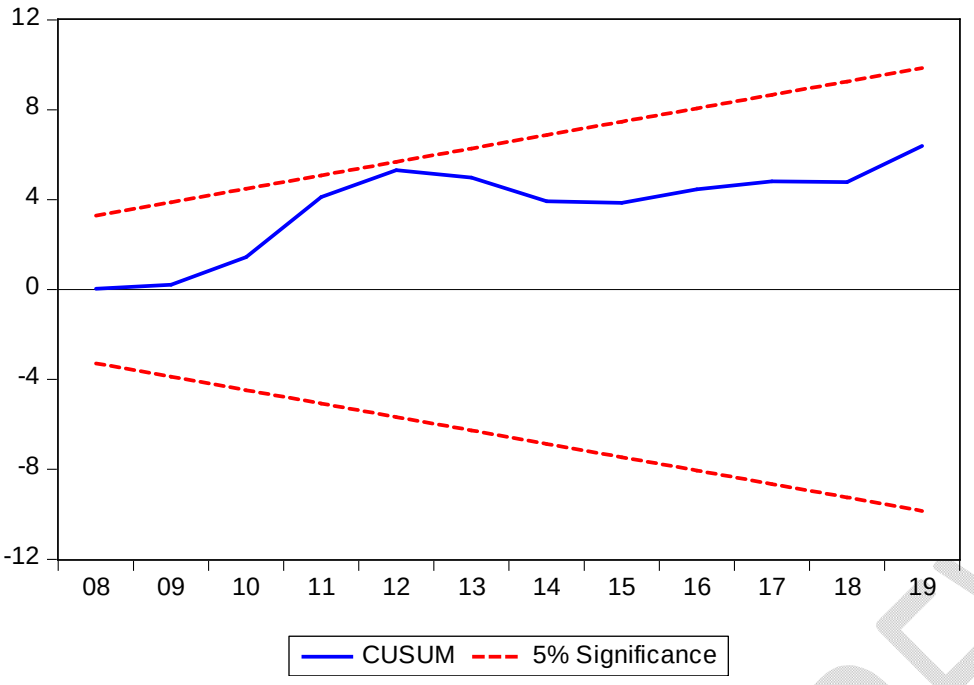

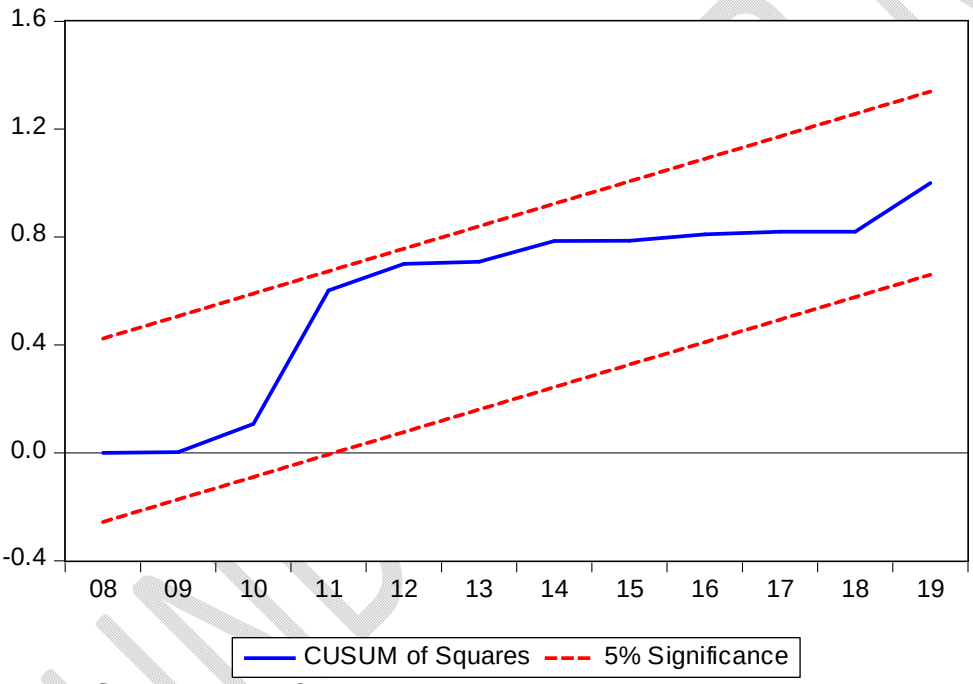

Fig 2, Source: Eviews9 output.

The CUSUM test result above shows that our model is fairly stable given that the CUSUM line is within the 5% significance boundary.

4.6 DISCUSSIONS ON OUR RESEARCH HYPOTHESES

Having carried out the necessary tests, it is now time to give responses to our research hypotheses based on our findings.

4.6.1 $\boldsymbol{H_0^1}$**:** Money supply rate in Nigeria has no significant effect on Nigeria's inflation rate.

Our findings in Table 3 show that money supply rate in Nigeria has no significant effect on Nigeria's inflation rate.
Decision: We accept $\boldsymbol{H_0^1}$**.**

4.6.2 $\boldsymbol{H_0^2}$**:** Exchange rate in Nigeria has no significant effect on Nigeria's inflation rate.
Our findings in Table 4.3.2 show that exchange rate in Nigeria has a significant effect on Nigeria's inflation rate.
Decision: We reject $\boldsymbol{H_0^2}$**.**

4.6.3 $\boldsymbol{H_0^3}$**:** Interest rate in Nigeria has no significant effect on Nigeria's inflation rate.
Our findings in Table 4.3.2 show that Interest rate in Nigeria has no significant effect on Nigeria's inflation rate.
Decision: We accept $\boldsymbol{H_0^3}$**.**

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings and Conclusion

Our model in this study was found to be stable and the empirical findings show that money supply rate and interest rate in Nigeria are not necessarily the factors responsible for Nigeria's high inflation rate within the period of time (1991 – 2021). Exchange rate, however, has a significant effect on Nigeria's inflation rate within the period.
In conclusion, therefore, we state that the less favorable the exchange rate is to Nigeria, the more biting the inflation.

5.2 Recommendations

Nigerian authorities should take giant strides to fix the insecurity problems of the country in order to create safe environment that can attract both local investments and foreign direct investments which will, among other benefits, favour Nigeria in exchange rate.

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