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An Investigation of the Impact of Foreign Direct Investment on Economic Growth in Nigeria: A Rigorous Approach

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Abstract
The work at hand makes the proposition that in-depth or rigorous analyses are required to investigate the impact of foreign direct investment (FDI) on the economic growth and development of Nigeria. Currently, development literatures are fraught with a single regression model that pretends to predict the complex interplay between growth variables as well as the manifold and intractable regression problems that plague ordinary least squares (OLS) estimates. We posit that the pragmatic, observant, delicate, curious and refinement spirit, common among experimental scientists, should be cultivated by FDI-growth empirical analysts to arrive at time and researchers invariant results. Using the data from one of the publications (Abu and Echegbulu, 2011) which employed only a single equation model in their FDI-growth studies, we demonstrate that rigorous tests of significance vis-a-vis several models are needed to arrive at a correct, clear and indisputable conclusion on the linkage between FDI and economic progress.

1. INTRODUCTION AND PROBLEM

While we admit that the impact of FDI on the economy of Nigeria is disputable, we are concerned about the way some empirical literatures conduct their investigations. Our review of the empirical literatures suggests that the lack of definitive conclusion on the role of FDI in Nigeria economy is traceable to methodology rather than sample issues.

The general method used is OLS technique. It is such a fundamental and essential tool that Gujarati (2004) interestingly pictured it as the bread-and-butter tool of econometrics. The upside of the method, however, lies in the numerous intractable regression problems that are associated with its estimates. The two major problems are autocorrelation and multicollinearity. The parameter estimates are not only biased but the associated student t-test statistics and F-distribution test are also unreliable in the presence of autocorrelation. The commonest way of detecting it is by using the widely celebrated Durbin-Watson (DW) test statistics. But Andren (2007) find that DW test applicability is dependent on the number of observations used as well as the values of the explanatory variables used in the regression. There is, thus, no precise critical value for the DW test statistic unlike t and F test statistic that have definite critical values. This is evident from the Durbin-Watson decision table that maps a range of limits within which one might speculate autocorrelation and some boundaries within which the test statistic is of no use as it fails out rightly to detect whether there is autocorrelation or not. This is, of course, distressing, considering the number of authors that rely on it and the serious implications of autocorrelation and consequently, the importance of its detection and correction in regression analysis.

Although regression result that contains autocorrelation is described as nonsense or spurious regression (Gujarati, 2004), some researchers (e.g. Ayanwele, 2007; Okon et al., 2011, Adofu, 2010, Ugwuegbe et al., 2013) conduct their analyses on the impact of FDI on the economic growth in Nigeria without detecting/correcting for autocorrelation in their result. Expectedly, such results might lead to misleading policy recommendation.

There are a number of approaches that can be used to overcome the problem of autocorrelation. The two common methods are by the use of instrumental variables or by adopting simultaneous equation approach. The choice of instrument arises if there is simultaneity problem. In that case, the OLS estimates are inefficient and inconsistent. If it can be shown that GDP and FDI are two simultaneous variables that are better connected using simultaneous equation, then the use of instrument is justified. What are these instruments?

First, it should be noted that the reason that guide the choice of instrument is to overcome autocorrelation which usually arise when the dependent variable correlate with the error term. Instrument used should thus be good at predicting FDI without correlating with the simultaneous dependent variable of interest (GDP in our case). Lensink and Morrisy (2001) admit that finding such instrument is problematic.

Aside the regression problems associated with OLS techniques; nonstationarity of data is a problem inherent in some econometric variable. Conducting an OLS analysis without testing for the presence of unit root is an indication that authors are probably unaware of the implications of nonstationarity of data in econometrics. Co-integration and granger causality tests are other important tests which are, disturbingly, just gaining currency among Nigeria FDI-growth investigators.

How about the time lag between FDI injection and the economic growth response time? This is, apparently, an exotic topic to Nigeria FDI-development researchers. Many authors are content with the traditional OLS that use current values of growth variables. But when the time lag between FDI registration in Nigeria and the actual operation as well as the time taken for the FDI to start exerting significant effects on the Nigeria economy are

taken into consideration, one tends to doubt the submission of such works. Otepola (2002) and Badeji and Abayomi (2011) are examples of works that used the current values of FDI and thus, arrive a negative conclusion.

In spite of this array of issues in FDI-growth related studies, almost every new paper boasts of its readiness to settle the controversy among researchers on whether FDI inhibits or promotes the economic growth of Nigeria. Obviously, settling such an age long dispute is tasking and requires holistic OLS regression techniques as well as econometric theories in respect to the parameters of interest. This is the ambition of the present paper.

In order to drive our point home regarding the literature gap or pitfalls of the existing FDI-growth related papers with respect to methodology, we will not introduce a new data. Rather, we will revisit already existing works and use one of the papers as well as its data as a case study.

2. LITERATURE REVIEW

FDI is an investment made to acquire a lasting management interest (normally 10% of voting sock) in a business enterprise operating in a country other than that of the investors defined according to residency (World Bank, 1996). There are, nonetheless, other definitions of FDI. This is because it is a complex field as it touches almost all facets of human endeavour. Consequently, its definition as well as its usefulness depends on the investing multinational corporations (MNCs) or the recipient/host country positions. The present review will focus more on the relevance of FDI to the Nigeria economy.

Two schools of thought exist with a strong wall of partition separating them. On one side are the pro-foreign international schools that see FDI as adding new resources in terms of capital, technology, managerial skill and technical know-how, productivity gains and so on to the host economy. They regard FDI as potent enough to improve the prevailing efficiency in the productive sector, stimulate change for faster economic growth, create jobs, faster growth, and improve the distribution of income by bidding up wages in the host economics.

On the other side of the wall are the opposing dependency school drawing their arrangement from Marist dependency theory. They doubt whether FDI – which do soak up local financial resources for their own profits – can bring about industrialization because foreign investors see host economics as merely serving the interest of their home countries in supplying basic needs for their companies. This schools view foreign investors as "imperialistic predators" that specialize in exploiting the entire globe for the sake of corporate few as well as creating a wet of political and economic dependence among nations to the detriment of the weaker ones. This group thought that foreign investors set artificial prices to extract excessive profits, make insufficient transfer of technology at too high cost, crowds-out domestic investment and exert serious strains on the balance of payment of the host country.

Robu (2010) assert that FDI is usually sought by countries that are going through the transition period and/or those that face severe structural unemployment. This is the situation of Nigeria. Aremu (1997) noted that Nigeria as one of the developing countries of the world, has adopted a number of measures aimed at accelerating growth and development in the domestic economy. One of such measures is FDI attraction. The realization of the importance of FDI had informed the radical and pragmatic economic reforms introduced since the mid-1980s by the Nigeria government. According to Ojo (1998), the reforms were designed to increase the attractiveness of Nigeria's investment opportunities and foster the growing confidence in the economy so as to encourage foreign investors in the Nigeria. The reforms resulted in the adoption of liberal and market-oriented economic policies, the stimulation of increased private sector participation and the elimination of bureaucratic obstacles which hinders private sector investments and long-term profitable business operations in Nigeria. One of the targets of these reforms is to encourage the existence of foreign MNCs and other private investors in some strategic sectors of the Nigeria economy like the oil industry, banking industry, communication industry and others. Since the enthronement of democracy in 1999, the government of Nigeria has taken a number of measures necessary to woo foreign investors in the country. Some of these measures include the repeal of laws that are inimical to the foreign investment growth, promulgation of investment laws, various overseas trips for image laundry by some presidents among others. Umah (2007) asserts that the Nigeria government has instituted various institutions, policies and laws aimed at encouraging foreign investors.

These efforts have not been in vain as the country has witnessed amazing inflow of FDI in the recent times (Adofu, 2010). But whether FDI plays the acclaimed role of pushing the economy forward is a topic that is currently generating a dramatic wave among researchers and economic law makers. The policymakers do not have much analytical tool to assess the performance of FDI in Nigeria economy. They generally add their voice by citing other countries of the world that actively engage in FDI and thus, hopefully, argue that FDI might be playing the same role in Nigeria's economy. They rather look forward to the empirical analyst to show, them the way forward.

But the empirical literatures do not have one voice as well. Some of the authors that find positive linkages between FDI and economic development in Nigeria are Aluko (1961), Brown (1962), Oyaide (1977), Obinna (1983), Ariyo (1998), Chete (1998), Anyanwu (1998), Oseghale and Amenkhienan (1987), Okodu (2009). Others such as Oyinlola (1995), Badeji and Abayomi (2011) and Otepola (2002) argue that FDI retard economic

growth in Nigeria. Amidst those who report positive connections are those that find that the contribution is statistically insignificant (e.g. Ayanwele, 1997; Adofu, 2010) and as such frown at, according to Adofu (2010), "undue attention" given to FDI in Nigeria. The implication of the conflicting economic advice that arises from these multifarious results is palpable.

The question that hangs on every lips at this stage is what is responsible for this contradictions and what could be the way out of the dilemma. But section one already blamed methodology as well as OLS regression problems as the kingpin that upsets the apple cart.

The next section will attempt to illustrate how superficial methodology has contributed to the confusion about the place of FDI on the economy of Nigeria. One of the papers that submit that FDI has positive but insignificant impact on Nigeria economy will be used as a case study. If investment is, indeed, the most development indicator that determines the economic growth of a country, then FDI and domestic investment data need be rigorously investigated in order to draw a definite and unbiased conclusion that could have true policy impact.

3 DATA SOURCE AND METHODOLOGY

3.1 DATA SOURCE

The data is taken from the recently published work of Abu and Echegbulu (2011). The authors use the data to examine the impact of FDI on economic growth in Nigeria.

3.2 METHODOLOGY

3.2.1 INTRODUCTION

Due to the indeterministic nature as well as the complex interplay between the economic growth variables, research methodology is of great importance to the economist. This is because the results and conclusions drawn from the research depend greatly on the method adopted. There is, thus, a need for a researcher to understand and hence, explain in details, the various techniques employed in a particular study. This will give some other person the room to assess the validity of the researcher's claim. This is the main focus of this section.

3.2.1.1 CONCEPTUAL FRAMEWORK AND DESCRIPTION OF VARIABLES

This section intends to highlight the nature and measurement of these economic growth variables around which the whole study revolves while the next section concentrates on the methodology of analysis of these variables. The chief corner-stone among these variables are FDI and GDP and they are, therefore, considered first.

(i) FDI: Tadaro (1999) defines FDI as investment by large multinational corporations with headquarters in the developed nation of the world. To buttress the definition, Makola (2003) noted that FDI is the primary means of transfer of private capital (i.e. physical or financial), technology, personnel and access to brand names and marketing advantage. Viewed as a private investment, some authors (e.g. Adofu, 2010) refer to it as private foreign direct investment (FPI). Amadi (2002) explains that FDI is not just an international transfer of capital but rather, the extension of enterprise from its home country which involves flows of capital, technology and entrepreneurial skills to the host country where they are combined with local factors in the production of goods for local and for export markets (Root,1984).

Still on the definition of FDI as a strong world development indicator, one of the pioneering study on FDI, Hymer (1960), described FDI as asset transfer by the formation of subsidiaries or affiliates abroad, without lots of control. The summary of these definitions is that FDI means asset (capital, technology, managerial abilities) transfer from the developed to the developing world. This is the reason why FDI is regarded as an important world development yardstick.

(ii) MARKET SIZE AND ECONOMIC GROWTH: GDP is taken as a measure of both market size and economic growth. GDP itself refers to the monetary measure of the total market value of all final goods and services (total output) produced within a country in one year. Lipsey (1986) defines economic growth as a positive trend in the nation's total output over long term. Thus economic growth implies sustained increase in GDP for a long time. Dolan et al. (1991) and Katerina et al. (2004) submit that economic growth is most frequently expressed in terms of GDP; taken as a measure of the economy's total monetary output of goods and service. Factors that determine whether Multinational Enterprises (MNEs) that engage in market seeking FDI invest in a country are the host country's market size and economic growth, both of which are represented by GDP in the present work.

Since FDI is expected to have positive effect on the economic growth of Nigeria, other economic variables that are known to influence the economic development of the nation are included in the present models. Understandably, factors that correlate with GDP may equally have a link with FDI.

(iii) EXPORT (EXP): This refers to the amount of goods export to other countries per annum. It is a good indicator of economic progress and is expect to be positively connected with GDP growth.

(iv) DOMESTIC INVESTMENT (DI)

This is the most strategic factor that determines the economic growth of any country. It is believed to be the main key that increases the level of economic productivity of a nation. Both theoretical and empirical literatures indicate a strong correlation between domestic investment and economic development. This parameter is quite relevant in FDI-growth studies since FDI is just a means of bridging the investment gap that exist in poor

economics like Nigeria. Inclusion of the variable in this study may clarify the connection between the two and growth in Nigeria. Proxies for investment are usually somewhat difficult to find though domestic savings are often taken as a good proxy. The authors that initially investigated the present data Abu and Echegbulu (2011) used gross fixed capital formation as a proxy for domestic investment.

3.3 MODEL SPECIFICATIONS

In order to estimate the relationship between FDI and economic growth in Nigeria, the present study will employ single equation models. Ordinary least-square (OLS) method will be used in the present investigation. OLS is, simply, a method of fitting the best straight line to the sample of XY observations.

The central goal of the present work is to investigate the role of FDI on the growth economy of Nigeria. Other economic variables believed to impact on growth are also included for completion and comparison purposes. A function that relates these parameters can be of the form:

$$GDP = f(FDI, DI, EXP) \quad (1)$$

3.3.1 STADNARDIZED REGRESSION MODEL

Regression on standardized variable has a number of advantages over the traditional regression model (A regression that contains the intercept term). In order to exploit these advantages, standardized model (equation 3) is also run.

$$GDP_t = \beta_1 FDI_t + \beta_2 DI_t + \beta_3 EXP_t + u \quad (2)$$

3.3.2 LAGGED OLS VARIABLE MODEL

Gujarati (2004) asserts that time lag exists between some economic growth variables. Wilhelms and Witter (1998) equally emphasize the need for using the lagged values of the explanatory variables of economic growth data. It is believed that it takes one to six years for FDI projects to exert any significant effects on the economy of a country. This time lag accounts for registration to actual operation. Domestic investment and export are in-house gestures that may not require any time lag to impact on the economy. In order to account for this time lag, a model of the form is equally specified:

$$GDP_t = \beta_1 FDI_{t-i} + \beta_2 DI_t + \beta_3 EXP_t + u \quad (3)$$

where i=1,2,3,.....

$$\beta_1, \beta_2, \beta_3 \succ 0$$

3.3.3 SIMULTANEOUS EQUATION SYSTEMS

If there is a simultaneity problem between GDP and FDI, then simultaneous equation can be specified thus:

$$GDP_t = \beta_1 FDI_t + \beta_2 DI_t + \beta_3 EXP_t \quad (4)$$

$$FDI_t = \beta_1 GDP_t + \beta_2 EXP_t \quad (5)$$

3.4 GRANGER CAUSALITY

Although OLS results can establish the existence of a relationship between two data time series, it cannot explain the direction of the relationship. Since the future cannot predict the past, Granger causality test attempts to establish if changes in FDI precede changes in GDP, that is, FDI causes GDP and not GDP causing FDI. Given:

$$GDP_t = \beta_0 + \sum \beta_j GDP_{t-j} + \sum c_j FDI_{t-j} + u_t \quad (6)$$

$$FDI_t = \beta_0 + \sum \beta_j FDI_{t-j} + \sum c_j GDP_{t-j} + u_t \quad (7)$$

Equation 4 postulates that current GDP is related to past values of itself as well as that of FDI, and 5 postulates a similar behaviour for FDI. There are four implications for each of the equations. (i) $GDP \rightarrow FDI$ [GDP causes FDI, unilateral causality]; (ii) $FDI \rightarrow GDP$ [FDI causes GDP, unilateral causality]; (iii) $GDP \leftrightarrow FDI$ [feedback or bilateral causality]; and $GDP - FDI$ [independence].

The null hypothesis is $H_0 : \sum c_j = 0$, that is lagged FDI and GDP terms do not belong to equations 4 and 5 respectively. The symbol $GDP \leftrightarrow FDI$ implies bilateral causality and is explained thus: Bidirectional causality exists between GDP and FDI in the two equations above if the null hypotheses $H_0 : \sum c_j = 0$ for the two equations are rejected. The test of significance of the overall fit can be carried out with an F test while the number of lags can be chosen with AIC criteria. The above equations are for bivariate causality model. For a multivariate causality, other variables in the model will be included. The details of granger tests are explained in section 3.6

3.5 DETAILS OF ANALYSES

Section 3.3 specifies a number of models ranging from the usual OLS models to granger causality or lagged models. While the ordinary OLS (un-lagged models) is an old and familiar method common in the literatures,

other methods such as granger causality test (GCT), unit root test and co-integration test are yet at the infancy stage in the development literatures. Some investigators are in the habit of indicating, for instance, that they conducted GCT but one may have no idea what or how the test is conducted. This section intends to give some little details of these relatively new techniques before quoting the final results in section 4.

3.5.1 UNIT ROOT TESTS

The results of FDI-economic growth can only be useful to the society if policy makers can accept the validity or significance of the results. In order to do any meaningful policy analyses with the OLS results, it is important to distinguish between correlations that arise from a sheer trend (spurious) and one associated with an underlying casual relationship. To achieve this, all the data used in the study are first tested for unit root (non-stationarity) by using the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) tests. Since our data cannot be mere noise, we assumed them to be stationary data with a constant only or stationary data with a constant and time trend. The results in Table 3.1 and 3.2 shows that all the variables except GDP are integrated of order one, I(1).

TABLE 3.1 UNIT ROOT TEST FOR STATIONARITY WITH CONSTANT ONLY

UNIT ROOT TEST FOR STATIONARITY WITH CONSTANT ONLY						
		LEVEL		1st Difference		
	Variables	DF	ADF	DF	ADF	Conc
1	LNGDP	-0.94	-1.16	-3.80**	-	I(1)
2	LNFDI	-0.75	-1.08	-3.36*	-	I(1)
3	LNDS	-1.25	-1.95	-4.3**	-	I(1)
4	LNEXP	-1.56	-1.57	-5.06**	-3.18	I(1)

Note: From CRITICAL DICKEY–FULLE table, 1% and 5% significance level for sample size less than 50 is given as -3.75 and -3.00 respectively. In this table, '**' and '*', represent 1% and 5% level of significance respectively.

TABLE 3.2 UNIT ROOT TEST FOR STATIONARITY WITH CONSTANT AND TIME TREND

UNIT ROOT TEST FOR STATIONARITY WITH CONSTANT AND TIME TREND						
		LEVEL		1st Difference		
	Variables	DF	ADF	DF	ADF	Conc
1	LNGDP	-1.96	-1.34	-3.71*	-	I(1)
2	LNFDI	-1.31	-2.20	-3.29*	-	I(1)
3	LNDS	-1.97	-1.85	-4.33*	-	I(1)
4	LNEXP	-3.28	-	-4.86**	-	I(1)

Note: From CRITICAL DICKEY–FULLE table, 1% and 5% significance level for sample size less than 50 is given as -4.38 and -3.60 respectively. In this table, '**' and '*', represent 1% and 5% level of significance respectively.

The implication of the presence of unit root is such that the regression result is spurious or nonsense result. This is why the above test is extremely necessary. The fact all the variables are stationary after the first difference is an indication of relatively high stability. Highly unstable time series data are still contain unit root even after the first difference.

3.6 GRANGER TEST (VECTOR AUTOREGRESSION MODEL (VAR).

Do past values of FDI help to explain the present values of GDP? Or do past values of FDI help to predict the present values of GDP? The test is conducted as follows. The first difference of GDP and FDI was taken resulting to the growth equation. The current GDP growth is regressed on all lagged GDP growth terms and other variables in the model, if any. The lagged FDI growth will not be included in this regression. This is called the restricted regression and from this, restricted residual sum of squares, RSS_R , is obtained. This is the first stage. The second stage involves re-running the first regression but including the lagged terms of FDI growth form. From this regression, the unrestricted sum of squares, RSS_{UR} , is obtained. The Akaike information is calculated using the formula below:

$$AIC = \ln(\frac{RSS_{UR}}{T}) + (\frac{2j}{T}) \qquad 8$$

where RSS_{UR} = error sum of squares of the unrestricted regression, T =current time, j = number of estimated parameters in the unrestricted regression.

The overall goodness of fit is measured by F values. The F value here is not, however, the normal F values embedded (F_{output}) in the regression packages. Instead, the F, generally referred to as F_{cal} in this project is

calculated from:

$$F_{cal} = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} \quad 9$$

Where: RSS_R = Restricted Sum of Square Residuals

RSS_{UR} = Unrestricted Sum of Square Residuals

m= Number of the lagged terms of the variable that is being tested for dependability. That is the parameter whose control on the depended variable is being investigated. n = number of observations, k = number of parameters estimated in the unrestricted regression. It is the F_{cal} that is used to test the goodness of fit of the regression. In order words, if F_{cal} of a regression is greater than the critical F-values for a regression of the type $FDI_t \rightarrow GDP_t$, then FDI is said to granger cause GDP and otherwise if not.

4. RESULTS AND DISCUSSIONS

It should be recalled that the target of this work is to undertake a rigorous analysis of an already investigated data. It should also be noted that the common practice among empirical literatures is to use one or two regression models in their studies. The publication under study (Abu and Echegbulu, 2011), for instance, uses only a model in their analysis and arrive at erroneous conclusion that FDI has no significant impact on FDI. Such single equation models are insufficient in the light of the numerous problems that plague both OLS regressions and econometric data. Admittedly, the number of econometric models and the various regression techniques employed in this study is not trivial. Settling the almost proverbial dispute among FDI-growth researchers is a formidable task that can only be satisfied by array of models and methods as attempted in this work.

Attempt is made, in order to make a meaningful investigation of the economic data, to test the significance or validity of our results. While a single linear or unlogged regression equation model is used as an indicator or a suggestive of the relationship between FDI and economic growth, several models such as logged, lagged and system of simultaneous equation models are employed to validate or test the significance of the suggested relationship. The results of the linear model that suggests the relationship between growth variables are presented in tables 4.1 and 4.2, other results presented in tables 4.3-4.8 are used to validate the result of table 4.2. This approach surely departs significantly from the conventional methodology of one or at most two regression equation models that characterize the Nigeria FDI-growth related publications.

4.1 DATA TREATMENT

One of the major demerits of OLS is its high susceptibility to measurement errors. And, ironically, measurement issues are potential problems inherent in economic data (see Tonia and Mararet, 2006 and the references therein). While other statistical tests like anova may not be influence by the presence of two or more outliers, a single outlier can seriously bias the result of OLS estimates. In order to avoid this, our data is first plotted in a scatter diagram to keep track of outliers. Appendix A shows that there is an outlier in the data. Specifically, domestic investment contains an outlier. The data was invested with and without the outlier. The results are respectively presented in tables 4.1 and 4.2. The effects of the outlier are evident in the results.

Another method of pre-processing or treating a data before feeding them into OLS packages is by standardizing the variables. Since economic data are generally biased with outliers or outbursts, feeding the raw data into the analysis package will only lead to garbage in garbage out.

4.2 STANDARDIZED OLS

While the traditional OLS contains the intercept term, the standardized OLS has no intercept term. Regression on standardized variables has some advantages over the ordinary OLS. Gujarati (2004) explains that all the variables in a regression are put on equal basis when the variables are standardized. The implication for this is that all the coefficients can be compared directly with one another. If the coefficient of one standardized regressor is larger than that of another standardized regressor appearing in the model, then the former contributes more relatively to the explanation of the regressand than the latter. The intercept term of a regression involving standardized regressand and regressors is always zero. And better still, such constant term is of secondary importance in FDI-growth studies since the primary objective is not to investigate the value of GDP when FDI is not being injected into the system. The results presented in this section are regressions on standardized variables.

4.2.1 STANDARDIZED OLS WITH OUTLIER

Even after standardizing the data, the effect of the outlier is still evident on the regression. The sign of the domestic investment is unexpectedly negative. The weight of the outlier on the statistical significant of the explanatory variables cannot, however, be determined here. We then removed the outlier and present the result in the next table for comparison.

TABLE 4.1. DEPENDENT VARIABLE: GDP (WITH OUTLIER)

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
FDI	0.26311	0.10300	2.55500	0.02052 *
DI	-0.20087	0.06616	-3.03600	0.00746 **
EXP	0.89026	0.10194	8.73300	1.08E-07 ***

Note: '***', '**', '*', and '.' imply significance at 0%, 0.1%, 1% and 5%.
Multiple R-squared: 0.9721, Adjusted R-squared: 0.9672,
F-statistic: 197.3, DW = 1.576109

4.2.2 STANDARDIZED OLS WITHOUT OUTLIER

It is surprising that the result of the regression without the outlier differs significantly from that with the outlier. Without the outlier, the sign of domestic investment became positive and more significant. The coefficient of FDI, however, became insignificant contrary to what the significant value it assumed in the previous table. One might be confused in the face of these two results.
With a wave of hand, it is easy to claim that domestic investment is wrongly sign in table 4.1 and one may go ahead to report and a positive and statistically significant coefficient of FDI. But table 4.2 introduces another confusion regarding the significance of the variables. This emphasizes the need for result validation.

TABLE 4.2. DEPENDENT VARIABLE: GDP (WITHOUT OUTLIER)

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
FDI	0.02002	0.07304	0.27400	0.78746
DI	0.45539	0.11129	4.09200	0.000851 ***
EXP	0.53222	0.08900	5.98000	1.92E-05 ***

Note: '***', '**', '*', and '.' imply significance at 0%, 0.1%, 1% and 5%.
Multiple R-squared: 0.988, Adjusted R-squared: 0.9858,
F-statistic: 439.5, DW= 2.794023

4.3 VALIDATION OF RESULTS

Wilhelms and Witter (1998) whose work is partly similar to ours submit that the robustness of unlogged regression results could be tested by using the semi-logged (linear-log) and the logged forms of the variables. The next two tables attempt to test the robustness of the results above by using the logged forms of the variables. The results of the logged forms are presented in the two tables below. The effects of the outlier are again striking. The negative sign remains but the contribution is no longer significant. Again, without further analysis, a researcher may merely use the conventional concept of approri expectation to claim that domestic investment is wrongly signed. But since prior knowledge of the sign of a variable does not account for the statistical significance of variables, the next option is to conclude that domestic investment in Nigeria do not exert significant influence on the economic growth of Nigeria.

Table 4.4 presents a different scenario still. The coefficient of DI is not only highly significant but shows a larger impact on the economy of Nigeria. Which of the results should be correct? Before attempting a choice, it is important to note that the authors who first investigated the data conducted their investigation without accounting for the outlier or any form of data treatment.
One often neglected but most important regression problem is autocorrelation. The presence of it in a regression can change both the sign and affect the statistical significance of the regressors. The DW statistics in tables 4.1, 4.2, 4.3 and 4.4 are respectively 1.576109, 2.794023, 1.554885 and 1.730752. Since DW statistic of about 2 is without autocorrelation, table 4.4 is comparatively free from autocorrelation and thus relatively unbiased regression result.
If the result in table 4.4 is valid, then it would imply that FDI, domestic investment and export have positive and significant effect on the economy of Nigeria. This is in contrast with the submissions of Abu and Echegbulu (2011) who first analysed the data. Is there another way of validating the result of table 4.4? Causality test will be the best bet.

TABLE 4.3. DEPENDENT VARIABLE: LNGDP (WITH OUTLIER)

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
LNFDI	0.30895	0.09098	3.39600	0.00344 **
LNDI	-0.02463	0.09279	-0.26500	0.793880
LNEXP	0.71957	0.10622	6.77400	3.25E-06 ***

Note: '***', '**', '*', and '.' imply significance at 0%, 0.1%, 1% and 5%.
Multiple R-squared: 0.9865, Adjusted R-squared: 0.9841,
F-statistic: 412.6, DW=1.554885

TABLE 4.4. DEPENDENT VARIABLE: LNGDP (WITHOUT OUTLIER)

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
LNFDI	0.18491	0.06831	2.70700	0.01554 *
LNDI	0.50638	0.13111	3.86200	0.00138 **
LNEXP	0.31562	0.11387	2.77200	0.01361 *

Note: '***', '**', '*', and '.' imply significance at 0%, 0.1%, 1% and 5%.
Multiple R-squared: 0.9935, Adjusted R-squared: 0.9923,
F-statistic: 812.8, DW = 1.730752

4.3 .1 MULTIVARIATE GRANGER CAUSALITY TEST (VECTOR AUTOREGRESSIVE MODEL)

If FDI, domestic investment and export exert significant influence on the growth economy of Nigeria, then granger causality test will not only confirm this but will equally show the direction of causality. Table 4.5 interesting shows strong causalities between the variables and hence confirm that the coefficients of all the variables in table 4.4 are indeed significant. In consonance with table 4.4, the causality test also shows that domestic investment makes the highest contribution to economic growth followed by export and lastly FDI. The similarities between the two results are buttresses our stand on the need for rigorous analysis in FDI-growth investigations. While in-depth analysis conducted by the different authors on the same data will lead to the same findings, superficial analyses or methodology applied on the same data will produce results that vary proportionally with the number of authors. And all those erroneous or spurious regression results will increase the debate on the role of FDI on the economy.

We note in passing that granger test is another means of investigating the determinants of FDI in an economy. It is evident from table 4.5 that GDP, domestic investment and export are all determinants of FDI in the country. Causality test may not, however, tell if the relationship between FDI and these variables are negative or positive.

4.3.2 LAGGED OLS

Another way of validating the result of table 4.4 is by the use of lagged values of FDI. As indicated earlier, the lagged values of FDI are needed to explain the role of foreign investment on the economy of a nation. While domestic investment and export may not need any time lag to impact on the economy of Nigeria, FDI, due to the official bottle neck or red tape from registration to actual operations requires incubation or gestation period to start influencing the economy. This is tested using the lag values of FDI in tables 4.6 and 4.7. The results also reflect what is presented in table 4.4. The impact of FDI on the economy is statistically significant. The contribution of domestic investment is more significant than that of FDI and export in the same spirit of table 4.4. The fact that lagged values of FDI is a good instrumental FDI variable is worthy of recognition in tables 4.6 and 4.7. The DW statistics in the two tables are just about 2, an indication of the absence of autocorrelation in the regression.

It might be surprising, however, to observe that the contribution of export to the economic growth is not significant at 2 year period. One might be tempted to doubt the result. But a closer inspection of table 4.5 validates the result. There is no causality between GDP and export at 2 lag. Absence of causality might imply independence (Gujarati, 2004) between two variables or it could mean that the two variables are contemporaneous (Dominick and Derrick, 2002). In the light of this, the insignificant role of export at 2 lags could imply that they are independent at that lag length as indicated by causality test. On the order hand, the lack of causality between GDP and DI could imply contemporaneous relationship.

The F-statistics and R-square values in the two tables are worth a special note. The huge size of F-values is an indication that these are the best regression fit. This is also reflected in the R-square values – 99.99% of variation in GDP is explained by the regressors. This also underscores the need for instrumental variables in FDI-growth studies. It equally indicates that there might be simultaneity bias between GDP and FDI. Should that be the case, then the result of table 4.4 would be doubtful. Another way of circumventing endogeneity problem is by the use of simultaneous equation.

TABLE 4. 5: MULTIVARIATE GRANGER CAUSALITY TEST (VAR)
(VARIABLES IN LOG FORM)

REGRESSION TYPE	NO OF LAGS	F_{cal}	Critical F values			
			1%	5%	10%	df_1/df_2
$FDI \rightarrow GDP$	1	0.004	7.82	4.26	2.93	1/24
$GDP \rightarrow FDI$	1	5.685**	7.82	4.26	2.93	1/24
$EXP \rightarrow GDP$	1	9.009***	7.82	4.26	2.93	1/24
$GDP \rightarrow EXP$	1	5.377**	7.82	4.26	2.93	1/24
$EXP \rightarrow FDI$	1	9.009***	7.82	4.26	2.93	1/24
$FDI \rightarrow EXP$	1	4.931**	7.82	4.26	2.93	1/24
$DI \rightarrow GDP$	1	0.361	7.82	4.26	2.93	1/24
$GDP \rightarrow DI$	1	1.221	7.82	4.26	2.93	1/24
$FDI \rightarrow DI$	1	6.773**	7.82	4.26	2.93	1/24
$DI \rightarrow FDI$	1	50.048***	7.82	4.26	2.93	1/24
$DI \rightarrow EXP$	1	15.687***	7.82	4.26	2.93	1/24
$EXP \rightarrow DI$	1	15.687***	7.82	4.26	2.93	1/24
$FDI \rightarrow GDP$	2	3.693*	8.65	4.46	3.11	2/8
$GDP \rightarrow FDI$	2	2.491	8.65	4.46	3.11	2/8
$EXP \rightarrow GDP$	2	2.695	8.65	4.46	3.11	2/8
$GDP \rightarrow EXP$	2	1.268	8.65	4.46	3.11	2/8
$EXP \rightarrow FDI$	2	3.485*	8.65	4.46	3.11	2/8
$FDI \rightarrow EXP$	2	3.916*	8.65	4.46	3.11	2/8
$DI \rightarrow GDP$	2	2.199	8.65	4.46	3.11	2/8
$GDP \rightarrow DI$	2	2.012	8.65	4.46	3.11	2/8
$FDI \rightarrow DI$	2	1.150	8.65	4.46	3.11	2/8
$DI \rightarrow FDI$	2	11.427***	8.65	4.46	3.11	2/8
$DI \rightarrow EXP$	2	5.452**	8.65	4.46	3.11	2/8
$EXP \rightarrow DI$	2	5.452**	8.65	4.46	3.11	2/8
$FDI \rightarrow GDP$	3	45.182***	16.7	6.59	4.19	3/4
$GDP \rightarrow FDI$	3	5.553*	16.7	6.59	4.19	3/4
$EXP \rightarrow GDP$	3	93.803***	16.7	6.59	4.19	3/4
$GDP \rightarrow EXP$	3	5.543*	16.7	6.59	4.19	3/4
$EXP \rightarrow FDI$	3	4.096	16.7	6.59	4.19	3/4
$FDI \rightarrow EXP$	3	6.945**	16.7	6.59	4.19	3/4
$DI \rightarrow GDP$	3	213.41***	16.7	6.59	4.19	3/4
$GDP \rightarrow DI$	3	6.328*	16.7	6.59	4.19	3/4
$FDI \rightarrow DI$	3	0.914	16.7	6.59	4.19	3/4
$DI \rightarrow FDI$	3	3.961	16.7	6.59	4.19	3/4
$DI \rightarrow EXP$	3	2.469	16.7	6.59	4.19	3/4
$EXP \rightarrow DI$	3	2.469	16.7	6.59	4.19	3/4

Note: '***', '**', and '*', represent significant at 1%, 5%, and 10% level of significance. The fraction, df_1/df_2, represents degrees of freedom (numerator and denominator respectively). It is used to reference upper (critical) points of the F Distribution table.

TABLE 4.6. DEPENDENT VARIABLE: GDP_t

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
FDI_{t-1}	0.26874	0.07345	3.65900	0.00289 **
DI_t	0.72772	0.10047	7.24300	6.52E-06 ***
EXP_t	0.20067	0.09004	2.22900	0.04410 *

Multiple R-squared: 0.9999, Adjusted R-squared: 0.9999,
F-statistic: 70030, DW = 2.187317

TABLE 4.7. DEPENDENT VARIABLE: GDP_t

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
FDI_{t-2}	0.26962	0.07884	3.42000	0.00456 **
DI_t	0.09797	0.09797	8.37900	1.34E-06 ***
EXP_t	0.10390	0.10390	1.15100	0.27048

Multiple R-squared: 0.9999, Adjusted R-squared: 0.9999,
F-statistic: 65540, DW=2.186305

4.3.3 HAUSMAN SPECIFICATION TEST

It is important to test if the GDP and FDI equations (section 3.3.3) are really simultaneous before attempting to solve them simultaneously. Hausman (1976) develops an ingenious technique for testing if simultaneity exists in a specified model. The test is as follows (assuming GDP and FDI are the endogenous variables): First regress GDP on FDI. Then FDI will be regressed on all the exogenous variables in the simultaneous model. This will give the reduced form of FDI (FDI_R). FDI is then regressed on FDIR. If u_1 and u_2 are respectively the residuals from the first regression (GDP on FDI) and the second regression (FDI on FDI_R), then simultaneity test is based on the statistical significance of the regression:

$$GDP_t = \beta_1 FDI_R + \beta_1 u_1 + B_2 u_2 \quad (10)$$

The null hypothesis of simultaneity is accepted if: (i) the correlation between u_1 and u_2 is zero; (ii) the coefficient of u_1 is statistically zero; and (iii) if the coefficient of FDIR is different from that of u_1. The result of our specification is:

$$GDP_t = -0.62 FDI_R - 0.62 u_1 - 0.784 u_2 \quad (11)$$

The correlation coefficient of u_1 and u_2 is 0.601 at p-level of 0%. The coefficient of u_1 is statistically significant even at p-level of 0% while it is evident that the coefficient of FDI_R and that of u_1 are the same. There is, thus, simultaneity bias between GDP and FDI. The next section, therefore, attempts a simultaneous equation solution for GDP and FDI.

4.5.2 SOLUTION OF THE SIMULTANEOUS EQUATION

The first stage is to regress FDI on export and DI in order to get the reduced FDI_R of FDI. This reduced form is given as:

$FDI_R = 0.1601 EXP - 0.7881 DI$. The second stage involves regressing GDP on the reduced FDI and DI. The result is presented in the next table. It is evident from the result that the contribution of FDI and domestic investment to economic growth is highly significant, re-affirming the result of table 4.4. The

contribution of domestic investment remains higher in two tables. The contribution of FDI is more significant in the simultaneous equation model than the single equation regression model (table 4.4).

TABLE 4.8. DEPENDENT VARIABLE: GDP

VARIABLES	COEFFICIENT	STD ERROR	T-VALUES	P-VALUE
FDI_R	2.12080	0.34470	6.15300	1.06E-05 ***
DI	3.09480	0.34470	8.97900	7.33E-08 ***

Multiple R-squared: 0.988, Adjusted R-squared: 0.9865, F-statistic: 697.2

We summarize this section by noting that in-depth analyses are required to settle the controversy on the place of FDI on economic growth in Nigeria as illustrated in this section. Admittedly, the approach employed to validate a single linear regression results are sufficient and the results so consistent that it is difficult, if not completely impossible, to doubt the submissions of the present work.

5. CONCLUSION

The present discussion suggests that the age long disagreement among empirical FDI-growth studies requires a re-assessment with respect to OLS techniques and model specifications. Time lag is also of great relevance to FDI projects and economic growth. Doubtlessly, the results of the present report are significantly differently from that of the paper that originally analysed the same data. While they find that FDI and domestic savings do not exact significant effects on the economy, our rigorous approach confirm that both make significant contribution on the growth economy of Nigeria. It is evident that what makes the difference is methodology. This paper (Adofu, 2010), has only been used as a case study. We conclude that other works, especially those that find negative or statistically insignificant impact like Adofu (2010), need be critically re-examined to reduce the number of voices who would exclude Nigeria from the ongoing trade liberalization and economic globalization that is sweeping across almost all the nations of the world.

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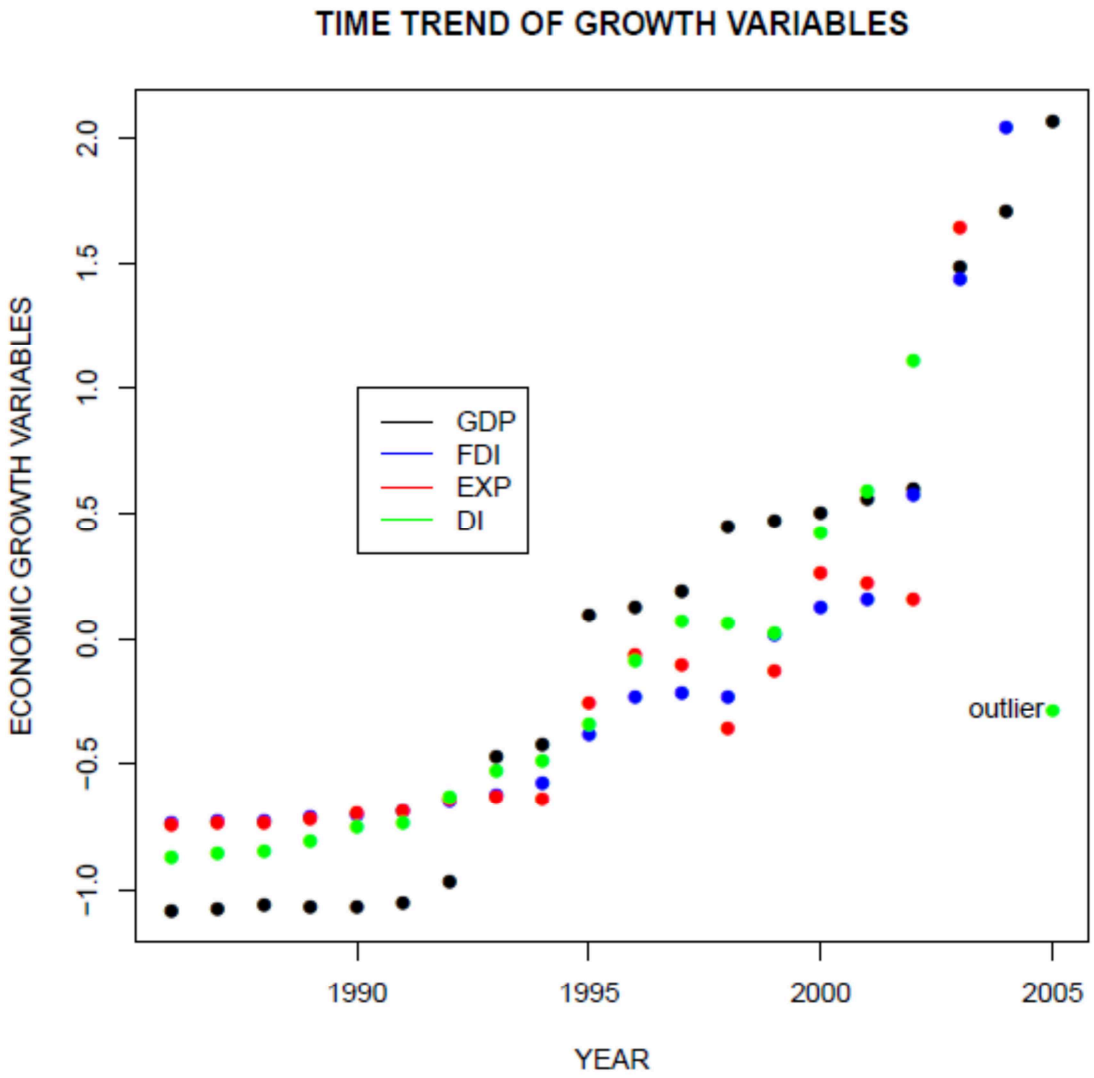
Appendix A


TIME TREND OF GROWTH VARIABLES
ECONOMIC GROWTH VARIABLES
YEAR
GDP
FDI
EXP
DI
outlier
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
1990
1995
2000
2005