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Relationship between Economic Growth and Inflation in Nigeria (1970 – 2013)

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ABSTRACT

This study makes a modest contribution to the debates by empirically analyzing the relationship between inflation and economic growth, using time series data from 1970 to 2013, obtained from the Central Bank of Nigeria Annual Report and Statement of Account and West African Institute for Finance and Economic Management. It employs the Engle-Granger two step modeling (EGM) procedure to co-integration based on unrestricted Error Correction Model and Pair wise Granger Causality tests. The result obtained reveal good degree of correlation between dependent and the independent variables. This is captured by the explanatory power of the models result of R–squared (R^2) value of 0.69 and adjusted R – squared (R^2) value of 0.65. From the analysis, our findings indicate that inflation and economic growth are positively related and that increase in inflation rate does not reduce economic growth which implies that, the rising cost of goods and services is not as a result of increase in real gross domestic product rather, it is as a result of rising cost of production more especially, the cost of energy and they both have short and long-run relationships. The granger causality test reveals uni-directional Causality running from inflation to economic growth at both lag 2, 3 and 4. The speed of adjustment to equilibrium is 58% within a year when the variables wander away from their equilibrium values. Based on the result of granger causality, the paper concludes that a very weak causality exist between the two variables used in this study. Therefore, the policy implication of these findings is that any increase in inflation rate would not have a negative repercussion on economic growth in Nigeria and recommends that government should come up with transparent policies that will improve the power sector.

Keywords: Inflation, Economic Growth; unit root; Cointegration; Granger Causality, Nigeria.

INTRODUCTION

The relationship between economic growth and inflation rate has continued to generate series of debates among scholars; some of them confirm the existence of either a positive or negative relationship between these two major macroeconomic variables. Moreover, with time a general consensus evolved that low and stable inflation promotes economic growth and vice versa (Mubarik, 2005). The level at which prices of goods and services increases and relatively purchasing power of people decreases is called inflation, while economic growth measures the level of increase in the capacity of an economy to produce goods and services, compared from one period of time to another and It is conventionally measured as the percent rate of increase in real Gross Domestic Product or real GDP (IMF, 2012).

The fundamental objective of macroeconomic policies in both the developing and developed countries is to sustain high economic growth together with very low inflation (Chimobi, 2010). According to Niyimbanira (2013), high inflation rate is and could hardly be favourable to economic growth. The consequence of inflation can easily be inferred. Given constant set of prices today, a situation of relatively much more chasing the same bundle of goods and services tomorrow with constant real wage income simply implies adjustment in consumption patterns. The same bundle of goods and services consumed today cannot therefore be consumed tomorrow. Hence a decrease in consumption capacity and standard of living is imminent (Maku and Adelowokan, 2013).Atkinson and Milward (1998) claim that inflation may also reduce a country's international competitiveness by making its exports relatively more expensive which impacts on the balance of payments. Moreover, it also can impact the country's tax system to distort borrowing and lending decisions.

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Recent cross-country studies, which found inflation affecting economic growth negatively, include Fischer (1993), Barro (1996) and Bruno and Easterly (1998). Fischer (1993) and Barro (1996) found a very small negative impact of inflation on growth. Yet Fischer (1993) concluded "however weak the evidence, one strong conclusion can be drawn: inflation is not good for longer-term growth. Khan (2002) also concludes that inflation reduces a country's international competitiveness, by making its exports relatively more expensive, thus impacting negatively on the balance of payments. The second is that there is positive relationship between inflation and economic growth e.g., Tobin (1965), Shi, (1999), Mallik and Chowdhury, (2001) and Gokal and Hanif (2004). In addition, Feldstein (1996) notes that "shifting the equilibrium rate of inflation from 2 to 0 percent would cause a perpetual welfare gain equal to about one percent of Gross Domestic Product (GDP) a year.

In this context, the main objective of this study is to examine the inflation-growth nexus in Nigeria using annual data for the period 1970–2013.

The study will examine the exact relationship between economic growth and inflation in Nigeria. In the short run, the relationship between growth and inflation is usually positive. Policies that raise output (for example, expansionary fiscal and monetary policies) also raise prices. If high economic growth is accompanied by soaring amount of inflation, in light with these objectives, the study considers if economic growth granger cause inflation.

This paper is organized in the following way. Section 2 highlights the relationship between inflation and economic growth within the period of study. Section 3 describes the data and the econometric model. Sections 4 discuss the main findings. Finally, Section 5 presents concluding remarks.

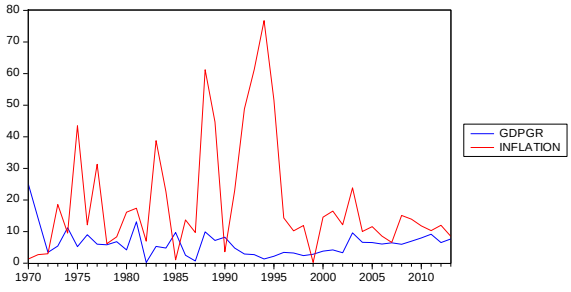
Inflation and Economic Growth in Nigeria

For the last four decades in Nigeria, the principal target of government has been the control of inflation and the rate is reported by the Central Bank of Nigeria (CBN). In the country, the average inflation rate from 1970 to 2013 was 19.2 percent, reaching the ultimate height of 76.8 percent in 1994 and a record low of 1.03 percent in 1985. Both politicians and economists say that this is the first economic duty of any government. And they tend to assume that other economic goals such as economic growth and low unemployment will be achieved only if the inflation is held under control. According to Frank and Bernanke (2001), as economic growth and low unemployment is achieved through successful controlling of inflation, then there is a relationship between inflation and economic growth.

Achieving price stability in Nigeria has remained one of the key objectives of monetary policy since the 1970s. In spite of this target by monetary authorities, a persistent increase in prices has constituted a major macroeconomic challenge.

The growth rate of GDP in Nigeria was 25% in 1970 and averaged 9.2% in the 1970s while inflation rate averaged 13.6%, it was highest in 1975 (43.5) when the second coup took place and lowest in 1970 (1.3) the year the civil war ended. It was 4.2% in 1980 and averaged 5.8% in the 1980s while inflation rate averaged 23.2%, it was highest in 1988 (61.2) and lowest in 1985 (1.03) shortly after the introduction of austerity measure. In 1990, it was 8.2% and averaged 3.4% in the 1990s while inflation rate averaged 30.2%, it was highest in 1994 (76.8) which can be described as a coup year because the coup took place in November the previous year and lowest in 1999 (0.2) a transition from military to civilian year. The GDP growth rate was 3.8% in 2000 and averaged 9.1% from 2000-2013, while inflation averaged 17.5, it was highest in 2003 (23.8) which was an election year and lowest in 2007 (6.6) which was also a transition from civilian to civilian regime and also, the election was highly rigged according to the candidate that emerged president in that election and the rate increased to 15.1 the next year. 2011, an election year had a double digit level see figure 1 for GDP growth rate and inflation.

Figure 1: GDP Growth Rate and Inflation 1970-2013



Source: CBN, 2013

Government expenditure increased by 0.3% in the 1970s, 0.2% in the 1980s, 0.4% in the 1990s and 0.1 from 2000-2013; while money supply increased by 0.3 in the 1970s, 0.2 in the 1980s, 0.3 in the 1990s and 0.2 from 2000-2013. This goes a long way to show that both the major monetary and fiscal policy of Nigerian government were less than 1% during the period of study and response of inflation to changes in both money supply and government expenditure was 0.0005% and 0.001 respectively which shows that this two major policy of government did not lead to increase in inflation in Nigeria see table one.

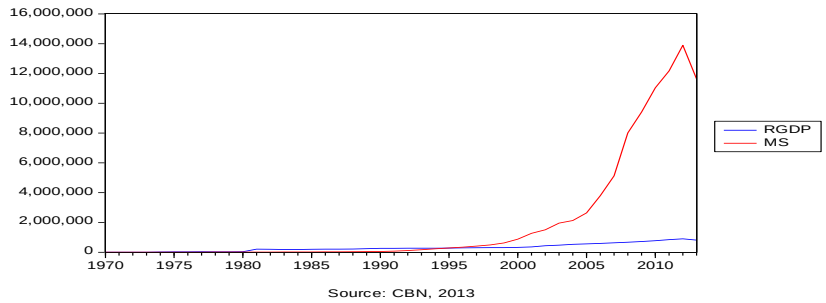
Table1.*Money supply and government total expenditure Elasticity of inflation*

Year	Money Supply	Government Total Expenditure	Inflation	RGDP
1970	978.2	903.90	1.3	4,219.00
2013	11628483.15	4241147.595	8.5	811386.9472

Source: *Computed by the authors, 2015*

Looking at the relationship between change in real GDP and the inflation rate using elasticity shows that it was also inelastic; a change in real GDP resulted to a lesser change in inflation (0.03). The country's real GDP increased by 105% from 1970 to 2013 see Figure 2: Real GDP and Money Supply 1970-2013.

Figure 2: Real GDP and Money Supply 1970-2013



Source: CBN, 2013

METHODOLOGY

Sources of Data

The understanding and explanation of the correlation between inflation and economic growth will be established in Nigeria using secondary time series data for the period 1970 to 2013. To that end, the data of real GDP in log form and inflation rate is taken and applied to regression and correlation analysis together with other determinants of economic growth which are money supply in log form, total government expenditure in log form, credit to the private sector in log form money supply in log form. The data is taken from CBN Statistical Bulletin, Volume 24, December, 2013 and World Bank resources for reliability and accuracy.

Method

The study employed the tools of time series econometrics to explore the possibility of long-run and short-run relationships among the relevant macroeconomic variables. Specifically, the Engle-Granger two step modeling (EGM) procedure (Engle and Granger, 1987) involving: Co integration analysis and error correction of parameter estimates were used. Additionally, Granger causality test was carried out to determine the direction of causation between economic growth and inflation.

Furthermore, a battery of diagnostic tests will be employed to test the robustness of the models to sundry econometric problems such as heteroskedasticity, autocorrelation, model misspecification and non-normality of the stochastic disturbance term. The entire study benefited immensely from various training and learning resources of the West African Institute for Financial and Economic Management Lagos.

Model Specification

The model specification benefited from several studies; Ahmed and Mortaza (2005), Alfred (2007) and Omoke (2010). The model showing the relationship between Economic growth and Inflation is specified thus:

$$RGDP = f(, MSGDP , CPS , GEXP , CPS , MPR , INF) \quad (1)$$

Where,

RGDP = Real Gross Domestic Product (This is the proxy for Economic growth)

MSGDP = Money supply to real GDP

CPS = Credit to the private sector

GEXP= Government expenditure

MPR= Monetary policy rate

INFL= Inflation rate

RGDP, MSGDP, GEXP and CPS, are all in logarithmic values. In log stochastic form, this can be rewritten as:

$$LogRGDP_t = c0 + c1\ LogMSGDP_t + c2\ LogCPS_t + c3\ LogGEXP_t + c4\ MPR_t + c5\ INF_t + e_t \quad (2)$$

Where:

RGDP = Log of Proxy for Economic growth at time t

MSGDP = Log of Money supply to real GDP at time t

CPS = Log of Credit to the private sector at time t

GEXP= Log of Government expenditure at time t

MPR= Monetary policy rate at time t

INFL= Inflation rate at time t

c0 = intercept

C1-c9 = Intercept

e = Error term

DATA ANALYSIS TECHNIQUES

The data plots indicate that the series in their raw (undifferentiated) form is typically constantly growing or wandering about with no tendency to revert to a fixed mean. This provides an intuitive idea that the data series is non-stationary in levels and any regressions involving such variables has the potential to lead to serious errors in inferences, that is, spurious regression (Green, 2003).

Unit Root Test

In order to avoid estimating spurious regression, the stochastic properties of the series were tested. This we did by testing for unit root which involved testing the order of integration of the individual series under consideration. Several procedures for the test of order of integration have been developed in which the most popular one is the Augmented Dickey-Fuller (ADF). The ADF test relies on rejecting a null hypothesis of unit root in favor of the alternative hypothesis of stationary. The tests were conducted with or without a deterministic trend for each of the series in order to ascertain the level of their stationary. The general form of the ADF is estimated by the following regression.

$$\Delta y_t = ao + a_1 y_{t-1} + \sum_{i=1}^{n} a\Delta y_1 + e_t \quad (3)$$

$$\Delta y_t = ao + a_1 y_{t-1} + \sum_{i=1}^{n} a_1\Delta y_1 + \vartheta_t + e_t \quad (4)$$

Where:

y_t = time series, it is a linear time trend,

Δ = First difference operator,

ao = constant

n = optimum number of lags in dependent variable

e_t = random error term.

Table2. *ADF Unit Root Test Result*

Variables	Test For Unit Root	ADF Test	Critical Value			Result
			1%	5%	10%	
LRGDP	Level	-0.915	-3.592	-2.931	-2.604	Not Stationary
	1st Difference	-5.286	-3.597	-2.933	-2.605	Stationary I(O)
LMSGDP	Level	-1.661	-3.592	-2.931	-2.604	Not Stationary
	1st Difference	-6.829	-3.597	-2.933	-2.605	Stationary I(O)
LCPS	Level	-0.713	-3.592	-2.931	-2.604	Not Stationary
	1st Difference	-4.208	-3.597	-2.933	-2.605	Stationary I(O)
LGEXP	Level	-1.363	-3.597	-2.933	-2.605	Not Stationary
	1st Difference	-7.304	-3.597	-2.933	-2.605	Stationary I(O)
MPR	Level	-2.218	-3.592	-2.931	-2.604	Not Stationary
	1st Difference	-7.100	-3.600	-2.935	-2.606	Stationary I(O)
INF	Level	-3.856	-3.592	-2.931	-2.604	Not Stationary
	1st Difference	-5.324	-3.610	-2.939	-2.608	Stationary I(O)

Table 2 reveals that all variables are non stationary at level but are stationary at their first-difference. In short, all variables are integrated of order one (i.e. they are I *(1)* processes) which sets the stage for Ordinary Least Squares test. Below is the Ordinary Least Squares test result.

The Estimation Results of the Co integration (Long Run)

The economic growth and inflation model has been estimated using money supply to GDP in log form, total government expenditure in log form, credit to the private sector in log form monetary policy rate. The signs of the coefficients are consistent with economic theory and in line with a priori expectations.

Table3.*The Impact of Nigeria's Economic Growth on Inflation 1970–2013 (Ordinary Least Squares Technique)*

Dependent Variable	Explanatory Variables	Coefficients	Standard Error	t-Statistic	(Prob)
DLRGDP	C	0.081259	0.032889	2.470690	0.0182
	DLMSGDP	-0.042171	0.005084	-8.295286	0.0000
	DLGEXP	0.243813	0.075137	3.244906	0.0025
	DMPR	-0.013979	0.006106	-2.289323	0.0279
	DLCPS	0.375545	0.120363	3.120093	0.0035
	DINF	0.001195	0.000979	1.220456	0.2300

R-Squared = 0.69: Adjusted R-squared: 0.65: DW = 1.952144: F = 0.000000

The increase in money supply enhances economic growth, lending to the private sector translates to enhanced economic growth. The higher the level of government expenditure, the higher the economic growth will be. The lower the monetary policy rate, the higher the economic growth. However, the result show that economic growth within the period of study is positively related to inflation but not statistically significant, the estimated coefficient positive but statistically not significant, implying that both inflation and real GDP affect each other positively, and inflation is not harmful for economic growth and economic growth does not help to reduce inflation in the country. This is not in line with studies by Fischer (1993), Barro (1996) and Bruno and Easterly (1998) but supports the work of Mallik and Chowdhury, (2001). According to Niyimbanira (2013) "the overall goodness of fit of the model can be analyzed by seeing the coefficient of determination or the value of R square and R square adjusted for the degrees of freedom." The R squared of about 69% percent indicates a good fit and the adjusted R squared of 65 per cent also confirms this. The D.W of 1.95 shows that it is white noise both the Akaike and Schwarz criteria prove the model selection good.

Since all the variables are random walk processes, there is the possibility that the regression results are spurious. Hence, the need to compare the ADF statistic on residuals to the MacKinnon response surface values since the Augmented Dickey Fuller (ADF) critical values are not appropriate for testing co integration (see Gujarati 2004). If the ECM is stationary at level, it means the regression is not spurious and that there is co integration, implying that there is a long run equilibrium relationship among the variables.

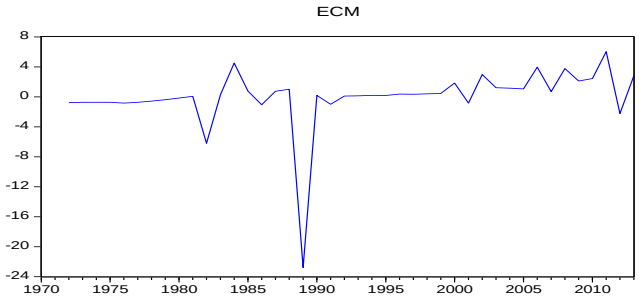


Figure 5: Cointegrating Residual: Graph

The residual of the long run static regression in Figure 5 seem to indicate mean reversion, thereby pointing to the likelihood of co integration. To confirm this view, a more formal test is conducted below.

Table4. *Cointegrating Residual: t-statistic*

		T-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.224343	0.0000
Test critical values:	1% level	-3.600987	
	5% level	-2.935001	
	10% level	-2.605836	

Table 4 show evidence of co integration at all levels (1%, 5% and 10%).

Diagnostic Testing

The model is subjected to rigorous diagnostic testing as shown in Table 5, the study notes that since the explanatory variables in the ECM are stationary, the assumptions of the classical least squares regression analysis are fulfilled. In all the tests, the null hypothesis is the scenario that is desired, for example, no serial correlation, and no heteroskedasticity. The Jarque and Bera normality test results present statistics for each equation and for all equations jointly against the null hypothesis of normality. The diagnostic test results reported in Table 5 indicates that the model passed all the statistical diagnostic tests as all the p-values exceeds the various α levels of significance. Thus, none of the assumptions of the ordinary least squares is violated.

Table5. *Diagnostic Tests*

Test	**F - Statistic**	**p-Value**	**Conclusion**
Stability			
Ramsey Reset	1.696579	0.2010	No Misspecification
Normality			
Jarque-Bera	0.580137	0.748212	Normally Distributed
Serial Correlation			
Breusch-Godfrey	0.648284	0.5291	No Serial Correlation
Heteroskedasticity			
ARCH LM	0.152135	0.6986	Homoscedasticity
White	1.718148	0.1095	Homoscedasticity

The Short-Run Dynamics: Error Correction Model (ECM)

After the estimation of the long run co integration relationship, the second stage of the Engle and Granger (1987) procedure consists of a determination of the error correction mechanism (ECM) in order to capture the short run or dynamic adjustment process to the long run equilibrium. It incorporate the equilibrium error estimated from the long run static regression. The ECM has several advantages: first, the ECM incorporates both the short-run and long-run effects assuming that the variables are co-integrated. The second one is that assuming co-integration; all the terms in the model are stationary so that standard regression techniques are valid (Harris, 1995). The parsimonious error correction model is provided in Table 6.

Table6. *Error Correction Model*

Dependent Variable	Explanatory Variables	Coefficients	Standard Error	t-Statistic	(Prob)
DLRGDP	C	0.042781	0.030856	1.386479	0.1741
	DLMSGDP	-0.043712	0.004477	-9.764577	0.0000

	DLGEXP	0.299013	0.067713	4.415853	0.0001
	DMPR	-0.017338	0.005436	-3.189274	0.0030
	DLCPS	0.496055	0.110978	4.469853	0.0001
	DINF	0.000779	0.000866	0.898913	0.3747
	ECML	-0.580230	0.166218	-3.490780	0.0013

R-Squared = 0.77: Adjusted R-squared: 0.73: DW = 1.8: F = 0.000000

The empirical results show the existence of short-run and long-run relationships between economic growth and money supply, government expenditure, monetary policy rate and credit to the private sector. This also implies short-run and long-run relationships between inflation and economic growth in the country. The estimate coefficient of the error correction term (-0.58) is statistically not significantly different from zero but with appropriate negative sign. This suggests the invalidity of a long run equilibrium relationship among the variables in equation. Whereas, the estimated coefficient of the error correction term is statistically significant at 1-percent level from real RGDP to INF with appropriate (i.e., negative) signs That means that in the long-run if the two series are out of equilibrium, real GDP will adjust to reduce the equilibrium error and vice versa. In other words, it shows that 58 percent (error correction term-0.58) of the deviation of the real RGDP from its long run equilibrium level is corrected each year. The estimated results in the ECM also show that short-run changes in real GDP affect INF positively.

Granger Causality Test

Granger causality analysis is used to test the hypothesis of prediction of future values of a particular variable(s) while incorporating the past lags of other variables in the model. In other words, a time series variable X_t is said to granger cause another time series variables Y_t if the former contains useful information to predict future values of the later. In this framework, if the F-test of the included lagged variables is statistically significantly different from zero, it implies that there is causality which can either be unidirectional or bidirectional in a bivariate case.

The granger causality test is estimated from the following equations

$$\Delta RGDP_t = \sum_{i=1}^{n} \alpha_i \Delta INF_{t-i} + \sum_{i=1}^{n} \beta_j \Delta RGDP_{t-j} + u_{1t} \quad (5)$$

$$\Delta INF_t = \sum_{i=1}^{n} \lambda_i \Delta INF_{t-i} + \sum_{i=1}^{n} \gamma_j \Delta RGDP_{t-j} + u_{2t} \quad (6)$$

Where α, β, λ and γ are the respective coefficient of the variables, t represents time while i and j are their lags, u_{1t} *and* u_{2t} are uncorrelated white noise error term. The null hypothesis is $\alpha = 0$ for all i_s and $\gamma = 0$ for all j_s while the alternative hypothesis is given as $a_i \neq 0$ *and* $\gamma_j \neq 0$.

Table7. *Pair wise Granger causality test*

Direction of causality	**F-stat**	**pvalue**	**Decision**	Lag length
INF → RGDP	2.67111	0.0829*****	**Do not reject**	2
INF ← RGDP	2.25498	0.1195	**Reject**	2
INF → RGDP	1.28185	0.0974*****	**Do not reject**	3
INF ← RGDP	1.28215	0.2967	**Reject**	3
INF → RGDP	2.22452	0.0900*****	**Do not reject**	4
INF ← RGDP	1.64286	0.1894	**Reject**	4

The arrow shows the direction of causality.

Since causality test is affected by number of lags included, we tested using 2, 3 and 4 lag lengths. The results in Table 7 show that up to four lag lengths at 5% level of significance. The null hypothesis that inflation does not Granger Cause Economic growth is accepted but rejected at the ten percent level of significance. At the same time, the null hypothesis that Economic growth does not Granger Cause inflation is accepted at all levels. Hence, the results suggest that Granger causality runs one way, from inflation to economic growth in Nigeria, also referred to as uni-directional causality with no reverse causality from RGDP to INF. The hypothesis that the lag value of RGDP and Inflation are statistically

significantly different from zero is not rejected for the second, third and fourth lag length as the p-values of the F-test indicate. Based on the result of granger causality, we conclude that very weak causality exists between the two variables.

CONCLUSIONS AND RECOMMENDATIONS

The link between inflation and economic growth was analyzed using co integration and error correction models to empirically examine long-run and short-run dynamics for Nigeria using annual data from 1970-2013. The main objective was to examine whether a relationship exists between economic growth and inflation and, if so, its nature. The paper concludes that inflation and economic growth are positively related and that increase in inflation rate does not reduce economic growth which implies that, the rising cost of goods and services is not as a result of increase in real gross domestic product rather, it is as a result of rising cost of production more especially, the cost of energy. Economic growth and inflation have both short-run and long-run relationships based on the empirical findings. The relationship between economic growth and inflation is inelastic i.e. a change in economic growth results to a lesser change in inflation. The average inflation rate from 1970-2013 was 19.2% and this should affect economic growth negatively but the study proves otherwise which still boils down on the cost of production been the major propeller of the rising cost of goods and services in the country. And also going by the country's per-capital income which is less than $3000, (CBN, 2013) you can see that Nigerians still need more money to be able to make demand effectively. Most big industries in the country depend solely on generators to run their businesses and these generators are powered at a very high cost which they transfer to their products. The cost of transportation is also very high, the difference between the cost of a product in a place where it is produced, is most times above 400% e.g. is the cost of a basket of tomatoes in Kaduna is sold for between 600 Naira to 1000 Naira but that same quantity is sold for 3000 to 4000 Naira at Owerri, a distance of less than 1000km. This high cost is as a result of lack of efficient rail system, the quantity of tomatoes that can be transported to Owerri at once by train, will be transported by over thirty trucks that will all buy diesel and also bribe the police on their way.

This paper recommends that government should address the problems facing the country's energy sector and also build and encourage the private sector to build refineries in the country. Government should also construct new rail lines linking major industrial cities like Lagos and Ibadan with big commercial cities like Aba, Owerri and Onitsha this will reduce the cost of doing business in the country which will also reduce the cost of goods and services. the study suggests that research should be carried out on the relationship between inflation and per-capital income and how these relationship can affect economic growth.

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Research in Progress:

My main focus is on academic research. My goal is to write approximately six Monetary Economics, International Trade and Development Economics with emphasis on Energy Economics and Poverty Reduction related article. This area is constantly being researched and always a work in progress. At the same time, I am also working on a number of research projects centered on corruption in the country.