

## THE EFFECT OF MONETARY POLICY ON CONSUMER PRICE INDEX

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### ABSTRACT

The effect of monetary policy on consumer price index is examined. Data on Nigeria's inflation rate, gross domestic product, credits to private sector, broad money, net credit to government and consumer price index from 1981 to 2010 was obtained from the Central Bank of Nigeria (CBN) and International Monetary Fund (IMF) as reported by International Financial Statistics (IFS) data file. Multiple regression analysis was applied to the data after certifying that all the assumptions hold. At 5% level of significance, two of the independent variables, Inflation Rate (IR) and Net Credit to Government (NCG) are not statistically significant while the rest indicators are statistically significant. The analysis indicates that inflation rate, gross domestic product and credit to private sector have positive relationship with consumer price index. This implies that as consumer price index increases inflation rate, gross domestic product and credit to private sector increases. Broad money and net credit to government shows a negative relationship with consumer price index indicating that an inverse relationship with consumer price index exists.

**Keywords:** Monetary Policy, Consumer Price Index, Inflation Rate, Multiple Regression, Multicollinearity, Autocorrelation

### INTRODUCTION

Statistics plays a vital role in every field of human activities. It has important roles in determining the existing position of per capita income, unemployment, population growth rate, schooling, medical facilities etc. in a country. Now statistics holds a central position in almost every field like Industry, Commerce, Trade, Physics, Chemistry, Economics, Mathematics, Biology etc. National income accounts are multipurpose indicators for the economists and administrators. Statistical methods are used for preparation of these accounts.

The relationship between supply and demands is studied by statistical methods, the imports and exports, the inflation rate, monetary policy, fiscal policy, economic growth, the per capital income are problems which require good knowledge of statistics. Monetary policy is the general process by which the government, central bank, or monetary authority of a country controls (i) the supply of money, (ii) availability of money, and (iii) cost of money or rate of interest, in order to attain a set of objectives oriented towards the growth and stability of the economy. Monetary policy rests on the relationship between rate of interest in an economy, that is the price at which money can be borrowed, and the total supply of money. The process uses a variety of tools to control one or more of these, to influence outcomes like economic growth, inflation, exchange rates with other currencies and unemployment. Inflation is a persistent increase in general price level of goods and services in an economy over a period of time. Wyplosz and Burda(1997), and Blanchard (2000).

When the general price level rises, each unit of currency buys fewer goods and services. Consequently, inflation reflect a reduction in the purchasing per unit of money- a loss of real value in the medium of exchange and unit of account within the economy, Walgenbach, Dittrich and Hanson, (1973). A chief measure of price inflation is the inflation rate, the annualized percentage change in a general price index (normally the consumer price index) over time, Mankiw (2002). A consumer price index (CPI) measures change in the price level of a market basket of consumer goods and services purchased by households. The CPI in the United States is defined by the bureau of labour statistics as "a measure of the average changes over time in the prices paid by urban consumers for a market basket of consumer goods and services". A CPI can

be used to index (i.e. adjust for the effect of inflation) the real values of wages, salaries, pensions, for regulating prices and for deflating monetary magnitudes to show changes in real values. Monetary policy is associated with interest rates and availability of credit. Instruments of monetary policy have included short-term interest rates and bank reserves through the monetary base, Bordo (2008). For many centuries there only two forms of monetary policy: (i) Decisions about coinage, (ii) Decisions to print paper money to create credit. The study is aimed at examining the effectiveness of the monetary policy on the Nigerian economy by studying the relationship that exists between consumer price index and other macro-economic indicators. Also, we intend to forecast inflation using consumer price index (CPI) as a measure of inflation rate.

## REVIEW OF LITERATURE

Various policies have been initiated to bring about stability in macroeconomic variables. Overall, the Central Bank of Nigeria's amended act granted banks more discretion and autonomy in the conduct of monetary policy management involved in the use of market (indirect) instruments to regulate the growth of major monetary aggregates. Under this frame work only the operating variables, the monetary base or its components are targeted, while the market is left to determine the interest rates and allocates credit. Essentially, the involves an econometrics exercise, which estimates the optimal monetary stock, which is deemed consistent with assumed targets for GDP growth, the inflation rate and external reserves. Thereafter market instruments are used to limit banks' reserve balances as well as their credit creating capacity. A number of studies have examined the suitability of consumer price index (CPI) as an instrument of monetary policy. For example, Abata, Kehinde and Bolarinwa (2012) assesses how fiscal and monetary policies influences economic growth and development in Nigeria. They argued that curbing the fiscal indiscipline of Government will take much more than enshrining fiscal policy rules in our statute books. Amassoma, Nwoza and Olaiya (2011) appraised monetary policy on macroeconomic variables in Nigeria for the period of 1986 to 2009. Adopting a simplified ordinary least squared technique after conducting the unit root test and co-integration tests, the finding showed that monetary policy have witnessed the implementation of various policy initiatives and has therefore experiences sustained improvement over the years. The result also showed that monetary effect had a significant effect on exchange rate and money supply while monetary effect monetary policy was observed to have an insignificant influence on price instability. The implication of this finding is that monetary policy has had a significant influence in maintaining stability in the Nigeria economy. The study concluded that for monetary policy to achieve its other macroeconomic objective such as economic growth; there is need to reduce the excessive expenditure of Government and align fiscal policy along with monetary policy measure. Okwu, Obiakor, Falaiye and Owolabi (2011) examined the effect of monetary policy innovation on stabilization of commodity prices in Nigeria. Consumer price index (CPI), broad money aggregates (BMA) and monetary policy rate (MRR) were applied to a multiple regression model specified on perceived functional link between the indicators of Central Bank Of Nigeria's monetary policy innovations and commodities prices indicator. The result showed that positive relationship existed between the respective indicators of monetary policy innovations and indicators of commodity prices, monetary policy rate has more immediate effect on commodity price than broad money on consumer price index, and the commodity prices responded more to monetary policy rates than to broad money aggregates, although both broad money and monetary policy rate exerted positive effect on commodity prices, only broad money exerted significant effect at 0.05 level of significance. Consequently, the study recommended among other things, that the Central Bank of Nigeria should always determine optimal mix of both variables to ensure stabilization of consumer goods and other commodity prices and engender confidence in the Bank's monetary policy. Abiodun and Tokunbo (2006) examined the

efficacy of monetary policy in controlling inflation rate and exchange rate instability. The analysis performed is based on a rational expectation frame work the incorporate the fiscal role of exchange rate. Using quarterly data spanning over 1980:1 to 2000:4, and applying times test on the data used, the paper shows that the effort of monetary policy at influencing the finance of government fiscal deficit through the determination of inflation tax rate affects both the rate of inflation and real exchange rate, thereby causing volatility in their rates. This paper reveals that inflation affects volatility of its own rate, as well as the rate of real exchange. The policy import of the paper is that monetary policy should be set in such a way that the objective it is to achieve is well defined. Mbutor (2010) evaluated the role of monetary policy in enhancing remittances for economic growth. The vector autoregressive methodology is applied with two stage deductions. The monetary policy rate first impact intervening variables:- exchange rate, inflation etc, which is true remittance flows. The data set were tested for temporal properties, including unit roots and co-integration. Preliminary evidence shows that domestic properties increase remittances to Nigeria, while exchange rate depreciation depresses remittances. The latter outcome reflects remitters' perception that a stronger Naira is a sign of things-getting-better-back-home. Hamed, Khaid and Sabit (2012) presented a review of how the decisions of monetary authorities influence the macro variables like GDP, money supply, interest rates, exchange rates and inflation. The method of ordinary least squares explains the relationship between the variables under study. Tight monetary policy with balanced with balanced adjustment in independent variables shows a positive relationship with dependent variable. Ajisafe and Folorunsho (2002) note that the relative effectiveness of monetary and fiscal policy on economic activity in Nigeria was determined through co-integration and error correction modeling techniques. The time series properties of the variables were investigated by conducting a unit root test using annual series data for the period (1970-1998) and the data source was mainly CBN Statistical Bulletin. The result of their analysis shows that monetary rather than fiscal policy exerts a great impact on economic activity in Nigeria. The emphasis on fiscal action of the government has led to greater distortion in the Nigerian economy. However, Ajisafe and Folorunsho (2002) were of the opinion that monetary policies should be complementary. Elsewhere, Jonathan and Phil (2006) investigated the impact of monetary policy on the exchange rate using an event study with intraday data for four countries. Carefully selecting the sample periods ensure that policy change is exogenous to the exchange rate. The researchers showed that the impact depends on how the surprise affects expectation of the future monetary policy. If expectations of the future monetary policy are revised by the full amount of surprise, then the researchers found that the impact on the exchange rate is larger (0.4 percent) than if the surprise only brings forward an anticipated change in policy (0.2 percent). Massages, Henri, Peter and Pict (2010) present the findings of a meta-analysis identifying the causes of variation in the impact of monetary policies on economic development. The samples of their observations included in their meta-analysis are drawn from primary studies that uniformly employ vector autoregressive (VAR) models. Their findings reveal that capital intensity, financial deepening, the inflation rate and economic size are important in explaining the variation in outcomes across regions and overtime. Differences in the type of models used in the primary studies also significantly contribute to the explanation of the variation in study outcomes.

## **MATERIALS AND METHODOLOGY**

The data is a secondary data. The source of data was from Central Bank of Nigeria (CBN), International Monetary Fund (IMF), International Financial Statistics and data files.

### **Multiple Regression**

In statistics, regression analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modeling and analyzing variables, when the focus is on the relationship between a dependent variable and one or more independent variables.

Multiple regression is a statistical method used to examine the relationship between one dependent variable,  $Y$ , and more than one independent variables,  $X_i$ . The regression parameters or coefficients  $b_i$  in the regression equation,

$$Y = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \hat{\beta}_3 X_3 + \dots + \hat{\beta}_k X_k.$$

are estimated using the method of least squares. The multiple linear regression function can be written as

$$Y = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \hat{\beta}_3 X_3 + \dots + \hat{\beta}_k X_k + U_i.$$

If there are  $n$  samples i.e.  $n$  observations, the model is in “ $n$ ” set of equations

$$Y_1 = \hat{\beta}_0 + \hat{\beta}_1 X_{11} + \hat{\beta}_2 X_{12} + \hat{\beta}_3 X_{13} + \dots + \hat{\beta}_k X_{1k} + U_i.$$

$$Y_2 = \hat{\beta}_0 + \hat{\beta}_1 X_{21} + \hat{\beta}_2 X_{22} + \hat{\beta}_3 X_{23} + \dots + \hat{\beta}_k X_{2k} + U_i.$$

$$Y_i = \hat{\beta}_0 + \hat{\beta}_1 X_{n1} + \hat{\beta}_2 X_{n2} + \hat{\beta}_3 X_{n3} + \dots + \hat{\beta}_k X_{nk} + U_n.$$

The number of  $x$ 's is denoted by  $k$ . the  $b$ 's are called regression co-efficient.

The regression model is:  $Y = X\beta + U$

### **Test for Autocorrelation**

Suppose that the model  $Y = XB + U$ , one suspect that the disturbance terms  $U_i$ 's are independent i.e  $E(U_i U_j) = 0 \quad \forall i \neq j$ . When this assumption fails, autocorrelation results. Durbin Watson can be used to test the existence of autocorrelation.

### **Durbin Watson Statistics**

This is the most popular and one of the most reliable tests for detecting autocorrelation. However, the test is valid only when the following conditions are fulfilled.

- i) The study uses time series data
- ii) Autocorrelation is of first order
- iii) There is constant term in regression equation
- iv) Regression equation does not include lagged value(s) of the independent variables.

The hypothesis is stated as:

$H_0$ :  $d = 2$ , no autocorrelation

$H_1$ :  $d \neq 2$ , autocorrelation exists.

Decision Rule: reject  $H_0$ , if  $d$  is not equals to or not approximately 2.

Durbin Watson statistics is defined as  $d = \frac{\sum_{i=2}^n (U_i - U_{i-1})^2}{\sum_{i=1}^n e_i^2}$

### **Multicollinearity**

Multicollinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others with a non-trivial degree of accuracy. In this situation the coefficient estimates of the multiple regression may change erratically in response to small changes in the model or the data. Multicollinearity does not reduce the predictive power or reliability of the model as a whole, at least within the sample data themselves; it only affects calculations regarding individual predictors. That is, a multiple regression model with correlated predictors can indicate how well the entire bundle of predictors predicts the outcome variable, but it may not give valid results about any individual predictor, or about which predictors are redundant with respect to others.

A high degree of multicollinearity can also prevent computer software packages from performing the matrix inversion required for computing the regression coefficients, or it may make the results of that inversion inaccurate.

Note that in statements of the assumptions underlying regression analyses such as ordinary least squares, the phrase "no multicollinearity" is sometimes used to mean the absence of perfect multicollinearity, which is an exact (non-stochastic) linear relation among the regressors.

### Detection of multicollinearity

Indicators that multicollinearity may be present in a model:

1. Large changes in the estimated regression coefficients when a predictor variable is added or deleted
2. Insignificant regression coefficients for the affected variables in the multiple regression, but a rejection of the joint hypothesis that those coefficients are all zero (using an F-test)
3. If a multivariable regression finds an insignificant coefficient of a particular explanator, yet a simple linear regression of the explained variable on this explanatory variable shows its coefficient to be significantly different from zero, this situation indicates multicollinearity in the multivariable regression.
4. Some authors have suggested a formal detection-tolerance or the variance inflation factor (VIF) for multicollinearity:

$$\text{Tolerance} = 1 - R_j^2 \text{ and } \text{VIF} = \frac{1}{\text{Tolerance}}$$

where  $R_j^2$  is the coefficient of determination of a regression of explanator  $j$  on all the other explanators. A tolerance of less than 0.20 or 0.10 and/or a VIF of 5 or 10 and above indicates a multicollinearity problem.[O'Brien, 2007]

5. Condition number test: The standard measure of ill-conditioning in a matrix is the condition index. It will indicate that the inversion of the matrix is numerically unstable with finite-precision numbers (standard computer floats and doubles). This indicates the potential sensitivity of the computed inverse to small changes in the original matrix. The Condition Number is computed by finding the square root of (the maximum eigenvalue divided by the minimum eigenvalue). If the Condition Number is above 30, the regression is said to have significant multicollinearity.

### DATA ANALYSIS

Running the regression of the Consumer Price Index (CPI) from 1981 to 2010 on IR – Inflation Rate ( $X_1$ ), GDP – Gross Domestic Product ( $X_2$ ), CPS – Credit to Private Sector ( $X_3$ ), BM – Broad Money ( $X_4$ ), NCG – Net Credit to Government ( $X_5$ ) gives the tables below.

Table 1: Model Summary for the Analysis

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.875	.769	.708	63.63997	1.961

Table 2: ANOVA Table for the Analysis

	Sum of Squares	df	Mean Square	F	Sig.
Regression	305511.121	5	61102.224	15.087	.000
Residual	97201.107	24	4050.046		
Total	402712.228	29			

Table 3: Regression coefficients of the analysis

	Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	99.552	67.534	3.474	.003		
IR	.846	.799	1.059	.300	.852	1.173
GDP	3.524	1.731	2.360	.045	.945	1.058
CPS	23.503	4.401	5.340	.000	.148	6.777
BM	-15.001	3.011	4.982	.000	.318	3.145
NCG	-1.650	2.008	-.821	.420	.186	5.375

Table 1 shows the coefficient of multiple determinations,  $R^2$  (0.769). This implies that 76.9% variation in the dependent variable is explained by the independent variable, which means that the model is moderately fit for the analysis. Since the Durbin Watson (DW) value obtained (1.961) is approximately 2, we do not have enough evidence to reject  $H_0$  (No autocorrelation) since Durbin Watson calculated is approximately 2 and we therefore conclude that autocorrelation does not exist i.e. there is no correlation between the explanatory variable and the disturbance term.

Table 2 also shows that the overall regression model is adequate at 5% level since the Sig. (0.000) <  $\alpha$  (0.05).

Table 3 reveals the regression model:

$$Y = 99.552 + 0.846X_1 + 3.524X_2 + 23.503X_3 - 15.001X_4 - 1.650X_5$$

At 5% level of significance, all the independent variables are statistically significant except IR and NCG. Table 3 also shows that multicollinearity is negligible in the model since none of the values of our variance inflation factor (VIF) for independent variable is greater than 10.

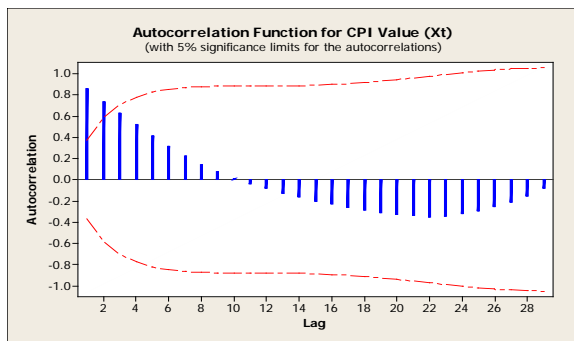


Fig.1a: The autocorrelation function for CPI

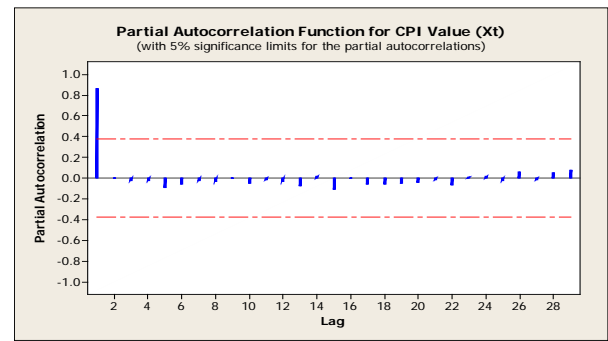


Fig.1b: The Partial ACF for CPI

The ACF suggest the CPI is stationary for the period under review.

## CONCLUSION

This research examines the effective of monetary policy on consumer price index. Analysis was carried out to examine the relationship that exists between consumer price index and other macroeconomic indicators (gross domestic product, inflation rate, net credit to government, broad money and credit to private sector). The analysis indicates that inflation rate, gross domestic product and credit to private sector have positive relationship with consumer price index. This implies that as consumer price index increases inflation rate, gross domestic product and credit to private sector increases. Broad money and net credit to government shows a negative relationship with consumer price index indicating that an inverse relationship with consumer price index exists. At 5% significant level inflation rate and net credit to government are statistically insignificant, while gross domestic product, credits to private sector and broad money are statistically significant. The insignificant statistics of inflation rate and net credit to government suggests that monetary policy is not totally influential on consumer price index.

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