



# The Effect of Macroeconomic Variables on Price Level in Nigeria, a Co-integration Approach

Onyejuwa, Daniel Chibueze  
08032957313; [danielchibueze@gmail.com](mailto:danielchibueze@gmail.com)  
Economics Department  
Samuel Adegboyega University

## Abstract

*Stability in price level is one of the main broad objectives of most economies over the world. Therefore, this study investigates the long-run relationship of macroeconomic variables effect on consumer price index from 1<sup>st</sup> quarter of 1998 to 4<sup>th</sup> quarter of 2015 and sourced data from Central Bank of Nigeria Statistical bulletin. The study adopted Park (1992) Canonical Co-integration regression (CRR) technique of analysis against other studies that used Vector Autoregressive Error Correction Model (VECM), Ordinary Least Square (OLS) and Error Correction Model (ECM). The study found out that, in the long-run, macroeconomic variables such as real income, money supply and exchange rate among others contributed positively and significantly to price level, while interest rate exert a negative significant effect. These explanatory variables combined to significantly influence the variations in CPI in Nigeria as much as 98% while the stochastic error term (U1) capture 2%. The study recommends that Nigeria government should pursue with vigour, policies that will enhance the reduction of the general price level and increased productive capacity of goods and services. Such policies may include wage control/freeze, monetary policy (reduction in money supply), good management of foreign exchange, total ban on importation of some goods and increase in domestic production of goods and services.*

**Keywords:** Price level, Canonical Co-integration Regression, macroeconomic variables, long-run

## 1. INTRODUCTION

The goal of achieving price stability is one of the macroeconomic challenges facing the Nigerian government in our economic history. This elusive factor is known and referred to as inflation in our economic history and this is defined by economists as a continuous rise in prices. By definition, inflation is a persistent and appreciable rise in the general level of prices (Jhingan, 2002). Not every rise in the price level is termed inflation. Therefore, for a rise in the general price level to be considered inflation, such a rise must be constant, enduring and sustained. Explicitly, inflation can be referred as a continuing rise in prices as measured by an index such as the Consumer Price Index (CPI) or by the implicit price deflator for Gross National Product (Jhingan 2002). The CPI is one of the most common measures of inflation. The CPI measures the cost of buying a fixed basket of goods and services representative of the purchase of consumers. Inflation is measured by measuring the percentage change in the prices of a given basket goods over time as compared to the price in the base year. In Nigeria, the National Bureau of Statistics computes the CPI. Inflation is considered a problem due to the fact that it tends to make economic planning challenging, distorts prices, deplete

savings, discourage investment, encourage capital flight, impede on economic growth and other and could lead to social and political upheavals (Akinifesi, 1984).

Maintaining monetary and price stability thus becomes the main objective of monetary policy with a view to strengthening the purchasing power of the domestic currency and promoting sustainable growth and economic development. For these reasons, maintaining a stable price level vis-à-vis the other key rates – interest and exchange rates - has been one of the most daunting tasks of central banks. This is more so in developing countries which are characterized by fiscal imbalances due to the declining prices of commodities which account for large proportions of government revenues.

From the foregoing, inflation has been apparent in Nigeria from the outset of our national life. Over the years, inflation is one of the most crucial macroeconomic problems in Nigeria, hence the need for a greater attention to it. Given the major distortions caused by it in the economic growth of the country and the living standard of the citizenry, various administrations in Nigeria in the past and present had adopted various measures to deal with inflation in the country without achieving the desired goal of long-term solution.

## **1.2 Statement of the Problem**

Earlier empirical studies into prices have been carried out using different equation model. One of the main study on inflation carried by Kuijs (1998) used Vector Autoregression to examine the long-run relationship of inflation and money demand. Terbia (1997) and Moser (1997) applied single-equation technique and co-integration test without specifying a co-integration model in their analysis. Kalra (1998) extended the relationship between inflation and economic growth using the unrestricted co-integration test and estimated error correction model without estimating a co-integration regression. One of the short comings of these techniques is that they do not correct for possible endogeneity that may arise in the relationship. The common approaches used to investigate the determinants of inflation are Co-integration analysis, Autoregressive distributed lag, Vector Autoregression and Vector Error Correction method (Jaradat, Zeaud and Rawahneh, 2011; Kandil and Morsy, 2011; Basher and Elsamadisy, 2012).

The estimation of a long-run relationship involving co-integrated variables has been the focus of a lot of recent papers. Many studies have reported alternative co-integrating vector estimators and their asymptotic properties (Phillips and Loretan, 1991). The general result is that those asymptotic properties are not affected by endogeneity or serial correlation if the estimators are properly corrected. However, the applied researcher does not usually have enough data to justify the application of

asymptotic theory. For this reason, it is important to consider the small-sample performance of alternative co-integrating vector estimators. This study intends to adopt and modify the econometric model used by past studies by employing the Canonical Co-integrating Regression (CRR) developed by Park (1992). CRR is one of the co-integration techniques particularly useful in estimating long-run relationships. Once a long-run equilibrium relationship has been identified among variables, CRR can be estimated. One of the main advantages of co-integration techniques is that most economic theories on price has a have a major role to play in explaining long-run relationships. Applying short-run dynamic model or Ordinary least square estimator would be mainly an empirical issue.

Additionally, most studies relied on money supply, exchange rate and domestic interest rates to determine inflation alongside factors like private sector credit growth, nominal foreign interest, foreign prices, expected inflation, real income, rainfall which were used in addition to the other determinants although not by all the studies reviewed. The current study differs from the ones reviewed in that it includes oil price and fiscal deficits in the model because of the peculiarities of the Nigerian economy, where oil is the major foreign exchange earner and is heavily import-dependent. Therefore, the research work intends to make a critical assessment of the determinants of increase in price level in Nigeria which is the necessary condition upon which a lasting solution to inflation can be found in Nigeria by using appropriate technique.

How do macroeconomic factors influence price level in Nigeria is fundamental questions the study attempt to address and also considering the long-run nature of the problem, what are the proper analytical methods to adopt. Therefore, the main objective of this study is to determine the effect of macroeconomic factors on inflation in the Nigeria in long-run relationship. This study centers on the appropriate technique to use in examining the long-run equilibrium relationship between price level and macroeconomic factors. This will help policy makers in their quest to establish measures for handling the issues of inflation in Nigeria.

## **2. LITERATURE REVIEW**

This section focuses on the theoretical and empirical literature on the link between price and macroeconomic variables.

### **2.1. Theoretical Literature**

#### **2.1.1 Theories of Inflation**

The earliest version of the classical theory of inflation was propounded by Irving Fisher in 1911. According to the classical theory, inflation occurs in direct proportion to increase in money supply,

given the level of output. It postulates that as the monetary authority increases the quantity of money in circulation, the value of a unit of money in real terms declines and this translates to a rise in the general price level. In essence, the classical theory of inflation shows how the equilibrium aggregate price level is determined by the interaction of money demand and supply (Jhingan, 2002).

The notion of demand-pull inflation is predicated on the Keynesian IS-LM framework where demand for output determines supply up to the full employment level. The theory of demand-pull inflation is of the view that when aggregate demand exceeds aggregate supply at full employment, an inflationary gap will arise. The increase in aggregate demand might come from one or several of its components such as investment, household consumption, government expenditure and net exports, occasioned by a rise in foreign income. The framework assumes an exogenous price level and a significant amount of unemployed labour and underutilized capacity in the economy. In this scenario, firms' short run average cost will remain unchanged as more output is produced in response to increasing demand. The price level will not change over this range where output is perfectly elastic (Levacic and Rebmann 1982). The increase in real wage in turn produces excess demand in the goods market and hence inflationary pressure. The interaction of the labor and goods market produces wage-price spiral that can only be reversed by checks to aggregate demand (Kibritçioğlu, 2002).

Monetarists says that “*only money matters*”, and as such monetary policy to them is a more important instrument than fiscal policy in economic stabilization. According to monetarists the money supply is the “*dominant, though not exclusive*” determinant of both the level of output and prices in the short run, and of the level of prices in the long run. The long- run level of output is not influenced by the money supply (Totonchi, 2011).

They further argue that when the money supply is increased in order to grow or increase production and full employment, it creates an inflationary situation within an economy. Monetarist believes that increases in the money supply will only influence or increase production and employment levels in the short run and not in the long run. Accordingly, there will be a positive relationship between inflation levels and money supply.

For the Cost-push inflation theorists, inflation is a phenomenon in which the general price levels rise due to increases in the cost of wages and raw materials (Totonchi, 2011). Cost-push inflation develops because the higher costs of production factors decrease in aggregate supply (the amount of total production) in the economy. Because there are fewer goods being produced (supply weakens) and demand for these goods remains consistent, the prices of finished goods increase. One of the

proponents of cost push theories is James Steuart in his *'Inquiry into the principles of Political Economy,'* argues that “*real forces derive individual and aggregate prices alike*” (Humphrey 1998).

The structural theories come in between the extremes of cost-push and demand-pull inflation theories and they are championed by economists who hold the view that inflation is attributable to structural imbalances in the economy. Dewett (2005) undertook a survey of variants of structural theories, which may be classified into: mark-up, bottle-neck and sectoral demand-shift (demand composition) theories. The mark-up inflation theory combines the notion of demand-pull and cost-push inflation. An increase in demand results in higher prices for goods and services, which when sold to other firms as intermediate goods prompts a further rise in prices of finished goods. Furthermore, contemporaneous wage increase will raise the general price level more. Thus, the underlying idea of mark-up inflation theory is that two key inflationary forces (demand-pull and cost-push) join in escalating inflation.

The bottle-neck inflation hypothesis is based on empirical evidence gleaned from studying several episodes of inflation. The findings indicate that inflation was not simply due to wage-price spiral but that there were certain capital good industries whose products enjoy high demand and transmit inflationary pressures to other sectors of the economy. These industries are known as bottle-neck industries. An increase in the demand of the products of these industries generates a rise in wages and prices, which is subsequently transmitted to the rest of the economy through purchases made by other firms. This type of inflation occurs despite the existence of widespread excess production capacity in the economy. The issue here is that the excess demand is not economy-wide (and as such not a demand-pull inflation) but is rather concentrated on the products of few industries.

Sectoral demand-shift theory is also hinged on the perspective that inflation is not just a cost-push or aggregate demand phenomenon. Rather, aggregate demand may remain constant but there could be sectoral adjustments or shifts in the demand composition of various industries (some industries may enjoy a boom in demand and concurrently, others could experience a downturn). An important point to note is that prices generally rise in response to higher demand and are downward sticky when demand declines. Therefore, the net effect of rapidly rising prices in certain sectors with high demand and near static price movements in other sectors with falling demand is inflation.

The new Keynesian framework synthesizes the cost-push, demand-pull and structural inflation theories.

The rational expectation hypothesis maintains that people do not always make the same mistakes in forming future expectations. Rather, economic agents tend to predict future events with reasonable accuracy and take appropriate proactive actions. According to the new classical macroeconomics, rational expectations involves making unbiased predictions about future conditions on the basis of all available information – both past and current. These forecasts are unbiased because they contain no systematic forecasting errors and more often than not, the rational expectations of economic agents, though lacking in perfect foresight, turn out to be correct (Totonchi 2011; Samuelson and Nordhaus 2005).

According to the notion of rational expectations, a fully anticipated monetary policy action cannot have the desired policy effects. If economic agents expect economic policy to be accommodating, they would take proactive actions to ensure that both prices and wages go up in order to compensate for the anticipated inflationary impact. Consequently, it is asserted that the monetary authority can influence output and employment in the short run through “surprise shifts” in money growth or by creating a “price surprise” (Dornbusch, Fischer and Starzt 2008; and Totonchi 2011).

According to NNS monetary (Marvin Goodfriend, Robert King, 1997), demand factors are a key determinant of business cycles, because of the incorporated new Keynesian assumption of price stickiness in the short run. At the same time, however, the NNS assigns a potentially large function to supply shocks in explaining real economic activity, as suggested in the new classical real business cycle theory. The highly complex model of the new neoclassical synthesis allow that Keynesian and real business cycle mechanisms to operate through somewhat different channels. The so-called new IS-LM-PC version of the NNS makes the price level an endogenous variable. In this model, IS refers to Investment and Saving .i.e. equilibrium equation of goods and services market, LM refers to demand for and supply of money .i.e. equilibrium equation of money market and PC refers to Philips Curve. The NNS also views expectations as critical to the inflation process, but accepts expectations as amenable to manage by a monetary policy rule.

The major important theories as mentioned above mainly focus on effect of macroeconomic factors on inflation and simply ignore the role of non- economic factors such as institutions, political process and culture in the process of inflation. Political forces, not the social planner, choose economic policy in the real world. Economic policy is the result of a decision process that balances conflicting interests so that a collective choice may emerge.

According to The new political economy theorist’s literature (Alberto Alesina, 1988) provides fresh perspectives on the relations between timing of elections, performance of policy maker, political

instability, policy credibility and reputation, and the inflation process itself. The case for Central Bank independence is usually framed in terms of the inflation bias (deviation) present in the conduct of monetary policies. However, the theoretical and empirical work suggests that monetary constitutions should be designed to ensure a high degree of Central Bank autonomy. They also overlook the possibility that sustained government deficits, as a potential cause for inflation, may be partially or fully indigenized by considering the effects of the political process and possible lobbying activities on government budgets, and thus, on inflation.

## **2.2. Empirical Literature**

The body of empirical evidence on the macroeconomic determinants of inflation and inflation expectations is vast. Thus, the scope of the empirical review covers studies carried out on Nigeria and those on other countries.

Moser (1995) assessed the main determinants of inflation in Nigeria using annual time-series data from 1960 to 1993 within the co-integration and error-correction modelling framework. The variables used were nominal broad money, the naira/U.S. dollar ex-change rate, expected nominal foreign interest rates adjusted for the expected change in the exchange rate, expected inflation and foreign prices, real income and rainfall. Results showed that in the long-run, money supply, income, and the exchange rate significantly explained the price level. Similarly, in the short-run, money growth, income, expected inflation, the exchange rate and agro-climatic conditions all significantly predicted current inflation. The author concluded that monetary expansion, driven mainly by expansionary fiscal policies, explains to a large degree the inflationary process in Nigeria. Kalra (1998) carried out a study on Inflation and Money demand developments in Albanian, and suggested that, for long run, there is a positive relationship between the price level and the exchange rate, and between nominal and real money demand and exchange rate expectations, interest rates and level of economic activities. The empirical findings of his study showed that there has been a tendency for the real exchange rate to appreciate, and long run determination of inflation and money demand remain unchanged.

Siregar and Rajaguru (2005) examined the sources of Inflation in Indonesia during the Post-1997 Financial Crisis using annual time-series data. The variables applied in the model were money supply, nominal domestic interest rates, expected depreciation, foreign interest rates and output. The findings showed that a significant rise in the expected depreciation of rupiah and a loose management of base money, particularly during the early stage of the 1997 financial crisis, had strong influence on inflation. In addition, they also found that the adoption of a more flexible exchange rate regime in

August 1997 made the rupiah to be more volatile and inflationary. However, there was limited evidence on the roles of monetary variables in explaining the inflation rate during the pre-1997 period. Thus, they concluded that the success of the country to manage its inflation during the pre-crisis period is largely due to its ability to keep the money supply growing at an acceptable rate of around 25 per cent.

Khan and Schimmelpfennig (2006) investigated the factors that explain and forecast inflation in Pakistan using standard monetary variables (money supply and credit to the private sector). The study used monthly time-series data spanning January 1998 to June 2005 and relied on the vector error-correction model for analysis of the data. Their results show that monetary factors determine inflation in Pakistan, and that they are good leading indicators for future inflation. Furthermore, broad money growth and private sector credit growth are the key variables that explain inflation developments with a lag of around 12 months. Finally, it was found that a long-run relationship exists between inflation and private sector credit. Thus, the study concluded that the monetary authority in Pakistan should implement monetary policy with a view to meeting its inflation target around 12 months from the day the inflation target was announced.

Hossain (1989) used a monetary model to assess inflation in Bangladesh based on the hypothesis that inflation in Bangladesh was a monetary phenomenon. The study used OLS and Instrumental variables technique to analyse quarterly time-series data from 1972:2 to 1985:4. Results show that changes in the prices of traded goods in the international market, real permanent income, real money stock, one period-lagged rate of inflation, and changes in the terms of trade between traded and non-traded goods were found to be the major determinants of inflation in Bangladesh.

Inflation it is seen as both monetary and market phenomenon by Lim and Sek (2015). Their study gave a close examination of what determine inflation in two groups of countries (high inflation group and low inflation group) by using the Autoregressive Distributed Lag (ARDL) modeling. The results indicated that GDP growth and imports of goods and services have a long run impact on inflation in low inflation countries, while in high inflation countries money supply, national expenditure and GDP growth are the determinants of inflation in the long run. In the short run, the study revealed that none of the variables is found to be significant determinants in high inflation countries. However, money supply, imports of goods and services and GDP growth has significant relationship with inflation in low inflation countries in the short-run.

Adeyeye and Fakiyesi (1980) estimated and tested the hypothesis that the main factor responsible for instability of prices and inflationary tendencies in Nigeria has been government expenditure. Using

annual time series data, spanning 1960-1977, they tested hypothesis that the rate of inflation in Nigeria is linearly related to the rate of growth of money stock, government expenditure, especially monetization of foreign exchange from oil export. The result established some significant positive relationship between inflation rate and growth in bank credit, growth of money supply and growth in government expenditure, while the relationship with growth of government revenue was uncertain.

Using quarterly data, Osakwe (1983) attempted to verify the amount of government expenditure that affected money supply in the ten-year period 1970–1980 using quarterly data. Significant statistical evidence obtained from the analysis showed strong relationships between increases in net current expenditure and growth in money supply, on the one hand, and growth in money supply and inflation, on the other hand. Further increases in money wage rate and money supply (with a lag in effect) were identified as the two most important factors that influenced the movement of prices during the period.

Adenekan and Nwanna (2004) investigated inflation dynamics in Nigeria, with the objective of exploring the ultimate sources of inflation in Nigeria. Using the co-integration and error-correction modelling framework, the authors analysed annual time-series data on consumer price index, money supply and exchange rate from 1959 to 2002. The findings showed that changes in the price level in the immediate past period was a major driver of inflation rate, suggesting a possibility of a self-generating inflationary process. However, money supply exerted a fairly significant influence on inflation, while the impact of exchange rate was not significant in the short-run. They concluded that the monetary authority should ensure monetary control in order to mitigate the problems of inflation and exchange rate depreciation.

Odusanya and Atanda (2010) critically analyzed the dynamic and simultaneous interrelationship between inflation and its determinants in Nigeria between 1970 and 2007. The time series variables properties were examined using the Augmented Dickey Fuller (ADF) unit root test and the result reveals that inflation rate, growth rate of real output and money supply, and real share of Fiscal deficit are stationary at levels, while other incorporated variables in the empirical analysis- real share of Import, Exchange rate and Interest rate-are stationary at first difference. The long-run and short-run mechanism of interaction between inflation and its determinants were examined using the Augmented Engle-Granger (AEG) integration test and Error Correction Mechanism (ECM) model respectively.

From the study of Fatukasi (2005), it was revealed that selected macroeconomic variables (fiscal deficits, money supply, interest and exchange rates) positively impacted on the rate of inflation in Nigeria during the period 1981 to 2003. He discovered that monetization policy in Nigeria is another

main determinant of inflation in the economy. Through the policy, a huge sum of money is pumped into the economy without a corresponding increase in the provision of goods and services.

### 2.3. Review of Canonical Co-integrating Regression (CRR)

CRR was developed by Park (1992) as a new procedure for statistical inference in co-integrating regressions. The technique was a further modification of Park and Ogaki ((1991) co-integration technique referred to as method of seemingly unrelated canonical co-integrating regressions (SUCCR). The CRR formulated with the transformed data. The required transformation involves simple adjustments of the integrated process using stationary components in the co-integration regression. CRR is constructed in such a way that the usual least square procedure yields asymptotically efficient estimators and chi square tests.

The technique was later compared with Ordinary least square (OLS), and other co-integration regressions such as fully modified OLS (FMOLS) and dynamic OLS (developed by Stokes and Watson, 1993) by Montalvo (1994). The fully modified OLS is similar to CCR. The difference is that the FMOLS transforms only the dependent variable, and in the second step, corrects the OLS estimate in the modified dependent variable. However, CRR transforms both the dependent and independent variables to solve endogeneity problems that may arise in the model (Inder, 1993). The paper also found out that CCR showed smaller bias than the OLS and FMOLS estimators. When measured in terms of ratio of the root mean squared error, it ranges from 20% improvement from OLS to FMOLS and 200% improvement from FMOLS to CCR. But, between CRR and dynamic OLS, the improvement is infinitesimal (Montalvo, 1994).

Park (1992) made some generalizations and assumptions underlying the CCR. He extended the concept of co-integration defined by Engle and Granger (1987) assuming a deterministic, stochastic, as well as trends variables. He assumed time series  $y_t$  and  $x_t$  which are assumed to be generated by

$$\begin{aligned} y_t &= \pi_1' c_t + y_t^0, \\ x_t &= \Pi_2' c_t + x_t^0, \end{aligned} \tag{2.1}$$

where  $c_t$  is a  $k$ -dimensional deterministic sequence and  $y_t^0$  and  $x_t^0$  are normal  $I(1)$  processes that are  $m$ -dimensional. This explains that the time series of  $y_t$  and  $x_t$  are determined by both the deterministic,  $c_t$  and purely stochastic components  $y_t^0$  and  $x_t^0$ .

$$\text{Given, } y_t^0 = \alpha' x_t^0 + \mu_t \tag{2.2}$$

It is also strongly assumed that  $y_t^0$  and  $x_t^0$  are co-integrated where the co-integrated error term,  $\mu_t$ , followed I(0). Another assumption is the model expect the long-run covariance of  $p_t$ , where

$$p_t = (\mu_t, \Delta x_t^0)' \quad 2.3$$

Note that  $\Delta$  denote the difference operator.

Niels Haldrup and Michael Jasson (1999 & 2000) introduce a unifying approach to spurious regression, Co-integration regressions (CCR) and near cointegration analysis (unrestricted co-integration test). They concluded that the notion of near co-integrating helps to bridge the gap between the polar cases of spurious regressions and co-integration. Olatayo, Adeogun and Lawal (2012) employed the used of co-integration regression to investigate whether exchange rate of US Dollar to NG Naira and GB Sterling pound to NG Naira Converge. They found out these relationship does not exhibit cointegration, thus their linear regression model will be meaningless.

### 3. METHODOLOGY

The theoretical framework used to specify the model in the study stems from Keynesian theory. The demand pull theory was used to justify the Keynesian approach to inflation. The demand pull theory, which is the traditional and the most common type of inflation results, form the aggregate demand exceeding the supply of goods and services in an economy. The shortage in the supply could result from underutilization of resources due to inadequate spare parts resulting from high interest and exchange rates or the inability of the production to be increased rapidly rise. The demand-pull theory is sub-divided in to the monetarists and Keynesian views (Jhingan, 2002) but the Keynesian view utilized for this study. According to John Keynes and his followers (the Keynesian view), demand-pull inflation occurs when aggregate demand exceeds aggregate supply at full employment level of output that is attributing inflation to the relationship between the aggregate expenditure (C+I+G) and full employment level of output (Agba, 1994). This implies that only an increase in price above the full employment can be called inflation. Therefore, as long as an economy has not reached the level of full employment, any increase in money supply or the price would exhaust itself in raising the level of employment and output and not the general price level in the economy (Bakare, 2000). They (Keynesians) also emphasized non-monetary influences such as government process (CBN, 1991).

The study makes use of quarterly data for the sample period 1998:Q1 - 2014:Q4. This period defines the 1999 transition from military to democratic regime, the 2007 global financial crisis and the reform periods all of which have implications for inflation in Nigeria. The variables adopted in the paper

were based on the outcome of what the literature espoused. They are core consumer price index (p), real gross domestic product (y), nominal broad money supply (s), exchange rate (e) and crude oil price (o). Others are Fiscal deficit (f) and prime lending rates (i). The data was obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin of various editions.

As earlier reviewed, the study adopted the Canonical Co-integration Regression (CCR) model developed by Park (1992). CCR is constructed in such a way when the usual least square procedure is applied on the transformed variables, it will yield asymptotically efficient estimators and chi square tests.

From the theoretical framework, we derived the variable functional relationship as thus:

$$p_t = f(y_t, m_t, o_t, e_t, g_t, i_t)$$

Where,  $p$  (price level measured with consumer price index) is dependent variables, while the independent variables are of  $y$  (real GDP),  $m$  (money supply), defined broadly,  $o$  (oil price) and  $e$  (exchange rate),  $g$  and  $i$  are fiscal deficits and interest rate respectively. We consider the CCR regression model below.

$$p_t = \pi'_i c_t + \alpha'_i X_t + \mu_t$$

where  $(X_t)$  is an m-dimensional I(1) series of the explanatory variables,  $(wt)$  is a k-dimensional I(0) series of the transformed explanatory variables,  $(p_t)$  is a one-dimensional series of unobservable I(1) disturbances with mean zero, and  $\pi'_i$  and  $\alpha'_i$  are conformable vectors of unknown parameters. The regressors may be cointegrated, as long as  $\alpha'_i$  are not a cointegrating vector of  $(X_t)$ . Under these assumptions,  $(p_t)$  is I(1) and cointegrated with  $(X_t)$  with cointegrating vector  $(1, \alpha'_i)'$ . In the CCR both the regressand and the regressors are transformed (see the model derivation in Park, 1992; Wang and Wu, 2012). The data on price level is valued in index, real GDP and money supply are valued in N' million, oil price and fiscal deficit are valued in naira, exchange rate is valued in rate while interest rate is valued in percent. All data are estimated without being transformed or converted into natural log equation for time series processing. Thus, the coefficients can be interpreted as rate of change in terms of units.

## 4. DATA ANALYSIS AND DISCUSSION

### 4.1. Data Analysis

The data used are in time series, and it is important to examine their properties for stationarity problem and the test of long-run equilibrium relationship among variables by carrying out co-integration test. Therefore Augmented Dickey-fuller (ADF) unit root tests and Johansen co-integration test were applied.

**Table 4.1: Unit Root Test**

Variables	Level	1 <sup>st</sup> Difference	Remark
Price level	-1.37	-3.71*	I(1)
Real GDP	-1.24	-8.57*	I(1)
Money supply	-1.86	-9.50*	I(1)
Oil price	-3.86	-6.82*	I(1)
Exchange rate	-3.47	-7.70*	I(1)
Fiscal deficit	-9.04	-7.78*	I(1)
Interest rate	-2.72	-6.14*	I(1)
1% level	-4.10	-4.10	
5% level	-3.48	-3.48	
10% level	-3.17	-3.17	

Source: E-views 8.

The results in Table 4.1 shows that variables in the model are I(1) and this suggests that while the hypothesis of non-stationarity is rejected at level for all the variables, the hypothesis that there is no unit root among the variables is accepted at first difference. Subsequently, the co-integration test in Table 4.2 reveals the existence of 4 co-integrating equations in the Unrestricted Cointegration Rank Test (Trace) and 3 co-integrating equations in the Unrestricted Cointegration Rank Test (Maximum Eigenvalue). This indicates thus, the variable could converge in the long-run despite the weakness to unit root problem. Therefore the assumption of Canonical Cointegrating Regression, that there exist co-integration among variables has been ascertained.

**Table 4.2: Unrestricted Cointegration Rank Test (Trace)**

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.835967	247.9541	125.6154	0.0000
At most 1 *	0.465790	130.4544	95.75366	0.0000
At most 2 *	0.456790	89.70153	69.81889	0.0006
At most 3 *	0.296022	50.03468	47.85613	0.0308
At most 4	0.211054	27.21915	29.79707	0.0964
At most 5	0.139785	11.81039	15.49471	0.1663
At most 6	0.030646	2.023169	3.841466	0.1549
Trace test indicates 4 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Source: E-views 8.

**Table 4.3: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)**

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.835967	117.4997	46.23142	0.0000
At most 1 *	0.465790	40.75286	40.07757	0.0419
At most 2 *	0.456790	39.66685	33.87687	0.0091
At most 3	0.296022	22.81553	27.58434	0.1815
At most 4	0.211054	15.40875	21.13162	0.2613
At most 5	0.139785	9.787225	14.26460	0.2263
At most 6	0.030646	2.023169	3.841466	0.1549
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Source: E-views 8.

The existence of convergence among the co-integration vectors presupposed that an appropriate long-run estimation is relevant. The CCR is presented thus in Table 4.4 alongside with OLS for comparison.

Table 3 reveals the estimated results, which presented Ordinary Least Square (OLS) and Canonical Cointegrating Regression (CRR) for comparison. The CRR provided a non-autocorrelation in its estimation, while there is presence of positive serial correlation in OLS estimator. CRR indicate a case of normality in the distribution and absence of violation of the assumption of least square.

The estimation results of OLS and CRR seem similar. However, CRR present a more robust estimation for long-run relationship than OLS, which support the claim of the study to examine a long-run relationship and sustainability test of main macroeconomic factors behind inflation in Nigeria. Therefore, the study focuses on the CCR estimator for data analysis.

**Table 4.4: Model Estimation**

Variable	OLS Estimator		CCR Estimator	
	Coefficient	Std. Error	Coefficient	Std. Error
Real GDP	0.000106*	3.59E-05	0.000206*	8.00E-05
Money supply	0.0000055*	4.10E-07	4.84E-06*	8.11E-07
Oil price	0.001137	0.052247	-0.008208	0.097439
Exchange rate	0.172377*	0.035285	0.147722*	0.055099
Fiscal deficit	0.0000041	5.73E-06	1.06E-05	1.49E-05
Interest rate	-1.104252*	0.441103	-1.180749*	0.703487
C	27.44227	10.06785	22.13638	17.18297
R-squared	0.98		0.98	
Adjusted R-squared	0.98		0.98	
F-statistic	598.32*			
Durbin-Watson stat	0.589894		1.048714	

Source: E-views 8. Dependent Variable: CPI.

The goodness of fit of the specification of CRR, that is, *R*-squared is 0.98. The *R*-squared suggest that there is high percentage of 98% explanation of price level variations that occur during the quarters. The robustness of the model has been defined by several diagnostic tests such as Durbin-Watson, Wald test of money supply, oil price and exchange rate and Jacque-Bera normality (see Appendix II). All the tests disclosed that the model has the aspiration of econometric properties, it has a correct functional form and the model's residuals are serially uncorrelated, normally distributed and relevant. Hence, the results reported are valid for reliable interpretation.

Therefore, Table 4.4 indicates that real GDP, money supply and exchange rate have the power to exert positive impact on price level in the long-run in Nigeria. The results also shows that interest rate have a negative significant impact on price level during the period. However, oil price, which is one of the main determinants of exchange rate in most developing and oil-rich countries, does not have any strong impact on price level. The effect of oil is not a direct effect on price level, especially in Nigerian case. Oil price has a spill over effect on price level through stock market price and exchange rate (Olayeni and Olofin, 2014; Abubakar and Umar, 2011). The significant positive relationship of exchange rate coefficient support the claim that price level is strongly affected by the rate at which Nigeria exchange it currency with other countries (Fatukasi, 2006). It shows that a unit increase in the exchange rate will lead to an estimated value of ₦0.17 in CPI. From the estimate, an ₦1.06 billion increase in real GDP would increase the CPI by ₦1. This suggest that as output increase over the years, price level would be affected. In the long-run, money supply showed a positive significant effect on price level. This suggest that the stock of money in the economy will push the price up in the long-run. This analysis demonstrates fiscal deficit will not contribute any significant effect on price level.

#### **4.2. Discussion of Results**

In another development, the findings from the research work revealed a moderately significant contribution of the money supply in the inflationary phenomenon. The positive result conformed to our a priori expectation as a unit rise in the money supply in the economy was supposed to result in a rise in price level, since increases in money supply lead to increase in the aggregate demand. Within the period under review, the real exchange rate of the Naira vis-à-vis the US Dollar (\$) is statistically significant and positive in influencing the price level in Nigeria. With increases in the exchange rate, price level increased moderately. With the depreciated naira, imports became more expensive. Expensive imports, coupled with the inelastic import substitution and over dependent on imported

goods lead to high cost of capital and intermediate goods. The chain reaction will continuously lead to increase of domestic price and eventually leads to inflation. The theory supporting this kind of inflation is cost –push inflation.

The impact of negative coefficient of interest rate will result in increased demand for money and investment will also increase. The rise in idle balances will result to excess money demand over money supply. The limited goods had to compete with the increase in money in circulation. A wage increase, largely resulting from the multiplier effect of increase in investment has been consistent in determining inflation. An extreme demonstration of this competition is borne out by the fact that in some cases producers and sellers increase the prices of their goods in anticipation of wage increases, usually to be followed by additional increases when the awards have actually been affected.

## **5. CONCLUSION AND RECOMMENDATION**

Instability in price level is one of the major macroeconomic problems that confront the Nigerian economy today. Attempts by the government to control this menace using the traditional monetary and fiscal policies have not provided a long lasting solution. Therefore, the knowledge of the determinants of price level in Nigeria is the necessary prerequisite to evolving a long term solution. In this research, the macroeconomic uncertainties that are associated with price in Nigeria are real income, money supply, interest rate, and exchange rate among others. These explanatory variables combined to significantly influence the variations in CPI in Nigeria as much as 98% while the stochastic error term (U1) capture 2%. At five (5) percent level of significance, they all impacted on the price level, measured with consumer price index, during the period. Thus, revealing some important facts about the general determinants of price in the Nigerian economy. These determinants are multi-dimensional and dynamic. Therefore, the government should pursue with vigour, policies that will enhance the reduction of the general price level but enhance increased productivity of goods and services. Such policies may include wage control/freeze, monetary policy (reduction in money supply), good management of foreign exchange, total ban on importation of some goods, increase in output of goods and services, over hauling distribution system, government/CBN intervention in FEM/SFEM to check excessive bidding or depreciation of the Naira among others. These will assist in controlling inflation, which if allowed to go out of control, would lead to macroeconomic instability and further reduce the already unacceptably low rate of economic growth.

## Reference

- Abubakar, J. and Umar, A. (2011) Crude oil prices and foreign exchange rates: evidence of cointegration and causality from Nigeria. *Energy Economics*, 33: 783-799.
- Adeyeye E. A. and Fakiyesi, T. O. (1980) Productivity Prices and Incomes Board and Anti-inflationary Policy in Nigeria". The Nigerian Economy under the Military, Nigerian Economic Society, Ibadan, Proceedings at the 1980 Annual Conference
- Agba, V. A (1994) "Principle of Macroeconomics", Concept Publication Ltd, Lagos.
- Ajayi, S. I and Teriba, O (1975) The Inflationary Process in Nigeria 1960 – 1972, Evidence from Quarterly Series. Inflation in Nigeria. Proceedings of a National Conference Edited by Onitiri, H. M. A and Awosika, K, Ibadan, NISER.
- Akinifesi, E. O (1984) "Inflation in Nigeria: Causes, Consequences Control" CBN Bullion, Silver Jubilee Edition vol. July.
- Basher, S. A. and Elsamadisy, E. M. (2012) Country heterogeneity and long-run determinants of inflation in the gulf Arab states. *OPEC Energy Review*, 36(2), 170-203.
- Central Bank of Nigeria (1974) Origin and Development of inflationary Trend in African Countries (Impact on Their Growth)". *CBN Economic and Financial Review*, 12 (2) December.
- Central Bank of Nigeria (1996) Money Supply, Inflation and the Nigerian Economy. Bullion Publication of CBN, Vol. 21 No 3 July/September.
- Central Bank of Nigeria (2003) "CBN Statistical Bulletin". Vol. 14 December.
- Central Bank of Nigeria (2003) Annual Report and Statement of Accounts.
- Christal and Lipsey (1999) *Principles of Economics*, 9th Edition, Oxford University Press Inc, New York, USA.
- Dakwat, S. (1997) Effects of Inflation on Structural Adjustment Programme. Unpublished work, University of Jos, Jos.
- Dewett K. K. (2005) *Modern Economic Theory*, S. Chand & Company Ltd., New Delhi, Revised Edition.
- Dibooglu S. & Kibritcioglu, A. (2004) Inflation, output growth, and stabilization in Turkey, 1980–2002. *Journal of Economics and Business*, 56, 43–61.
- Doland & Lindsey (1991) "*Economics*". 6th edition, Dryden Press, U.S.A.
- Durlauf, S. N., and P. C. B. Phillips (1988) Trends versus Random Walks in Time Series Analysis. *Econometrica*, 56, 1333-1354.
- Engle, R. F., and C. Granger (1987) Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55, 251-276.
- Fashoyin, T. (1986) *Incomes and Inflation in Nigeria*. Longman Publishers Ltd, New York.
- Fatukasi, B. (2006) Determinants of inflation in Nigeria: an empirical analysis. *International Journal of Humanities and Social Science*, 1(18), www.ijhssnet.com 262.

- Granger, C. W. J and Newbold. (1974) Spurious Regressions in Econometrics'. *Journal of Econometrics*, 2, III-120.
- Grant & Stanlake (1999) *Introductory Economics*. 6th Edition, Longman Publishers, London
- Humphrey, T. M. (1998) Historical origins of the cost-push fallacy. *Economic Quarterly*, Issue sum, 53-74.
- Hyman, D N (1996) *Economics*. 4th Edition, Irwin Publishers, Chicago USA.
- Itua, G (2000) Structural Determinants of Inflation in Nigeria (1981 – 1998). Unpublished work, ABU, Zaria.
- Iyoha, M (2002) Budget of Economic Growth and Development. *Bullion Publication of CBN*, 26 (2) April/June.
- Jaradat M., Zeaud, H. A. A. and Rawahneh, H. A. (2011) An econometric analysis of the determinants of inflation in Jordan. *Middle Eastern Finance and Economics*, 15, 120-132.
- Jhingan, M. L (2002) *Macroeconomic Theory*. 10th Edition, Vrinda Publications Ltd, New Delhi.
- Joon Y. park (1992) Canonical Co-integration regression, *econometrica*, 60(1), 119-143.
- Kandil, M. and Morsy, H. (2009) Determinants of inflation in GCC. *IMF*, working paper 09/82.
- Levacic, R. & Rebmann, A. (1982) *Macroeconomics: An Introduction to Keynesian-Neoclassical Controversies*, Palgrave Macmillan, UK.
- Montalvo J. G. (1995) Comparing co-integration regression estimators: some additional Monte Carlo results. *Economic Letters*, 48, 229-234.
- Moser, G. G. (1995) The main determinants of inflation in Nigeria. *Staff Papers (International Monetary Fund)*, 42 (2), 270-289.
- Ogaki, M., and C.-Y. Choi (2001) The Gauss-Markov Theorem and Spurious Regressions. Working Paper No. 01-13, Department of Economics, Ohio State University.
- Olatayo T. O., Adeogun A. W. and Lawal G. O. (2012) Co-integration approach to the spurious regression model, *American Journal of Scientific and Industrial Research*, <http://www.scihub.org/AJSIR>.
- Olayeni O. R. and Olofin O. P. (2014) Spillover from oil market to stock market in Nigeria: evidence from granger causality in risk *The Journal of Developing Areas*, 11, 1-20.
- Osagie E (1988) The Relevance of Income Policy in a Free Market Economy. A paper presented at the workshop on Income Policy and Structural Adjusted Economy, Lagos.
- Osakwe J. O. (1983) Government Expenditure, Money Supply and Prices, 1970 – 1980. *CBN Economic and Financial Review*, 21 (2) June.
- Park, J. Y., and M. Ogaki (1991) Seemingly Unrelated Canonical Cointegrating Regressions. RCER Working Paper No. 280.
- Phillips, P. C. B., and M. Loretan (1991): Estimating Long-Run Economic Equilibria," *Review of Economic Studies*, 58, 407-436.

- S. Kalra, (1998), "Inflation and money demand in Albania," IMF Working paper WP/98/101.
- Samuelson, P. A. & Nordhaus, W. D. (2005) *Economics*. 18<sup>th</sup> edition. New York, MacGraw-Hill.
- Stock, J. H., and M. W. Watson (1993) A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems, *Econometrica*, 61(4), 783-820.
- Suleiman, B. S (1998) Inflationary Effects of the Petroleum Industry on the Nigerian Economy. *Jos Journal of Economics* 1 (1).
- Teriba, A. (1997) Demand for Money in Nigeria: New Evidence from Annual (1960-94) and Quarterly (1962Q1-1995Q1) Data. IMF Seminar Series, No. 1997-25a, Washington: International Monetary Fund.
- Totonchi, J. (2011) Macroeconomic Theories of Inflation, *2011 International Conference on Economics and Finance Research IPEDR vol.4 IACSIT Press, Singapore*.
- Tule, M. K (2004) Determinant of Public Sector Wages in Nigeria (An Application of the Error Correction Methodology). *CBN Economic and Financial Review*, 42 (1) March.
- Udu, E (1989) *New System Economics*. African Publishers Ltd, Onitsha.
- Wang Q. and Wu N. (2012) Long-run covariance and its applications in co-integration regression. *The Stata Journal*, 12(3), 515-542.



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).