

Application of Time Series Analysis to Some Indices of Economic Growth during the Period 1960 to 2010 in Nigeria

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Abstract

The private sector is recognized as a critical stake holder and partner in economic development. The study was conducted to determine the effects of Credit to Private sector on Economic Growth in Nigeria. Data on Gross Domestic Product (GDP), Credit to Private Sector (CPS), Export (EX) and Import (IM) were collected from the Central Bank of Nigeria Statistical Bulletin spanning from 1960 through 2010. Analysis of data was achieved using the Augmented Dickey-Fuller test for stationarity, the Johansen test for Cointegration, the Granger's test for Causality and the Error Correction Mechanism to reconcile the short-run and the long-run behavior of the variables. The results indicate that a long-run relationship exists between Economic Growth (GDP), Credit to Private Sector ratio (CG) and Terms of Trade (EXIM) in Nigeria. A unidirectional relationship exists between Economic Growth and Ratio of Credit to GDP, in the direction $CG \rightarrow GDP$, in Nigeria. Economic Growth in Nigeria was discovered to be in its equilibrium. Based on these findings, it was recommended that the Federal Government of Nigeria should increase efforts in pursuing Credits for economic growth and foreign partnership. These will encourage economic growth and help the private sector in Nigeria overcome its challenges.

Keywords: Credit to Private Sector, Gross Domestic Product, Terms of Trade, Unit root, Cointegration.

1. Introduction

Economic growth is defined as a positive change in the national income or the level of production of goods and services by a country over a certain period of time. This is often measured in terms of the level of production within the economy. Other possible measures include total factor productivity, factors of production such as technological change, human capital termed the Schumpeterian approach etc. (Odedokun, 1998; King, 1993; Allen, 1998). A widely used measure is the Gross Domestic Product (GDP). The GDP is the money value of goods and services produced in an economy during a period of time irrespective of the nationality of the people who produced the goods and services. It is calculated without making deductions for depreciation (Central Bank of Nigeria Statistical Bulletin, 2012).

In a developing country such as Nigeria, the economy is severely segmented. The government is more interested in appropriating returns from the oil economy, while other sectors have been ignored or preyed upon. More than 80% of the Nigeria GDP is accounted by oil (Nwaosu & Ali, 2012), but some other areas such as Agriculture, industry, building and construction, wholesales and retails trade, and services (transport, communication, Hotels, etc.), which constitute the private sector, also contribute to the national finance and development hence to the GDP. This is not the case in most developed countries whose economies are diversified and not concentrated on a particular sector such as the oil sector.

The private sector is recognized as a critical stake holder and partner in economic development, a provider of income, jobs, goods and services to enhance people's lives and help them escape poverty (International Finance Institution Report, 2011). Private sector development and investment (tapping private sector initiative and investment for socially useful purposes) are critical for poverty reduction. In parallel with public sector efforts, private investment, especially in competitive markets, has tremendous potential to contribute to growth. Private markets are the engine of productivity, growth, creating productive jobs and higher incomes.

In the past, successive Nigerian governments have failed to properly utilize windfall revenues resulting from major spikes in world prices particularly oil. Consequently, when prices have fallen, they have resorted to borrowing to sustain public expenditure. Such actions have led to many fluctuations in the cost of credit to the private sector. It is against this back drop that an interest lies in carrying out statistical analysis on the interplay of economic growth and private sector credit using Nigeria as a case study. The study is presented in five sections. Section one is the introduction, followed by section two which is the literature review. Section three covers the methodology. Section four is the results and the discussion, while section five covers the conclusion.

2. LITERATURE REVIEW

There has been a renewed interest globally into the study of credit and its ability to generate growth. Some of these studies concluded that firms that are able to get external finance are more likely to grow than those limited to internal finance only.

Study conducted by King and Levine (1993) on seventy seven countries made up of developed and developing economies, to find out whether high levels of financial development are significantly correlated with

faster current and future rates of economic growth, physical capital accumulation and economic efficiency improvements, showed that finance not only follows growth; finance seems important to lead to economic growth. This is similar to the recent work of Demirguc-Kunt & Levine (2008) in a review of the various analytical methods used in finance literature; they found strong evidence that financial development is important for growth.

Demetriades & Hussein (1996) conducted a study on 16 less developed countries between 1960 and 1990 with the aid of time series technique. They observed long-run relationship for indicators of financial development and per capital GDP in 13 countries. They found bi-directional causality in six countries and reverse causality in six countries while South Africa showed no evidence of causation between the variables. Beck, *et al* (2005) also observed private credit as a good predictor of economic growth while Boyreau-Debray (2003) found a negative correlation between growth and banking debt due to the fact that Chinese banks were mobilizing and pouring funds into the declining parts of the Chinese State Enterprise and hence the system has not been growth promoting.

Using time series analysis, Hondroyannis, *et al* (2005) find a bilateral causal relationship between financial development and economic growth in Greece. Patrick (1996) also postulated a bi-directional relationship between financial development and economic growth.

Gold Smith (1969) emphasized the role of capital accumulation in economic growth. He is of the opinion that policy makers may achieve greater returns by focusing less on the extent to which their country is bank based or market based and more on legal, regulatory and policy reforms that boost the functioning of the markets and banks. Using data from 35 countries between 1860 and 1963, where he employed the method of cointegration, concluded that a rough parallelism exist between economic and financial development in the long-run.

Elliott (1998) shows that large size distortions can occur when performing inference on the cointegration vector in a system where the individual variables follow near-unit-root processes rather than pure unit-root processes.

Cho (2006) in their paper: Testing for Cointegration and Causality between TSX Composite Index and TSX Venture Composite Index, concluded that between 2001 and 2004, the TSX Composite and TSX Venture Composite indices are not cointegrated, indicating that there is no significant long-run relationship between them. The results of their study also show that there is evidence of unidirectional causality from TSX Composite index to the TSX Venture Composite index.

Ukpolo (1998) in his study, Exports and Economic Growth in South Africa: Evidence from Cointegration and Granger Causality Tests, show that during the period 1964 – 1993, the export-led hypothesis was not verified but supports the existence of reverse causality.

Onuche, *et al*, (2014) in their study titled “Determination of Long term Relationship between Foreign Private Investment and Gross Domestic Product using Cointegration” concluded that a long run relationship exist between GDP and FPI in Nigeria for the period of 1965 to 2012.

Nigeria Gross Domestic Product (GDP) between 1960 and 2008 over different political regimes by Nwaosu & Ali (2012), using Time Series Cross-Sectional method, discovered that oil presently contributes to more than 80% of the real GDP while industry, building and construction are the least contributors. He Advocated for the diversification of economic activities in Nigeria which he believes will lead to growth and employment. In this respect, the researcher decided to determine the long run relationship between the private sector and economic growth in Nigeria. This study also used the Gross Domestic Product at current basic prices which is an aggregate of the sectorial Gross Domestic Product over the period covered. The credit private sector was used as well, which is the sum of all forms of credits given to individuals and organizations (not owned by the government). This will enable us capture the long run relationship between the private sector and economic growth in Nigeria, hence serve as an enlightenment tool to stakeholders and the public. This will also be useful to the Government for planning and policy formulation, particularly in the area of poverty alleviation.

3. Methodology

3.1 The Data

Data was collected on GDP at Current Basic Prices (otherwise known as the Nominal GDP) which equals GDP at current market prices less indirect taxes net of subsidies, CG which is Private Sector Credit ratio; obtained by dividing the private sector credit CPS_t at time t by the gross domestic product GDP_t at time t , and EXIM (Terms of Trade) was obtained by dividing Export, EX_t at time t by Import, IM_t at time t . Data spanning from 1960 through 2010 were obtained from the Central Bank of Nigeria Statistical Bulletin, 2012.

3.2 The Unit root test

According to augmented Dickey-Fuller (1979), a random walk model without drift and trend is given by

$$Y_t = \rho Y_{t-1} + u_t ; \quad -1 \leq \rho \leq 1 \quad \dots \dots \dots \quad (i)$$

where u_t is a white noise error term.

by a little transformation,

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + u_t$$

$$\Delta Y_t = \delta Y_{t-1} + u_t \quad \dots \dots \dots \quad (ii)$$

where $\delta = (\rho - 1)$

Δ is the first difference operator.

Thus we test the hypotheses;

$$H_0 : \delta = 0 \quad \text{vs} \quad H_1 : \delta < 0$$

If the null hypothesis is accepted, $\delta = 0$, then $\rho = 1$, that is we have a unit root, meaning the time series under consideration is non-stationary.

The augmented Dickey-Fuller, ADF (1979) test values can be used to compare for the test statistic given by the $t (= \tau)$ value of the Y_{t-1} coefficient ($= \delta$).

$$\text{where } \tau = \frac{\hat{\delta} - 0}{\hat{\sigma}_{\hat{\delta}}}, \quad \hat{\sigma}_{\hat{\delta}} = \hat{\sigma} \left[\frac{1}{\sqrt{(\sum Y_{t-1}^2 - n \bar{Y}_{t-1}^2)}} \right]$$

If the computed absolute value of the tau statistic ($|\tau|$) exceeds the DF critical tau value, we reject the hypothesis that $\delta = 0$.

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3.3 Testing for cointegration

A number of methods for testing cointegration have been proposed in existing literature. Here we shall consider only the Johansen method;

The Johansen's methodology takes its starting point in the VAR of order p given by;

$$Y_t = \phi D_t + \pi_1 Y_{t-1} + \dots + \pi_p Y_{t-p} + \varepsilon_t \quad \dots \dots \dots \quad (i)$$

where Y_t is an $(n \times 1)$ vector of variables that are integrated of order one, commonly denoted as $I(1)$ and ε_t is an $(n \times 1)$ vector of innovations.

This VAR can be rewritten as;

$$\Delta Y_t = \phi D_t + \pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \quad \dots \dots \dots \quad (ii)$$

where; $\pi = \pi_1 + \dots + \pi_p - I_n$

$$\Gamma_k = -\sum_{j=k+1}^p \pi_j, \quad k = 1, \dots, p-1$$

If the coefficient matrix π has reduced rank, $0 < \text{rank}(\pi) = r < n$, then there exist $n \times r$ matrices α and β each with rank r such that $\pi = \alpha\beta'$ and $\beta' Y_t$ is stationary. r is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector.

3.4 Error Correction Model

The Error Correction Model (Sargan, *et al*, 1983) links the long-run equilibrium relationship implied by cointegration with the short-run dynamic adjustment mechanism that describes how the variables react when they move out of long-run equilibrium.

Consider a bivariate $I(1)$ vector $Y_t = (y_{1t}, y_{2t})'$ and assume that Y_t is cointegrated with cointegrating vector;

$$\beta = (1, -\beta_2)'$$

so that;

$$\beta' Y_t = y_{1t} - \beta_2 y_{2t} \text{ is } I(0).$$

Then the existence of an error correction model (ECM) implied by the above cointegrated, Y_t is of the form;

$$\Delta y_{1t} = C_1 + \alpha_1 (y_{1t-1} - \beta_2 y_{2t-1}) + \sum_j \varphi_{j11} \Delta y_{1t-j} + \sum_j \varphi_{j12} \Delta y_{2t-j} + \varepsilon_{1t} \quad \dots \dots \quad (i)$$

$$\Delta y_{2t} = C_2 + \alpha_2 (y_{1t-1} - \beta_2 y_{2t-1}) + \sum_j \varphi_{j21} \Delta y_{1t-j} + \sum_j \varphi_{j22} \Delta y_{2t-j} + \varepsilon_{2t} \quad \dots \dots \quad (ii)$$

Equation (i) relates the change in y_{1t} to the lagged disequilibrium error $y_{1t-1} - \beta_2 y_{2t-1}$, and equation (ii) relates the change in y_{2t} to the lagged disequilibrium error as well. The reactions of y_{1t} and y_{2t} to the disequilibrium error are captured by the adjustment coefficients α_1 and α_2 .

3.5 Granger causality test

The Granger (1969) causality test assumes that the information relevant to the prediction of the variables involved, y_{1t} and y_{2t} , is contained solely in the time series data on these variables. The test involves estimating

the following pair of regressions;

$$y_{2t} = \sum_{i=1}^n \alpha_i y_{1t-i} + \sum_{j=1}^n \beta_j y_{2t-j} + \varepsilon_t \quad \dots\dots\dots (i)$$

$$y_{1t} = \sum_{i=1}^n \lambda_i y_{1t-i} + \sum_{j=1}^n \delta_j y_{2t-j} + u_t \quad \dots\dots\dots (ii)$$

where it is assumed that the disturbances ε_t and u_t are uncorrelated.

Equation (1) postulates that current y_{2t} is related to past values of itself as well as that of y_{1t} and equation (ii) postulates a similar behavior for y_{1t} . Granger distinguished four cases;

- (1) Unidirectional causality from y_1 to y_2 is indicated if the estimated coefficients on the lagged y_1 in (i) are statistically different from zero as a group (ie $\sum \alpha_i \neq 0$) and the set of estimated coefficients on the lagged y_2 in (ii) is not statistically different from zero (ie $\sum \delta_j = 0$).
- (2) Unidirectional causality from y_2 to y_1 exists if the set of lagged y_1 coefficients in (i) is not statistically different from zero (ie $\sum \alpha_i = 0$) and the set of the lagged y_2 coefficients in (ii) is statistically different from zero (ie $\sum \delta_j \neq 0$).
- (3) Feedback, or bilateral causality, is suggested when the sets of y_1 and y_2 coefficients are statistically significantly different from zero in both regressions.

3.6 The Model

Consider the following model

$$GDP_t = \alpha_0 + \alpha_1 CG_t + \alpha_2 EXIM_t + \mu_t \quad \dots\dots\dots (3.6.1)$$

Where;

GDP_t = the Gross Domestic Product at time t

CG_t = Credit to Private Sector Ratio

$EXIM_t$ = the ratio of EXT_t to IMT_t , known as Terms of Trade.

The third variable EXIM was added to avoid the problem of biasness when using bivariate model (Lucas; 1988, Al-Yousif; 1999).

4.0 Results and Discussion

4.1 Unit Root Test Results

The stationarity test was conducted on the variables, using the Augmented Dickey Fuller (ADF) test, to determine the order of integration (stationary levels) of the variables. The table below shows the result of the analysis.

Table 4.1 ADF UNIT ROOT TEST RESULTS

Variable	Level		Second Difference	
	ADF Test Stat.	Critical Value (1%)	ADF Test Stat.	Critical Value (1%)
GDP	10.89425	-2.6090	-4.788591	-4.1630
CG	1.017967	-2.6090	-8.771512	-2.6110
EXIM	-1.112514	-2.6090	-11.69752	-2.6110

The results of the unit root tests from table 4.1 shows that the Gross Domestic Product (GDP) and the Credit to Private Sector ratio (CG) and Terms of Trade (EXIM) are integrated of order 2 respectively. That is, each of the variables is stationary after second differencing. Since the condition of the same order of integration was met, a cointegration test among the variables was carried out.

Table 4.2 Johansen Cointegration Test

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.516930	62.61597	29.68	35.65	None**
0.361734	26.96389	15.41	20.04	At most 1**
0.096323	4.962873	3.76	6.65	At most 2*

(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R test indicates 3 cointegrating equation(s) at 5% significance level

The Johansen Cointegration test result shows the existence of long- run relationship between the Gross Domestic Product (GDP), Terms of Trade (EXIM) and Credit to Private Sector ratio (CG), being that the likelihood ratios; 62.61597 and 26.96389 are greater than the 5% and 1% critical values respectively, while the likelihood ratio 4.962873 is greater than the 5% but less than the 1% critical values.

Table 4.3 Normalized Cointegrating Coefficients: 2 Cointegrating Equation(s)

GDP	EXIM	CG	C
1.0000	0.0000	-13623830 (7575033)	-1396969
0.0000	1.0000	-1.249236 (1.40686)	-1.292992
Log likelihood -636.2555			

Explicitly, from table 4.3, the cointegration test result shows the existence of long-run relationships between the Gross Domestic Product (GDP) and Credit to Private Sector ratio (CG), and also, Terms of Trade (EXIM) and Credit to Private Sector ratio (CG) in the study of Nigeria economy.

Table 4.4 Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Probability
DDCG does not Granger Cause DDGDP	39	3.00915	0.02026
DDGDP does not Granger Cause DDCG		2.24767	0.06475
DDEXIM does not Granger Cause DDGDP	39	0.44698	0.90272
DDGDP does not Granger Cause DDEXIM		0.72468	0.69272
DDEXIM does not Granger Cause DDCG	39	0.77834	0.64867
DDCG does not Granger Cause DDEXIM		1.30687	0.29803

The Granger causality test result shows that Credit to Private Sector ratio (CG) Granger causes the Gross Domestic Product (GDP), since the probability value 0.02026 corresponding to the hypothesis, is less than 0.05. Whereas the Gross Domestic Product (GDP) does not Granger cause the Credit to Private Sector ratio (CG), since the probability value 0.06475 is greater than 0.05. These imply that a unidirectional relationship exists from Credit to Private Sector ratio (CG) to the Gross Domestic Product (GDP) in the study of Nigeria economy. Also, the Granger causality test result shows that Terms of Trade (EXIM) does not Granger cause the Gross Domestic Product (GDP) and vice versa. Terms of Trade (EXIM) does not Granger cause Credit to Private Sector ratio (CG) and vice versa. This is as a result of their probability values, corresponding to respective hypothesis, being greater than 0.05. These results show that Credit to Private Sector ratio (CG) and Terms of Trade (EXIM) can only be predicted from their respective past values.

Table 4.5 ECM Regression Result

White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	117283.4	91731.86	1.278546	0.2082
ECM(-1)	0.004596	0.022311	0.206020	0.8378
DDGDP(-1)	-1.049719	0.168010	-6.247971	0.0000
DDCG(-1)	-6010038.	2669085.	-2.251722	0.0298
DDEXIM(-1)	2348.681	136209.7	0.017243	0.9863
DDEXIM(-2)	37149.70	104255.1	0.356335	0.7234
R-squared	0.669026	Mean dependent var		93859.28
Adjusted R-squared	0.628663	S.D. dependent var		953937.1
S.E. of regression	581304.8	Akaike info criterion		29.50268
Sum squared resid	1.39E+13	Schwarz criterion		29.73887
Log likelihood	-687.3130	F-statistic		16.57533
Durbin-Watson stat	1.625603	Prob(F-statistic)		0.000000

$$\widehat{DDGDP} = 117283.4 - 1.049719 DDGDP(-1) - 6010038 DDCG(-1) + 2348.681 DDEXIM(-1) + 37149.70 DDEXIM(-2) + 0.004596 ECM(-1) \dots \dots \dots (4.1)$$

The above Error Correction Mechanism (ECM) regression result shows that the constant C, the equilibrium error term at lag 1, ECM (-1), the second difference of Terms of Trade at lag 1, DDEXIM (-1) and at lag 2, DDEXIM (-2) are not significant (since the probability values 0.1777, 0.7958, 0.9848 and 0.7518 corresponding to their respective coefficients, 117283.4, 0.004596, 2348.681 and 37149.70 are greater than 0.05 respectively) in model 4.1. These imply that their coefficients are not significantly different from zero. Thus they do not contribute to the prediction of the Gross Domestic Product GDP. The equilibrium error term being equal to zero suggests that the Gross Domestic Product GDP adjusts to changes in Credit to Private Sector ratio CG in the same time period. This also tells us that the ECM regression model is in equilibrium. The second differences of the Gross Domestic Product at lag 1, DDGDP (-1) and Credit to Private Sector ratio at lag 1 DDCG (-1) are significant (since the probability values, 0.0000 and 0.0224, corresponding to the coefficients -1.049719 and -6010038 are respectively less than 0.05), which imply that the previous year values of the Gross Domestic Product GDP and Credit to Private Sector ratio CG are significant in the prediction of the current year Gross Domestic Product GDP. These also buttress the result obtained in the Granger's Causality Test that Credit to Private Sector ratio Granger causes the Gross Domestic Product (GDP). The result of ECM regression also shows that the second differences of the Gross Domestic Product at lag 1, DDGDP (-1) and Credit to Private Sector ratio at lag 1, DDCG (-1), both have negative coefficient of -1.049719 and -6010038.0. This implies that

short-run changes in the Gross Domestic Product GDP and Credit to Private Sector ratio CG in the previous year have negative effects on short-run changes in Gross Domestic Product GDP of the current year in Nigeria. This may be as a result of the credit to private sector not being utilized for the main purpose of which it was implemented, which is to increase productivity of the private sector and their contribution to the economy of Nigeria. In general, the result of the ECM regression shows that in the short run, GDP_t depends on its previous year values as well as the extent of Credit to Private Sector ratio of the previous year. However, the R^2 value of 0.669026 implies that about 66.9% of the variation in economic growth in Nigeria is accounted for, in the short-run, by the explanatory variables included in the final model.

Table 4.6 Residual Analysis

Test	Value	Probability Value
B-G Serial Correlation	3.103385	0.211889
White's Heteroskedasticity	43.78529	0.001608
J-B Normality	4.936093	0.084750

It could be observed from the above table that the Breusch-Godfrey Serial Correlation test indicates the absence of auto-correlation in the residuals, given that the probability value of 0.211889 is greater than 0.05. The White's Heteroskedasticity test indicates that the ECM regression model is not free from the problem of heterogeneity of variance, given that the probability value of 0.001608 is less than 0.05. This was adjusted for using the White Heteroskedasticity-Consistent Standard Errors and Covariance option. The Jarque-Bera test also reveals that the assumption of normality of the error terms cannot be rejected being that the associated probability value 0.084750 of the J-B statistic 4.936093 is greater than 0.05; Meaning that asymptotically, the residuals are identically and independently distributed. Further diagnostic check was carried out on model 4.1 by plotting the ACF and PACF of the residuals ($DDGDP - \widehat{DDGDP}$). The result shows that none of the autocorrelation or partial autocorrelation value is significant. This tells us that the final ECM regression model has been correctly specified.

5. CONCLUSION

Credit to private sector is believed to stimulate economic growth as a result of the role of the private sector in productivity, generation of employment in a nation and the promotion of the integration world economies. In this respect, the study carried out an empirical analysis of the possible influence of credit to private sector on economic growth in Nigeria for the period 1960-2010. Data sourced from the Central Bank of Nigeria statistical bulletin were analyzed using cointegration, Granger's causality and Error correction technique and the following findings were made:

1. A long run relationship exists between Economic growth, Credit to Private Sector ratio and Terms of Trade in Nigeria.
2. A unidirectional relationship exists from Credit to Private Sector ratio to Economic growth in Nigeria.
3. Economic growth in Nigeria is in its equilibrium value of $[-1.049719 GDP(-1) - 6010038 CG(-1)]$.
4. Short-run changes in Economic growth of previous year were significantly and negatively related to the short-run changes in Economic growth of the current year in Nigeria.
5. Short-run changes in Credit to Private Sector ratio of previous year have significant and negative influence on short-run changes in Economic growth of the current year in Nigeria.

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