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An Analysis of the Relative Effectiveness of Innovation and Fiscal Policy on Economic Growth in Nigeria

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Abstract
The traditional approach to stimulating economic growth has been challenged in the recent past with the advent of innovation technologies around the world. This work examined the relative impact of innovation and fiscal policy on economic growth in Nigeria for the period 2008Q1 to 2017Q4. A Vector Autoregressive (VAR) model was employed and the findings revealed that government capital expenditure (GCE) has a more significant and positive impact on economic growth than the Information and Computer Technology (ICT) that was used to proxy innovation. It was also discovered neither fiscal policy variable nor innovation variable could Granger cause GDP. It was therefore recommended that more deliberate expenditure on capital projects should be embarked upon to stimulate economic growth to higher heights. At the same time, it was recommended that more of government expenditure should be geared towards ICT or innovation technology based like R and D and that will have a strong effect on economic growth.

Key Words: Innovation, Capital Expenditure, Economic growth, Fiscal Policy

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I. Introduction:

The debate for supremacy of fiscal policy over all other forms of policy in the control of the economic growth has been of concern for a few decades now. Recent developments across nations have shown that attention is beginning to shift away from the primary orthodox policy frameworks in the light of the globalization and knowledge driven economies (Hall, Mairesse and Mohnen2010). The 2016 meeting of the G20 economies revealed very clearly that there are many factors other than fiscal or monetary that can be stimulatedto trigger economic growth. One of the major factors prominently highlighted is the attention on innovation in driving the growth process of the economies.

There is a fundamental truth that can be taken as given, two ways of increasing output and growth. The first is to increase inputs in order to increase output, and the second is to creatively use the same number of inputs to create more output or use less inputs to create the same quantity of output as before. Economically, the second approach generates more interests and seems more important. This is why Abramovitz in the 1950s submitted that innovation is the most important factor determining long term growth. His analysis on the relationship and the effect of changes in the inputs, such as labour and capital, on growth between 1870 and 1950 accounted for just about 15% in output growth, and by implication, the residual and unexplained factors for growth is about 85%, which was questionable and further aroused research interests. Economists like Robert Solow was one of the later researchers who further investigated the relationship and still came out with similar results. It was this results that made economists to come to the conclusion that it must have been some form of technological innovation that must have been responsible for the large residual, which invariably accounted for the larger explanation for the determination of the output growth. This development generated the curiosity that the growth of an economy is endogenously determined as postulated and pioneered by Romer (1986). Central to these models is the postulation that endogenously determined innovation generates sustainable economic growth, given that there are constant returns to innovation in terms of human capital employed in the Research and Development (R&D) sectors.

On the other hand, fiscal policy attempts to use either the government expenditure or taxation to control the economy. If the government decides to use government expenditure, the essence is to stimulate demand so as to boost productivity. Similarly, if tax structure is altered, the essence is to influence demand and consequently productivity, going through the demand side of the economy. But if we consider the supply side, the alteration of the tax structure is to motivate the demand for labour to go up so as to produce more. None of these efforts has any creative means of attaining the same level of output using less inputs or the same units of input to attain higher productivity. Prior to the discovery in the 1950s, several models have been built with the hypothesis that the only thing it takes to increase output is just to keep adding to the inputs. But with the large residuals that they kept getting, it began to send serious message that there must have been something else that was being neglected that could actually better account for growth.

A close look at the USA economy will clearly reveal that the role of innovation has been critical to economic development as the nation has evolved over the decades. The statistical and empirical link between innovation and gains in the standard of living is quite interesting. Scientific and engineering advances have spurred new products and processes since independence. For example, imagine the country that was initially largely an agrarian economy, but through innovation it advanced from being an emerging nation status in the mid-19th century to an industrial powerhouse by the First World War. Innovation produced vast improvements in agricultural productivity and consequently released workers for other activities.

Innovation in the agricultural, automobile, telecommunications, household appliances, industrial machinery, medical equipment, and computers, etc, have in one way or the other spurred economic growth in the countries that have been able to carry out those innovative activities. Much of the increase in the standard of living today has been as a result of innovation. Expenditures on R&D as well as the Patent rights do not generate higher productivity until they are matched with market structures and the regulatory environment that will enable the more productive activities to expand.

It seems yet very obvious that the interests of governments and policy makers of most of the developing economies are still on how they can manipulate the fiscal policy variables to attempt to stir the economic growth. The challenges of proper policy formulation, implementation and the lag before the actualization have been the causes of failure of such policies, coupled with the timing of policy implementation, whether it is in recession or boom. On the other hand, a proper innovation on any product, process, organization and marketing of any kind will fit into promoting growth at any stage of the business cycle.

This work is structured in to five sections. The following section presents the literature review, and theoretical framework of the study. Section three presents the methodology and the model for the work, while section four presents the results of the finding and the final section presents the conclusion and recommendations.

II. Theoretical Review

Park and Choi(2019) examined how advancement in technologies and their adoption affects economic growth in different nations. An integrative model was built to verify innovative growth path of nations by applying Diffusion of Innovation Theory (DoI) and Technology (T)-Organization (O)-Environment (E) framework, which can explain factors affecting innovation. Eight hypotheses were evaluated with data collected from 137 to 212 nations using international information index by credible organizations. A Structural Equation modelling was used to analyse the path analysis and the findings revealed that the path from technological innovation capabilities, human capital, and environment is has a direct relationship with economic growth.Broughel and Thierer (2019) conducted a literature review assessment of how technological innovation affects economic growth and human progress. The findings revealed that the impact of innovation on economic growth is very clear and therefore recommends that there should be a cultural and attitudinal change towards innovation technology considering the impact it has on economic growth.

Moradana, Rudra, Saurav, Kunal, Manju, and Debaleena (2017) examined the relationship between innovation and per capita growth in the long run among 19 European countries between 1989 and 2014. The work employed Granger causality test to establish the relationship and the causality among them. The findings of the results include both uni and bidirectional causality between innovation variables and per capita growth. Although the results vary from country to country depending on the innovation variable used for the country. It was therefore recommended that countries should pay attention to the role of innovation so as to be able to enhance per capita growth in the countries. This study under review did not establish the nature of relationship that exists between the variables and the causality test may be misleading.

Dmitriev, Drigo, Kalinicheva, Shadoba, Ozherelieva and Matyushkina (2016) investigated the relationship between the different types of growth and innovation. The work placed emphasis on the effect of innovation on Schaumpeterian creative destruction on economic growth. The study came to the conclusion that ability to build and practical use of innovation is an essential requirement for economic growth. The findings also revealed that the cross-country differences in terms of growth and innovation are responsible for the degree of inequality and income distribution.

Pece, Simona, and Salisteanu (2015) investigated an analysis of the long run economic impact of innovation potentials in some Eutopean countries, such as Poland, Czech Republic and Hungry. The study employed the multiple regression technique for the analysis. The findings revealed that there is a positive relationship between innovation variables and economic growth. The data were not subjected to unit root test, it may be possible that the regression results are spurious.

Iwaisako and Futagami (2013) investigated how patient protection affects economic growth in an endogenous growth model, where innovation and capital accumulation are the driving forces of economic growth. The model revealed that stronger patent protection increases the profit flow obtained by innovation but reduces the factor demand for capital. As a result, innovation is accelerated but discourages capital accumulation, and because of the negative effect on economic growth through reducing capital accumulation, strengthening patent protection may then impede economic growth.

Browyn (2011) conducted an investigation on the relationship between innovation and productivity among firms in Finland. Using a cross sectional data and the findings revealed there exists some positive relationship between innovation and revenue productivity but the impact on process innovation is still very ambiguous.

Shqipe and Veland (2010) examined the different types of innovation or avenues by which companies can achieve innovation at the level of organization and further analysed the channel by which that can be achieved, by looking at their products and services and selling strategies. Their work established the fact that innovation is essential for economic growth and innovation is essential for value creation, employment and it will lead to higher level of competitiveness among different companies.

Birgitte and Björn (1997) in a study of how innovations affect economic growth concluded that the main contribution from the systems of innovation approach to growth theory lies in its emphasis of the importance of institutions and institutional change and especially in the focus on interactions between institutional, organizational and technical change as the basic source of growth. Their findings show that, policy makers who intend to stimulate growth by supporting innovations, the focus should be on designing and implementing institutional changes which continuously supports technical and organizational learning and innovation. This systems of innovation approach is not to assume away the role of institutions and institutional change nor treat them exogenous. On the contrary, these factors are at the very heart of the economic process; they define the character of the economic problem for the actors and shape the whole process of growth.

III. Theoretical framework

This work is hinged on the integration of both the Neo-classical and endogenous growth models of Solow-Swan (1956) and Romer (1986), Lucas (1988) and Robelo (1991) respectively. The combination of the theories showed that in order to sustain growth, there must be a continuous process of technological change to offset diminishing marginal returns to capital stock accumulation. The emphasis of the endogenous model is how growth can be enhanced by increasing both labour and capital productivity, without leading to diminishing returns and this could be achieved though innovation. The general framework of economic growth can be presented using the neoclassical production function.

$$Y = f(L, K, T) \quad [1]$$

Where Y is the output or GDP, L is the labour input, K is the capital input and T is the level of technology.

We can then state the functional form of our model adapted from the works of Pece, Simona and Salisteanu (2015) and Moradana, Rudra, Saurav, Kunal, Manju, and Debaleena (2017) where they modelled economic growth as a function of innovation variables. This work will employ the Information and Computer Technology (ICT) as the innovation variable that will be used.

The functional specification of our growth model is then given as:

RGDP = f (ICT, GCEX) [2]

where RGDP is the real GDP, ICT is the index of creative innovation and GCEX is government capital expenditure.Since this work is aimed at comparing the effectiveness of innovation and fiscal policy measures on growth.

3.1 Methodology and Model specification

This work employs a Vector Autoregressive (VAR) model to capture the interrelationships among the variables. A VAR model enables all the variables to be treated as endogenous to find out the effect of each of the variables on the others.

Following the work of Quenouille (1957) who investigated the Vector Autoregression of order p (VAR(p)), we can express the VAR model as:

$$Z_t = \boldsymbol{B}_1 Z_{t-1} + \ldots + \boldsymbol{B}_p Z_{t-p} + e_t \quad \ldots \quad [3]$$

where Z_t and e_t are n x 1 vectors and Bj are n x n matrices and e_t satisfying the following conditions:

E(e_t) = 0; the mean of the error term is zero

E($e_t e_t^{'}$) = Ω; the contemporaneous covariance matrix of error terms is Ω (a $k \times k$ positive-semi definite matrix).

E($e_t e_{t-k}^{'}$) =0; for any non-zero k — there is no correlation across time; in particular, no serial correlation in individual error terms

Equation (1) specifies that any series depends on the past history of all the n series through their lagged values.

More generally, we can specify the VAR (p) model in a matrix format where p = 1, in a two variable model:

$Y = BZ + U$ … [4]

$$\begin{bmatrix} y_{1,t} \\ y_{2,t} \end{bmatrix} = \begin{bmatrix} c_{1t} \\ c_2 \end{bmatrix} + \begin{bmatrix} a_{1,1} & a_{1,2} \\ a_{2,1} & a_{2,2} \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \end{bmatrix} + \begin{bmatrix} e_{1,t} \\ e_{2,t} \end{bmatrix} \quad \ldots \quad [5]$$

Expression (3) can be written in a system of equations as:

$y_{1,t} = c_{1t} + a_{1,1}y_{1,t-1} + a_{1,2}y_{2,t-1} + e_{1,t}$ … [6]

$y_{2,t} = c_2 + a_{2,1}y_{1,t-1} + a_{2,2}y_{2,t-1} + e_{2,t}$ … [7]

We can therefore state the functional VAR relationships of this work as follows:

$RGDP_t = f(GCE_t, ICT_t)$,,, [8]

$RGDP_t = \beta_1 + \beta_2 RGDP_{t-1} + \beta_3 GCE_{t-1} + \beta_4 ICT_{t-1} + \mu_{t1}$ … [9]

$GCE_t = \delta_1 + \delta_2 GCE_{t-1} + \delta_3 RGDP_{t-1} + \delta_4 ICT_{t-1} + \mu_{t2}$ [10]

$ICT_t = \theta_1 + \theta_2 ICT_{t-1} + \theta_3 RGDP_{t-1} + \theta_4 GCE_{t-1} + \mu_{t3}$ … [11]

Where RGDP is the real Gross Domestic Product, GCE is total government capital expenditure, ICT is Information and Computer technology, a proxy for innovation.

3.2 Data Collection and Sources

The data is secondary in nature. Data on government expenditure, Gross Domestic Productwere obtained from Central Bank of Nigeria Statistical Bulletin, several issues. The scope of the data is quarterly data from Q12008 to Q42017. Quarterly data was used due to the availability of data on ICT from 2008.

The data were subjected to pretests of unit root and cointegration tests. This is to confirm the order of integration of the variables and to find out if there is any long run relationship among the variables. Impulse Response function was employed to check the effects of a shock in government expenditure and innovation on GDP.

IV. Presentation and Analysis of Results

4.1 Unit root tests

The data for each variable was subjected to unit root tests using Augmented Dickey Fuller and Phillip Peron tests and the results show that all the variables are stationary at first difference as presented in table 4.1.

Table 4.1: Unit Root tests results

Phillip Peron					
	At Level		**At First Difference**		
	t-Statistic	**Prob.**	**t-Statistic**	**Prob.**	**Order of Integration**
GDP	-1.272	0.6328	-6.767	0.0000	I(1)
GCEX	-1.8071	0.3717	-3.3333	0.0202	I(1)
ICT	-0.9507	0.761	-6.1157	0.0000	I(1)
Augmented Dickey Fuller					
	t-Statistic	**Prob.**	**t-Statistic**	**Prob.**	**Order of Integration**
GDP	-1.1944	0.6672	-6.8247	0.0000	I(1)
GCEX	-2.7971	0.0693	-4.9574	0.0100	I(1)
ICT	-0.9371	0.7656	-6.1158	0.0000	I(1)

Source: Computed by author with Eviews 10

4.2 Lag selection

The lag selection criterion indicated that lag 1 should be chosen.

4.3 Cointegration Tests

The cointegration tests were carried out and it indicated no cointegrating equation among the variables as indicated in the table 4.2.

Table 4.2: Cointegration test results

Trace test				
Hypothesized		**Trace Statistic**	**0.05 Critical Value**	**Prob.**
No. of CE(s)	**Eigenvalue**			

None	0.431428	48.5516	69.81889	0.6993
At most 1	0.294189	27.09574	47.85613	0.8506
At most 2	0.192265	13.85624	29.79707	0.8486
At most 3	0.089422	5.742451	15.49471	0.7257
At most 4	0.055823	2.182782	3.841466	0.1396
Max-Eigen test				
Hypothesized		**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.**
No. of CE(s)	**Eigenvalue**			
None	0.431428	21.45586	33.87687	0.6496
At most 1	0.294189	13.2395	27.58434	0.8713
At most 2	0.192265	8.113788	21.13162	0.8966
At most 3	0.089422	3.559669	14.2646	0.9027
At most 4	0.055823	2.182782	3.841466	0.1396

Source: Computed by author with Eviews 10

4.4 Estimation of VAR, IRF and FEVD

The VAR estimate was carried out and the impulse response was computed as presented in figure 4.1. The first figure above shows the response of GDP to a shock in ICT. A shock to ICT generates a response which began in the positive region and declined steadily from period one to period 4, when it gradually began to rise, howbeit, in the negative region. It finally entered the positive region after the seventh period. This is perhaps due to the fact that ICT development is still very low in the country and has not been able to positively affect GDP.

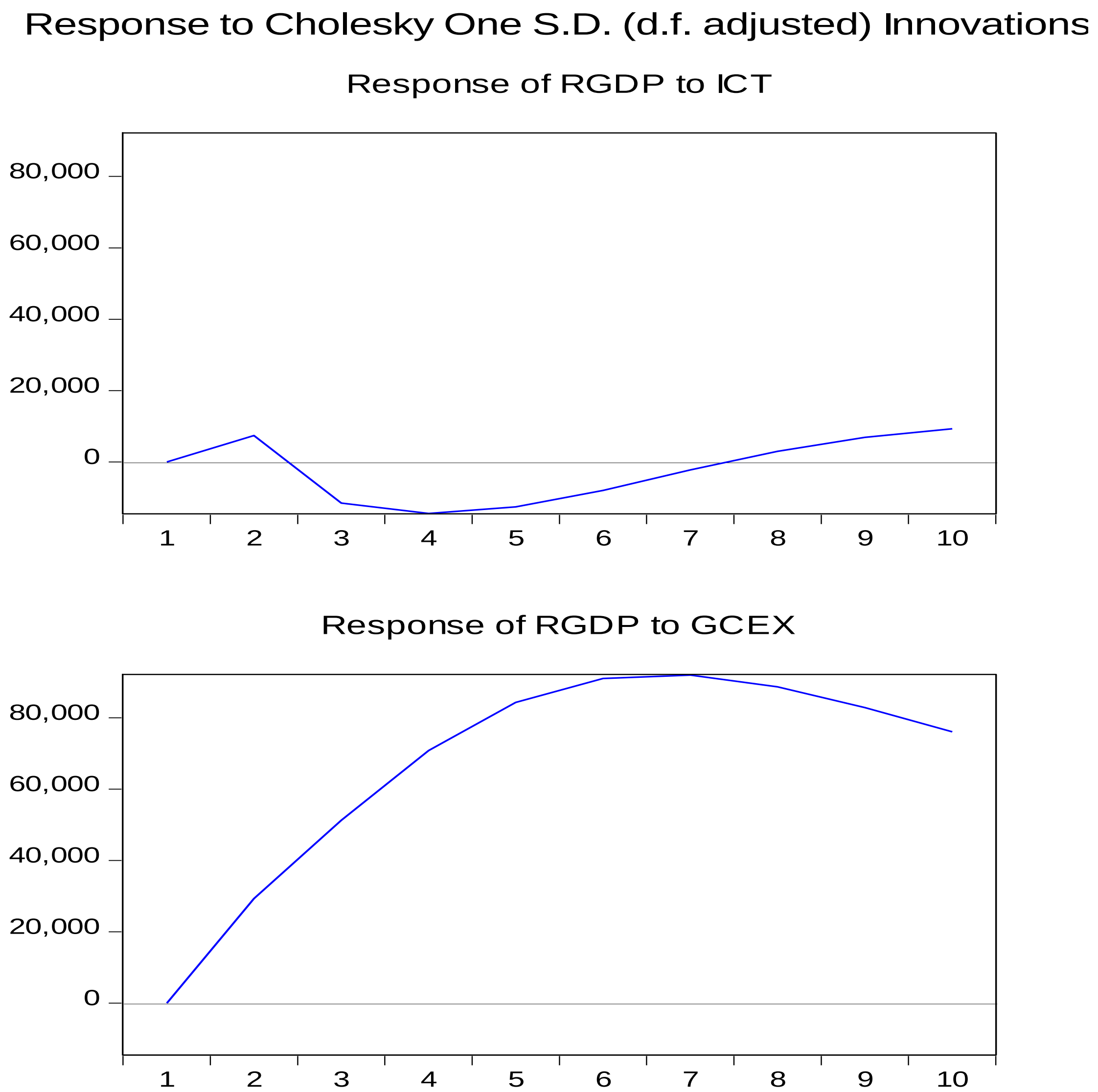

Figure 4.1: Response Function of RGDP to ICT and GCE

Source: Computed by author with Eviews 10

The second figure in figure 4.1 showed that total government capital expenditure exerted a positive impact on GDP growth all through the time under consideration. The response of GDP to GCEX is positive but at a decreasing rate and finally began to decline at period seven, howbeit, in the positive region.

The overall relative effectiveness of innovation and fiscal policy on economic growth can be measured by the level of impact each of the variables has on the real GDP. Impulse response function showed that GCEX has more positive impact on GDP growth than ICT.

Table 4.3: Variance Decomposition of RGDP:

Variance Decomposition of RGDP:				
Period	S.E.	RGDP	ICT	GCEX
1	520914.4	100.0000	0.0000	0.0000
2	702776	99.815	0.011054	0.173949
3	840731	99.4797	0.026475	0.493826
4	955289.2	99.02411	0.043234	0.932661
5	1050791	98.53538	0.050173	1.414449
6	1131505	98.08425	0.048218	1.867535

7	1200387	97.70978	0.043194	2.247021
8	1259815	97.42433	0.039777	2.535893
9	1311743	97.22218	0.039473	2.738343
10	1357730	97.08837	0.041498	2.870134
Cholesky Ordering: RGDP ICT GCEX				

Source: Computed by author with Eviews 10

The second IRF on GCE shows that GDP responds positively to a shock in government expenditure. It rose from year one to the tenth year and remained significant. The variance decomposition table (table 4.3) clearly showed the contributions of GCEXand ICT to the variations in GDP. The contribution of ICT to GDP growth was less than 1 percent all through the period. However, the contribution of capital expenditure to GDP growth was less than 3 percent, just a little higher than that of ICT.

From period one, ICT contributes nothing to GDP and rose to 0.04 percent in period 10 and subsequently. This indicates that over a 10 period interval, only about 0.04 percent of changes in GDP is attributable to changes in innovation. This contribution is not significant, although positive. This positive relationship implies that innovation should be able to drive GDP in the longer horizon.

On the other hand, government capital expenditure contributed about 2.9 percent to variations in GDP all through the time horizon. This contribution is positive but not significant too.

4.5 Granger Causality

The estimates of the VAR model were tested for causality in the VAR environment. The decision criteria are that if the P-value of the joint lag values of the independent variables is less than 5%, then we conclude that they both can cause the dependent variable. From table 4.4, both ICT and GCEX cannot granger cause GDP. Both of them cannot granger cause GDP.

Table 4.4: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: RGDP			
Excluded	Chi-sq	df	Prob.
ICT	0.207225	2	0.9016
GCEX	0.302572	2	0.8596
All	0.343799	4	0.9868

Source: Computed by author with Eviews 10

The implication of the IRF, FEVD results is that government capital expenditure is more potent to influence GDP and that means that fiscal policy is relatively more potent in affecting economic growth in Nigeria.

4.5 Residual Diagnostic Tests

The errors in the VAR model were subjected to diagnostic tests and it was found that there was no serial correlation since the P-value is greater than 5% level as shown in table 5, the residuals are not normally distributed but they are homoscedastic. The overall residual tests is indicative of a good model.

Table 4.5: Residual Diagnostic tests

Diagnostic tests	**Prob. Value**
Serial Correlation LM test	0.5377
Normality: Jarque Bera test	0.0000
Heterosckedasticity test	0.4424

Source: Computed by author with eviews 10

V. Summary and Policy Recommendations

This work has been able to display the theoretical and empirical relationship between innovation, fiscal policy and economic growth. The findings have shown that fiscal policy has more positive and significant relationship with GDP and the variations in GDP can be more attributable to variations in fiscal policy. It has also been shown that none of fiscal policy and ICT can granger cause GDP. All these findings simply indicate that fiscal policy is affects GDP more than ICT and therefore is more potent in affecting economic growth in Nigeria.

The policy implications of these findings demonstrate the need to:

i. Embark on a more rigorous and deliberate capital expenditure that is capable of driving economic growth positively, such as expenditure on infrastructures, education, health, etc.

ii. Theoretically, innovation has the potential of boosting economic growth if more efforts can be geared towards developing innovation technologies. More improvement in Research and Development, Patent rights, and so on will be avenues to boosting innovation technologies.

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