The FDI-Growth Hypothesis: A VAR Model for Nigeria

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ABSTRACT

The objective of this study was to examine the causal relationship between foreign direct investment and economic growth in Nigeria using annual data covering the period 1970 to 2002. The study employed the Granger causality procedure to test the direction of causality between foreign direct investment and economic growth for the Nigerian economy. The endogenous production function was derived to accommodate foreign investment and other domestic policies that could influence growth and foreign investment. The study found a one-way causality between from foreign direct investment to economic growth. The implication arising from this study is that Nigeria should adopt policy whereby FDI is attracted to promote economic growth.

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1 INTRODUCTION

There has been an increase in debate about the economic impact of foreign investment in the Nigerian economy as in other host developing economies. This debate assumes special importance in view of recent changes in the composition and direction of foreign direct investment (FDI), and liberalization of government policies towards FDI in developing economies, including Nigeria.

According to Lall (1998), after a decline of about 4 per cent each year during 1980-1985, the volume and share of FDI to developing economies has risen significantly. During the later part of the 1980s, FDI in developing economies increased by 17 per cent each year. In 1993, total FDI to developing countries was $70 billion, and the value of inflows of FDI increased by 125 per cent in the first three years of the decade. In Nigeria, between 1970 and 2002, foreign direct investment inflow into the country averaged 17 per cent each year. This was an improvement over an average of 12 per cent between 1970 and 1980.

The inflows of FDI to developing countries often raise the question of how these inflows affect these economies.

Thus, the objective of this study is to examine the direction of causality between foreign direct investment and economic growth within the framework of endogenous growth model for Nigeria using data from 1970 to 2002. This analysis is crucial for a developing economy like Nigeria for some reasons. First, the consensus view on FDI seems to be that there is a positive association between FDI inflows and developing country growth. However, the results of existing empirical studies on the causality based on different econometric techniques or data sets in general give mixed results. Second, many empirical investigations have been carried out in Nigeria on the determinants as well as the impact of foreign private investment on economic growth (see, for example, (Ekpo & Egwaikhide (1998); Chete (1998); Olomola & Akinbobola (2000)). However, studies that examine the causality between them are sparse. This study therefore intends to fill this gap.

The rest of the paper is organized as follows. Section 2 presents some theoretical and empirical issues. Section 3 presents the model specification and estimation technique. Section 4 presents the empirical results, while section 5 concludes.

2 FDI AND GROWTH: SOME THEORETICAL AND EMPIRICAL ISSUES

The theoretical foundation for empirical studies on FDI and growth derives from either the neo-classical models of growth or the endogenous growth models. In neoclassical models of growth, FDI increases the volume of investment and/or its efficiency, and leads to long-term level effects and medium-term, transitional increases in growth. The new endogenous growth models consider long run growth as a function of technological progress, and provide a framework in which FDI can permanently increase the rate of growth in the host economy through technology transfer, diffusion, and spillover effects.

The endogenous growth literature argued that the role of rapid growth of foreign trade in stimulating a higher learning coefficient is twofold. First the import-export sector serves as a vehicle for technology transfer through the importation of technologically advanced capital goods (Bardhan & Lewis, 1970; Chen, 1979; Khang, 1987; Keesing, 1987). Second, rising exports help to relieve the foreign exchange constraints. A country's ability to import technologically superior capital goods is augmented directly by rising export receipts and indirectly by the higher flow of foreign credits and direct investment.

Evidence in the existing empirical literature on the causal relationship between FDI and economic growth is rather inconclusive. Most of these studies conduct traditional causality tests, using single time series or panel data. In the latter case, the relationship between FDI and growth is assumed to be homogeneous across countries. In this section, we briefly review select papers that have investigated the causal relationship between FDI and growth and note several drawbacks of these traditional approaches. The empirical evidence on the relationship between foreign direct investment and growth can be categorized into two groups. On the one hand, there are those that focused on the role of multinational firms and on the determinants of FDI. On the other hand, there are those that apply causality tests based on time series data to examine the nature of causal relationship between FDI and output growth.

Most studies have applied the Granger causality procedure (Karikari, 1992; Saltz, 1992; de Mello, 1996; Pfaffermayr, 1994 and United Nations, 1993). There are some problems with most of these studies. Many of these studies adopted arbitrary choice of lag lengths (Kasibhatla & Sawhney, 1996; and Jordan *et al*., 1997). Also, some of them applied cross sectional data. The problem with this approach is that it implicitly a common economic structure and similar production function across different countries. This, however, may not hold true, and further, economic growth of a country is influenced not only by FDI and other factors inputs, but also by a host of domestic policies such as monetary, fiscal and external policies (Jordan *et al*., 1997).

In attempt to take care of these methodological problems, Ericsson and Irandoust (2001) adopted the Vector Autoregression (VAR) approach to examine the causal effects between FDI growth and output growth for four OECD countries. The countries included namely Denmark, Finland, Norway and Sweden. Using a multivariate VAR model including FDI, output and TFP growth and using the estimation techniques developed by Toda and Yamamoto (1995) and Yamada and Toda (1998), the authors failed to detect any causal relationship between FDI and output growth for Denmark and Finland. They however found a long-run uni-directional causal relationship running from FDI growth to GDP growth for Norway.

In another development, Chakraborty and Basu (2002) examined the link between FDI and output growth in India using a cointegration model with a vector error correction mechanism. Their studies concluded that Real GDP in India was not Granger caused by FDI and the causality runs more from real GDP to FDI. Earlier, Nyatepe-Coo (1998) assessed the contributions of FDI to economic growth in selected countries in Southeast Asia, Latin America and Sub-Saharan Africa covering the period 1963-1992. Based on the model of endogenous growth and following the work of Borensztein, De Gregorio and Lee (1995), Nyatepe-Coo constructed a model with growth as the dependent variable and FDI, human capital and a matrix of relative determinants (i.e. government consumption, trade policies, inflation and degree financial development) as independent variables. He found that FDI promotes economic growth in the majority of the 12 countries examined. He likewise found some evidence suggesting a direct relationship between foreign capital and economic growth.

Also, Liu, Burridge and Sinclair (2002) wherein they tested the existence of a long-run relationship among economic growth, foreign direct investment and trade in China. Using a cointegration framework with quarterly data for exports, imports, FDI and growth from 1981 to 1997, the research found the existence of a bi-directional causal relationship among FDI, growth and trade.

Although useful and illuminating, previous studies on causality between FDI and economic growth are biased due to the omission of variable phenomenon. In other words, they are bivariate in that they only focus on the relationship between FDI and economic growth. Economic theory indicates, however, that other variables, such as the degree of openness and domestic capital (including investment in human capital) are equally important in the determination of FDI and real output growth. Thus, bivariate models are potentially misspecified and may be flawed due to the omission-of-variable phenomenon. As a result, one would expect that both causality and cointegration tests would yield biased estimates or at best mixed results in these models (see Miller, 1991 and Darrat, 1994).

Therefore, in this paper, the intention is to re-examine the relationship between FDI and economic growth in the Nigerian context using a multivariate model in which other relevant factors (degree of openness, human capital and domestic physical capital) are allowed to exert their influence on the two time series (FDI and economic growth). Consequently, the present model explores the relationship among four variables, namely, real GDP growth (g_y), FDI growth (g_f), degree of openness (σ), domestic capital stock (g_d), and human capital stock (g_h).

3 MODEL

The theoretical model follows that of Ericsson and Irandoust, 2001; De Mello, 1997, 1999) where the production function is defined as:

$$Y = A\psi\,(K, L) \tag{1}$$

where *Y=output, A=efficiency, K=Physical capital and L=labor*. A, captures the variable influencing the level of productivity in the economy. It contains control and policy variables as well as technology. K is decomposed into domestic capital, K_d, and foreign capital, K_f , that is:

$$K = K_d + K_f \tag{2}$$

It is equally assumed that the recipient economy's stock of knowledge, H, depends on the level of domestic and foreign capital, such that:

$$H = \left[k_d \quad k_f^{\alpha}\right]^{\xi} \tag{3}$$

where $k_d=K_d/L$, *and* $k_f=K_f/L$, α and ξ are the marginal and inter-temporal elasticities of substitution between foreign and domestic capital stock respectively. Since foreign capital, k_f, enters the human capital definition, H, then it can be said that FDI affects the production function directly through its effects on capital, k_f, and indirectly through its effect on human capital, H. Thus, expressing equation (1) in per capita Cobb-Douglas production function, we have:

$$y = Ak_d^{\beta+\theta}k_f^{\alpha\theta} \tag{4}$$

where β is the share of domestic capital, which is assumed to be less than one, implying diminishing returns to domestic capital, $\theta=\xi(1-\beta)$, with $\xi>0$.
By taking the logarithm and time derivatives of equation (4), we have a general growth accounting equation of the form:

$$g_y = g_A + \left[\beta + \theta\right]g_d + \left[\alpha\theta\right]g_f \tag{5}$$

where g_y = per capita income growth;
g_A = total factor productivity growth;
g_d = growth of domestic capital stock;
g_f = growth of foreign capital stock.

In endogenous growth models, however, technology, A, the ultimate cause of growth evolves endogenously. It is not the consequence of a deliberate action by any economic agent. The models of Aghion and Howitt (1992), Grossman and Helpman (1990), and Romer (1990) all associated evolution of technology with a measurable input such as research and development expenditure, the number of scientists and engineers, etc. The level of technology, which is fundamental to the endogenous growth model, is assumed to be of the form;

$$g_A = \ln A + \pi(\sigma) \tag{6}$$

where Φ is a set of other economic and non-economic policy variables that affects growth. Given equation (6), our estimating model becomes:

$$g_y = \ln A + \pi(\sigma) + [\beta + \theta]g_d + [\alpha\theta]g_f \tag{7}$$

where InA is assumed to be the constant and Φ the degree of openness. Unlike Ericsson and Irandoust (2001), however, we do not assume that gd, is constant.

As opposed to the limited contribution that the neoclassical growth theory accredits to FDI, the endogenous growth literature points out that, FDI can not only contribute to economic growth through capital formation and through trade (Bloomstrom *et al*., 1996; Borensztien *et al*., 1995) but also do so through the augmentation of the level of knowledge through labor training and skill acquisition (de Mello, 1997, 1999) and organizational arrangements.

METHOD OF ESTIMATION

The first step is to examine the time series properties of the variables under consideration using the Augmented Dickey Fuller (ADF) tests. If the variables are non-stationary and integrated of order one, then they are cointegrated and they would have long-term co-movements evidenced by the number of cointegrating vectors. To determine the long run among the variables the Johansen co integration procedure is utilized (see Johansen 1991, and Johansen and Juselius 1990). The procedure involves the estimation of Vector Error Correction (VECM) in order to obtain the likelihood-ratios (LR) for the short-run relationship. The approach is set up as a vector auto regression (VAR) of non-stationary series:

$$\Delta Y = \Pi Y_{t-1} + i = \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-1} + \mu + v_t \tag{8}$$

Where $Y = [\sigma, g_y, g_d, g_f]$ and;

σ = degree of openness
g_y = per capita output growth
g_d = domestic investment growth
g_f = foreign direct investment growth

Δ is the difference operator that induces stationary; μ are the intercepts, and v_t is a vector of normally and independently distributed error terms, $v=[v_{1t}, v_{2t})'$. The model is assumed to be vector white noise, that is, v_t has mean zero, $E[v_t]=0$, and nonsingular covariance matrix $\Sigma_v = E[v_t v'_t]$ for all. The coefficient matrix Π, is also referred to as the long-run impact matrix, contains information about the stationarity of the variables and the long-run relationship between them. The existence of co integrating vectors (v) implies Π is rank-deficient (Kul and Khan, 1999). If Π is of full rank, that is, $r=p$, then all variables in Y are themselves stationary with no common stochastic trend or long-run relationship exists between them. On the other hand, if Π is a full matrix, that is, r=0, then co integration is not also present but variables in Y are non-stationary. In this case, the usual VAR model is specified. The number of significant non-zero eigen values determines the number of co integrating vectors in the system. However, if Π is of rank $r(0<r< 2)$, then there are r linear combinations of variables in X that are stationary. This is an indication that the variables are co-integrated in the long run with r co integrating vectors. In this case, Π can be decomposed as $\Pi=\varphi z'$, while $\varphi_{(5xr)}$ and $z_{(5xr)}$;.

If the variables are cointegrated, then there exists at least Granger causality in at least one direction. However, according to Granger (1988) the conventional VAR analysis cannot be employed given cointegration, therefore, the following specification is used to establish the feedback effect:

$$\begin{bmatrix} g_y \\ \sigma \\ g_f \end{bmatrix} = \begin{pmatrix} a_y \\ a_a \\ a_f \end{pmatrix} + \sum_{i=1}^{k} \left(\beta_i \begin{pmatrix} g_{yt-1} \\ \sigma_{t-1} \\ g_{ft-1} \end{pmatrix} \right) + \begin{bmatrix} \Psi_1 z_{1,t-1} \\ \Psi_1 z_{2,t-1} \\ \Psi_1 z_{3,t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{gy} \\ \varepsilon_{gA} \\ \varepsilon_{gf} \end{bmatrix} \tag{9}$$

The rows of z are interpreted as the distinct cointegrating vectors. The Ω(L) are finite polynomials in the lag operator. The Ψ's are the error-correction coefficients (loading factors) which indicate the speed of adjustment towards long-run equilibrium. This approach is particularly attractive over the standard VAR because it permits temporary causality to emerge from (1) the sum of the lagged coefficients of the explanatory differenced variable and (2) the coefficient of the error-correction term.

In addition, the VECM allows causality to emerge even if the coefficients of the lagged differences of the explanatory variable are not jointly significant (see Miller and Russek, 1990; Miller, 1991; Engle and Granger, 1987; Granger, 1983; and, Anoruo and Ahmad, 2001). It must be pointed out that the standard Granger-causality test omits the additional channel of influence (z_{t-1}).

In the model, the null hypothesis of non-causality from FDI to economic growth is rejected if either the group coefficient on the FDI is significant or the coefficient of lagged error-correction term is negative and statistically significant. The statistical significance of d^k_{21} (L) and Φ is exposed through joint F and t-tests. The F-test of the explanatory variables (in first differences) indicates the "short-run" causal effects, whereas the long-run causal relationship is implied through the significance or otherwise of the t-test of the lagged error-correction term that contains the long-run information.

4 DATA AND ESTIMATION RESULTS

Data and data sources

Annual values for real GDP growth per capita, export growth, foreign investment growth were used. The sample point for the variables is 1970-2002. The degree of openness was measured by the export growth. Alternative measure of degree of openness such as (export+import)/GDP proved insignificant in the analysis. The data for the variables were extracted from the Statistical Bulletin published by the Central Bank of Nigeria.

Empirical results

The results of the ADF test for the variables in level and first difference form are presented in tables 4.1 and 4.2. Table 4.1 gives results without trend while Table 4. 2 present the results with trend. As evidenced from Table 4.1, all the variables are non-stationary at levels both with and without trend. However, without trend, only foreign capital variable was not stationary. Output growth per capita and degree of openness measured by export growth were stationary after first differencing them. On the other hand, when the trend variable was introduced into the ADF equation, only export growth was stationary after first differencing. Output growth and foreign capital demonstrated non-stationarity

Table 4.1 ADF test (without trend)

Variable	Level	First difference
g_y	0.22	-2.98
σ	0.07	-3.44
g_f	0.17	-2.68

critical levels at 5%=-2.970

Table 4.2 ADF test (with trend)

Variable	Level	First difference
g_y	-1.64	-2.92
σ	-1.72	-3.87
g_f	-1.90	-2.72

Critical levels at 5%=-3.58

However, the results of the Augmented Dickey Fuller (ADF) test cannot be said to be conclusive evidence of the time series properties of the data. This is because the ADF test has been described as being too restrictive given the assumption of independently and identically distributed guassian processes. Therefore, the Philip-Perron z-test was employed to further examine the time series properties of the variables. The results are stated in tables 4.3 and 4.4 below, without and with trend variable respectively.

Table 4.3 PP test (without trend)

Variable	Level	First difference
g_y	0.60	-3.60
σ	0.36	-4.27
g_f	0.11	-4.39

critical levels at 5%=-2.970

Table 4.4 PP test (with trend)

Variable	Level	First difference
g_y	-1.63	-3.61
σ	-1.45	-4.25
g_f	-1.72	-4.43

Critical levels at 5%=-3.58

As evidenced from tables 4.3 and 4.4, all the variables are stationary after first differences with trend and without trend. Thus, the next step is to test for cointegration. The Johansen (1988) and Johansen and Juselius (1990) multivariate cointegration test was adopted. It should be noted that given that the cointegration test is sensitive to the choice of lag length, and following Judge *et al*. (1988), Akaike's AIC criterion was used to determine the lag length. The model with the smallest AIC was the one with two lag lengths. The results of the maximal eigen values and those of trace tests are in Table 4.5.

Table 4.5 Johansen cointegration test results (Trace statistics under H_o:rank=r)

Model	Trace statistics		Maximal eigenvalue statistics	
	r=0	r≤1	r=0	r≤1
VAR= (g_y, σ, g_f)	51.6**	30.1	32.1**	12.5

** denotes rejection of the hypothesis at 1 per cent level of significance

The respective 5 per cent critical values for the trace tests are 39.68 and 32.6 respectively for r=0 and r=1. The 5 per cent critical values for the maximal eigenvalues are 21.1 and 17.88 for r=0 and r=1 respectively. ** indicate rejection of the null at 5 per cent level.

As reported in Table 4.5 above, both the trace test and maximal eigenvalues statistics shows that the VAR for Nigeria has only one cointegrating vector. This implies that a long run relationship exists among the variables. Here, the first cointegrating vector is normalized as the per capita output growth. Thus, the result of the cointegrating vector is given as:

$$g_y = -3.21 + \underset{(0.149)}{0.33\sigma} + \underset{(0.012)}{0.08g_f}$$

The standard errors are in parenthesis. The cointegrating vector shows that long-run per capita output growth in positively and significantly related to foreign capital growth and export growth. The coefficients suggest that an increase in FDI by 1 million Naira would raise economic growth by 0.08 per cent. This finding supports de Mello (1999) that foreign direct investment has a positive impact on output growth.

The results of the Granger causality tests are reported in Table 4.6. The significance of F-statistic for the lag values of the independent variable indicates the presence of unidirectional short-run causal effect running from the independent variable to the dependent variable. The estimated results show positive short-run causal effect running from FDI to economic growth.

In the FDI equation, there is no causal relationship from economic growth to FDI as the F-statistic was insignificant. In the long run, there is unidirectional causality running from FDI to GDP as evidenced in the output equation in Table 4.5 above. Thus it can be concluded that for the Nigerian data over the period of 1970 to 2002, there is uni-directional causality between FDI and economic growth and the causal direction is from FDI to economic growth.

Table 4.6 Causality results based on vector error-correction model (VECM)

Dependent variable	**F-Statistics**		**t-statistics**
Model	GDP (g_y)	FDI(g_f)	z_{t-1}
GDP	4.14		-3.93
FDI	0.65		0.26

This result confirms other studies for developing countries. UNCTAD (1999) for example found that past inflows of FDI causes growth in less developed countries. Similar findings were obtained by Borensztein *et al*. (1998) for 69 LDCs and Bloomstron Lipsey and Zejan (1994) for developing countries. It is also confirmed similar findings for advanced countries such as Belgium, Denmark, Germany, France and the U.K where foreign direct investment Granger causes economic growth (Mondatsu, 2001).

The observations for Nigeria's recent economic development fit into the FDI-led growth hypothesis. An important implication of this finding is that since FDI Granger causes growth, this weakens the arguments for restricting FDI in Nigeria. The role of multinational corporations in Nigeria's economic development over the years cannot be overemphasized. The inflow of foreign investment induces and creates the production from other industries, which can be measured by the backward linkage index. Magbagbeola (1998) in a study argued that the advantage Nigeria have derived over the years from foreign investment has been the increase in income, increase in the productivity of labor and other external economies as foreign exchange, managerial ability, personnel and technological knowledge, administrative efficiency and innovations in products.

5 CONCLUDING REMARKS

This paper used the Granger causality procedure to test the direction of causality between foreign direct investment and economic growth for the Nigerian economy. The test was based upon annual time series data in a five variable VAR model. The results indicate that there is a one-way causality between FDI and economic growth with the direction of causation running from FDI to economic growth. The Nigerian economy has benefited from the inflow of foreign investment into the country over the years which has enable Nigeria to achieve economic growth.

The implication arising from this study is that Nigeria should adopt policy whereby FDI is attracted to promote economic growth. Such policies could include granting concessional terms to foreign investors. Moreover, good governance, with fiscal and monetary accountability and transparency, and eschewing corruption, would instill confidence in foreign investors and thus feel willing to direct investment to the country. Moreover, political stability and less of religious and ethnic riots could stimulate foreign investment as it is a crucial variable in Nigeria's growth prospects.

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