The Position of Monetary Policy Mechanism in Controlling Inflation Growth in Nigeria Using Standardized Regression Model

A. P. Oluwagunwa a, S. K. Atanlogun a and O. A. Edwin a*

a Department of Mathematics and Statistics, Rufus Giwa Polytechnic Owo, Ondo State Nigeria.

Authors’ Contributions

This work was carried out in collaboration among all authors. Authors SKA and OAE designed the study, performed the statistical analysis. Authors SKA and OAE wrote the first draft of the manuscript and managed the analyses of the study. Authors SKA and EOA managed the literature searches. All authors read and approved the final manuscript.

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Abstract

This study examined the role of monetary policy mechanism in controlling inflation growth in Nigeria. Standardized Multiple Linear Regression Model (SMLRM) estimating technique was considered as a tool in fitting the model where inflation rate served as response variable and income growth rate, money supply, exchange rate, domestic credit growth rate and government expenditure served as explanatory variables. Data were collected from the Central Bank of Nigeria (CBN) Statistical Bulletin, December 2018 for the period of 1998 to 2018. The R-Statistical software package was adopted to carry out the analysis. The result of the P-value of Money supply, Exchange rate and Domestic credit growth rate were all statistically significant with 0.00165, 0.000038 and 0.00864 respectively at (0.05). Though, the Real income growth rate and Government expenditure do not appreciably contribute in controlling inflation growth rate. The overall model contributes significantly in controlling inflation growth rate with a p-value of 2.2 x 10-16. The coefficient of determination (R-square) is very high, which implies that the model best captured the control of inflation growth rate that is being considered. The study however concluded that three of the explanatory variables made much significant impact in controlling inflation growth in Nigeria.

*Corresponding author: Email: toyinedwin@gmail.com, toyinedwin@yahoo.com;
Keywords: Monetary policy; inflation growth; standardized regression model; money supply; exchange rate; domestic credit growth rate; government expenditure.

1 Introduction

In everywhere, inflation can be observed as a monetary phenomenon, in the sense that it can be yielded only by rapid increase in the quantity of money than in output. In our own remark, we will try to see the reconciliation between the monetary theory and the current behaviour of inflation. Consequently, the development of recent, made an establishment that traditional approach that captures the connectivity between monetary policy, money and inflation are obsolete and needed to be revised. As a matter of fact, the remark of ours, represent our own knowledge of understanding and not necessarily those in the Federal Reserve System. Before the advent of interest on reserves approach, the opportunity cost for holding noninterest-bearing bank reserves was regarded as nominal short term interest rate, such as the federal funds rate. The demand for reserves is slopping downwardly which implies that when the federal funds rate is low, the quantity of bank’s reserves likely to hold increase. By adjusting the amount of reserves, so that the federal funds rate equals a targeted level at which demand and supply for reserves are in equilibrium makes the conventional monetary policy works [1,2]. This is done, by the implementation of trading noninterest-bearing reserves for interest-bearing securities, typically for short term treasury bills. Consequently, banks are strong enough to incentively put reserves to work by lending them out. If the whole banking system found itself with an excessive reserves, then the system tends to increase the availability of credit facility in the economy, thereby driving private sector borrowing rate lower and spur economy activity [3].

Precisely the reason lies behind the classical monetary theories of multiple deposit creation and the money multiplier, which hold that increase in the monetary base should lead to a proportional rise in the money stock [4].

However, if the economy is operating at its potential, with the banking system holding excess reserves, too much “money” will chase too few goods leading to higher inflation. Freidman’s maxim would be confirmed. One of the main obligations saddled with the monetary agency is to maintain relative stability in the domestic prices of goods and services. The emphasis is imperatively based on the belief that monetary policy enhances sustainable growth and development by strengthening the value of money and prevents inflation and its associated uncertainties, thereby increasing the future economy growth prospect of the country. Thus, maintaining relative stability remains one of the vital goals of monetary authorities in the country [3].

A federal exchange of bank reserves that pays interest for a Treasury-bill that carries a very similar interest rate as virtually no effect of the economy. Instead, what matter for the economy is the level of interest rate, which are affected by monetary policy, which implies that the traditional historical association or relationship between the amount of reserves, the money supply and the economy are unlikely to hold in the future [5]. If the banks are interested to hold excess reserves as an interest bearing asset, then the marginal money multiplier effect on those reserves can be close zero. In a situation, where the federal pays interest on bank reserves, traditional theories that indicate a mechanical link between reserves, money supply and ultimately inflation are no longer valid. In particular, the work takes a new dimension if the federal wishes to pay high enough rate on reserves [6].

2 Definition of Terms

**Monetary Policy:** is the process by which regulative bodies such as the government, central bank of a country or monetary authority manages the supply of money or trading in foreign exchange market to achieve sustainable economic growth. The central bank of a country uses micro economy policy to manage the supply of money and interest rate.

**Inflation:** This is an increase in the general level of price or in the cost of living, a decline in the value of money. An increase in the quantity of money leading to devaluation of existing money.

**Discount Rate:** This express the amount of interest paid or earned as percentage of the balance at the end of the annual period which is an alternative measure of interest rate to the standard annual percentage rate. It is also
an interest rate that a central bank charges depository institutions that borrow reserves from it. This interest rate used to discount future cashflows of a financial instrument; the annual interest rate used to decrease the amount of future cashflows to yield the present value.

**Liquidity Ratio:** Liquidity itself is the degree in which something is in high supply or demand making it easily convertible to cash. Liquidity ratio can then be stated as bank regulation that set the minimum reserves each bank must hold. It is the ability of an organisation to repay short term creditors out of its total cash.

**Money Supply:** This is the total amount of money such as bills, coins, loans, credits and other liquidity instrument in a particular economy. It can also be refers to as the total volume of money held by the public at a particular point in time in an economy.

**Economic Growth:** This is just the growth of the economic output of a country and can also be describe as the improvement in the inflation-adjusted economy over time which is measured by the increase in the amount of goods and services produced.

**Exchange Rate:** This is the rate at which one’s currency will be exchange for another currency and is also regarded as the value of one country’s currency in relation to another currency for instance at what rate you will change one naira to U.S dollars.

**Domestic credit growth rate:** The part of an increase in the amount of money in a country’s economic which includes bank loans and the money government borrow to finance the economy. The international monetary fund (IMF) uses monetary aggregate to restrain member country with a deficit balance as condition to access the fund resources. Domestic Credit growth is also a key mechanism in linking capital flows.

**Government Expenditure:** (GE) which also can be term as Government Spending refers to money spend by the public sector (government) on the acquisition of goods and provision of services such as education, health care, social welfare and defence. Government expenditure can be classified as government final consumption spending and Government investment.

### 3 Model Specification

**Standardized Multiple Linear Regression Model (SMLRM):** In this type of model, we have the results shows that all predictors and outcome have initially been converted into Z-Scores (formula refer later in the article). Standardized coefficient simply represents regression results with standard scores, by default, most statistical software automatically converts both criteron (DV) and predictors (IVS) to Z-scores and calculate the regression equation to produced standardized coefficients. Many statisticians argued that standardized coefficient offer no or little advantage over unstandardized coefficient and often offer confusing information. In some discipline, researchers routinely prefers standardized coefficient over unstandardized because they believe that standardized coefficients are more interpretable, provide an assessment of predictor importance \([7,8]\). The larger the standardized coefficient in absolute value is, the more important the predictor. Standardized coefficients are dependent upon the sample standard deviation and if that value is inflated or deflated relative to the population standard deviation, then standardized coefficients will produce an incorrect inference for the population value.

http://www.bwgriffin.com/gsu/course/edu8132/notes/king standardized coefficients.pdf.

### 4 OLS Estimator

Denote by \(Y\) the \(N \times 1\) vector of independent variable and \(X\) the \(N \times K\) matrix of regressors, so that the regression equation can be written in matrix form as

\[
Y = X\beta + \epsilon
\]
Where $\beta$ is the $K \times 1$ vector of regression coefficients and $\epsilon$ is the $N \times 1$ vector of error terms.

The OLS estimator of $\beta$ is

$$\hat{\beta} = (X^T X)^{-1} X^T Y$$

When all the variables are standardized, the OLS-estimator can be written as a function of their sample correlations.

Denote by $x_i$ the $i$-th row of $X$. Note that the $(K, I) - th$ element of $(X^T X)$ is

$$\left( X^T X \right)_{Ki} = \left( \sum_{i=1}^{N} x_i^T x_i \right)_{Ki} = \sum_{i=1}^{N} x_i x_i = N s_{ki} = N r_{ki}$$

Furthermore the $K - th$ elements of $X^T Y$ is

$$\left( X^T Y \right)_K = \left( \sum_{i=1}^{N} x_i^T y_i \right)_K = \sum_{i=1}^{N} x_i y_i = N s_{ky} = N r_{ky}$$

Denote by $r_{xx}$ the sample correlation matrix of $X$ that is the $K \times K$, matrix whose $(K, I) - th$ entry is equal to $r_{xy}$.

Then $X^T X = N r_{xx}$

Similarly denote by $r_{xy}$ the $K \times 1$ vector whose $K - th$ entry is equal to $r_{xy}$, so that $X^T Y = N r_{xy}$

Thus, we can write the OLS estimator as a function of the sample correlation matrices:

$$\hat{\beta} = (X^T X)^{-1} X^T y = r_{xx}^{-1} r_{xy}$$

Hence, to standardized variables we subtract the mean value of its variable from its individual values and divide the difference by the standard deviation of that variable. Hence, we have $Z = \frac{X - M}{sd}$

Where $X$ is the raw score, $M$ is the mean and $sd$ is the standard deviation.

Thus, the regression of $Y$ on $X$, if we redefine these variables as

$$Y^*_i = \frac{Y_i - \overline{Y}}{S_y}$$
\[ X_i^* = \frac{X_i - \overline{X}}{S_X} \]

Where \( \overline{Y} \) = Sample mean of \( Y \), \( S_Y \) = Sample standard deviation of \( Y \), \( \overline{X} \) = Sample mean of \( X \) and \( S_X \) = Sample standard deviation of \( X \); the variables \( Y_i^* \) and \( X_i^* \) are called standardized variables, with mean zero and variance one. However instead of running the regression

\[ Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_{p-1} x_{i,p-1} + \epsilon_i \]

we could run regression on the standardized variables as

\[ Y_i^* = \beta_0^* + \beta_1^* x_{i1}^* + \beta_2^* x_{i2}^* + \ldots + \beta_{p-1}^* x_{i,p-1}^* + \epsilon_i \]

Therefore, we have

\[ \beta_0^* = Y_i^* - \beta_1^* X_{i1}^* - \beta_2^* X_{i2}^* - \ldots - \beta_{p-1}^* X_{i,p-1}^* \]

Since \( Y_i^* = X_{i1}^* = \ldots = X_{i,p-1}^* = 0 \) (standardized variables has mean zero (0)) and \( \beta_0^* = 0 \)

Hence, we have

\[ Y_i^* = \beta_1^* x_{i1}^* + \beta_2^* x_{i2}^* + \ldots + \beta_{p-1}^* x_{i,p-1}^* + \epsilon_i \]

Is called a standardized multiple linear regression model with \( P - 1 \) predictor variables. It can also be written as:

\[ Y_i = \sum_{k=1}^{p-1} \beta_k^* x_{ik}^* + \epsilon_i \]

Since \( E(\epsilon_i) = 0 \), the response function for SMLRM above becomes:

\[ E(Y) = \beta_1^* x_{i1}^* + \beta_2^* x_{i2}^* + \ldots + \beta_{p-1}^* x_{i,p-1}^* \]

5 Interpretation

\( \beta_1^* \) up to \( \beta_{p-1}^* \) are known in the literature as beta coefficient. The interpretation is that if the (standardized) regressor increases by one standard deviation, on average, the (standardized) regressand increases by \( \beta_1^* \) standard deviation units. Thus, unlike the traditional model, we measure the effect not in terms of the original units in which \( Y \) and \( X \) are expressed, but in standard deviation units.

The Model of interest:

Standardized model:

\[ PF^* = \beta_1^* RY^* + \beta_2^* MS^* + \beta_3^* EXR^* + \beta_4^* DC^* + \beta_5^* GEXP^* \text{ OR} \]

\[ Z \sim PF = \beta_1^* Z \sim RY + \beta_2^* Z \sim MS + \beta_3^* Z \sim EXR + \beta_4^* Z \sim DC + \beta_5^* Z \sim GEXP \]
Implication of Terms:

- $PF \Rightarrow$ Inflation rate
- $RY \Rightarrow$ Real income growth rate
- $MS \Rightarrow$ Money supply
- $EXR \Rightarrow$ Exchange rate
- $DC \Rightarrow$ Domestic credit growth rate
- $GEXP \Rightarrow$ Government expenditure

$Z \sim PF \Rightarrow$ Standardized Inflation rate
$Z \sim RY \Rightarrow$ Standardized Real income growth rate
$Z \sim MS \Rightarrow$ Standardized Money supply
$Z \sim EXR \Rightarrow$ Standardized Exchange rate
$Z \sim DC \Rightarrow$ Standardized Domestic credit growth rate
$Z \sim GEXP \Rightarrow$ Standardized Government expenditure.

6 Material

The data used for this study was extracted from the central Bank of Nigeria (CBN) statistical bulletin. It covered the period 1998 to 2018.

7 Discussion of Results

The statistical model fitted for this research work with their estimated parameters is SMLRM. The R-statistical software package was adopted to obtain the necessary results for discussion.

**DECISION RULE:**

If $Pr(Z < \alpha)$: Reject $H_0$

**Output of Standardized Regression Analysis**

$Z \sim PF$ Versus $Z \sim RY$, $Z \sim MS$, $Z \sim EXR$, $Z \sim DC$, $Z \sim GEXP$

**Coefficients:**

| Term   | Estimate | Std. Error | t value | Pr(>|t|) |
|--------|----------|------------|---------|----------|
| $Z \sim RY$ | 0.00265  | 0.03152    | 0.084   | 0.93402  |
| $Z \sim MS$ | 0.55093  | 0.14583    | 3.778   | 0.00165 ** |
| $Z \sim EXR$ | 0.31703  | 0.05636    | 5.625   | 3.8e-05 *** |
| $Z \sim DC$ | -0.07739 | 0.02587    | -2.991  | 0.00864 ** |
| $Z \sim GEXP$ | 0.17989  | 0.12433    | 1.447   | 0.16723  |

Signif. codes:

0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 1

Residual standard error: 0.09249 on 16 degrees of freedom
Multiple R-squared: 0.9932, Adjusted R-squared: 0.991
F-statistic: 464.4 on 5 and 16 DF, p-value: < 2.2e-16

a. Dependent variable $Z \sim PF$
Source: Authors computation from R-Software Package

From the SMLRM output in table above, the model becomes:

\[ Z \sim PF = 0.00265Z \sim RY + 0.55093Z \sim MS + 0.31703Z \sim EXR - 0.07739Z \sim DC + 0.17989Z \sim GEXP \]

Atanlogun S.K, Edwin O.A. and Omotosho S.A. [9]

**Interpretation:**

The coefficient of z-score in the above model could be interpreted as follows;

- \( \beta_1^* = 0.00265 \): A1 standard deviation increase in \( Z \sim RY \) is predicted to result in a 0.00265 standard deviation increase in \( Z \sim PF \) holding \( Z \sim MS, Z \sim EXR, Z \sim DC \) and \( Z \sim GEXP \) constant.

- \( \beta_2^* = 0.55093 \): A1 standard deviation increase in \( Z \sim MS \) is predicted to result in a 0.55093 standard deviation increase in \( Z \sim PF \) holding \( Z \sim RY, Z \sim EXR, Z \sim DC \) and \( Z \sim GEXP \) constant.

- \( \beta_3^* = 0.31703 \): A1 standard deviation increase in \( Z \sim EXR \) is predicted to result in a 0.31703 standard deviation increase in \( Z \sim PF \) holding \( Z \sim RY, Z \sim MS, Z \sim DC \) and \( Z \sim GEXP \) constant.

- \( \beta_4^* = -0.07739 \): A1 standard deviation decrease in \( Z \sim DC \) is predicted to result in a \(-0.07739\) standard deviation decrease in \( Z \sim PF \) holding \( Z \sim RY, Z \sim MS, Z \sim EXR \) and \( Z \sim GEXP \) constant.

- \( \beta_5^* = 0.17989 \): A1 standard deviation increase in \( Z \sim GEXP \) is predicted to result in a 0.17989 standard deviation increase in \( Z \sim PF \) holding \( Z \sim RY, Z \sim MS, Z \sim EXR \) and \( Z \sim DC \) constant.

**8 Conclusion**

In this research, SMLRM was considered as a tool in carrying out the analysis with the aid of R-Package software. The P-values of three of the estimated variables were less than the significance level \( \alpha(0.05) \), with the remaining two variables contributing less. The study therefore concluded that three of the explanatory variables made much significant impact in controlling inflation rate in Nigeria.

**Competing Interests**

Authors have declared that no competing interests exist.

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