Review

A Dynamic Panel Analysis of the Determinants of Economic Growth in Some Selected Sub-Sahara African Countries

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The preoccupation of this study is to examine the cointegrating relationship and direction of causality between trade openness, foreign direct investment, domestic investment, government expenditure and economic growth for a panel of 17 highly aid-dependent Sub-Sahara African countries, for the period 1975-2010. The selected countries are: Benin, Botswana, Burkina Faso, Cameroon, Cote d'Ivoire, Gabon, Gambia, Ghana, Kenya, Liberia, Malawi, Nigeria, Senegal, Sierra Leone, Togo, Zambia and Zimbabwe. The Kao and the Johansen-Fisher panel cointegration tests identify cointegrating relationships between the panel variables. The long-run effects of trade openness, domestic investment and government expenditure on economic growth are significantly positive. However, the long-run effect of foreign direct investment on economic growth is insignificant. The direction of causality between the panel variables is also examined by performing the Engle and Granger (1987) test on the first-differenced variables. Since the long-run elasticities of economic growth with respect to trade openness, domestic investment and government expenditure are greater than the short-run elasticities, it is recommended that greater openness to international trade and increases in domestic investment and government expenditure will expectedly raise the economic growth of the Sub-Sahara African countries.

Keywords: Dynamic panel, Trade openness, Investment, Economic growth.

INTRODUCTION

Many African countries implemented liberal trade policies to attract foreign direct investment (FDI) for economic growth and development since the mid-1970s. While the impact of FDI on economic growth has been largely positive for many of the Sub-Sahara African economies, the role of foreign direct investment in economic growth of Sub Saharan Africa has been a contentious issue for many years. According to a World Bank report published in 2008, half the population in Sub-Saharan Africa was still living below the poverty line in 2005. This appears unbelievable considering the amount of development assistance received by the Sub Sahara African countries from external sources over the years. It is evident in previous studies that the more foreign direct invesment the Sub Sahara African countries have received, the more aid dependent they have become. As growth faltered despite massive aid flows, most of the Sub Sahara African countries have been wallowing in a debt trap. This present study provides answers to the following questions: (i) do the liberal trade policy measures and

foreign direct investment have had any significant positive impact on economic growth of Sub Sahara African countries?; and (ii) is there any significant long-run relationship between trade openness, foreign direct investment, domestic investment and economic growth for the Sub-Sahara African countries?

The objective of this study, therefore, is to examine both the cointegrating relationship and the direction of causality between trade openness, foreign direct investment, domestic investment, government expenditure and economic growth for a panel of 17 Sub Sahara African countries for the period 1975-2010. The rest of the article is organized into four sections. Following this introduction is section two that reviews the relevant literature; Section three discusses the data issues and model specification; Section four articulates the empirical analysis and finally section five concludes with a summary of the main findings and policy implications.

A Review of Relevant Literature

A vast body of empirical literature has investigated the relationship between economic growth and its determinants for developing countries and the results are mixed and inconclusive. Amongst numerous studies, Onafowara and Owoye (1998), Foster (2008) and Yavari and Mohseni (2012) reported a positive long-run correlation between trade openness and economic growth. While Murty et al. (1994), Levy (1998) and Gounder (2001) reported positive relationship between foreign direct invesment and economic growth, Nyoni (1998) and Mallik (2008) observed a negative impact of foreign direct investment on economic growth. Burke and Ahmadi-Esfahani (2006) reported lack of any significant relationship between foreign direct investment and economic growth. Domestic investment and government expenditure are highly correlated with economic growth. Studies that have reported a positive relationship between domestic investment and economic growth include Firebaugh (1992), Ciftciouglu and Begovic (2008) and Adams (2009). While Loizides and Vamvoukas (2005) found a positive relationship between government expenditure and economic growth, Hsieh and Lai (1994) reported lack of evidence of any definite relationship between the two.

Trade openness has also been used extensively in the economic growth literature as a major determinant of growth performance (Artelaris *et al.,* 2007). Openness affects economic growth through several channels such as exploitation of comparative advantage, technology transfer and diffusion of knowledge, increasing scale economies and exposure to competition. It has been found that economies that are more open to trade and capital flows have higher GDP per capita and grow faster.

Foreign direct investment has recently played a crucial role of internationalizing economic activity and as a primary source of technology transfer and economic growth. The empirical literature examining the impact of FDI on growth has provided more-or-less consistent findings affirming a significant positive link between the two (Lensink and Morrissey, 2006).

Data Issues and Model Specification

This research makes use of annual time series data for a panel of 17 Sub Sahara African countries for the period 1975-2010. The variables used are per-capita real GDP (PGDP), trade openness (TOP), foreign direct investment (FDI), domestic investment (DOI), and government expenditure (GEX). Per-capita real GDP (PGDP) is measured in constant 2005 prices and exchange rates in US dollars and is used as a proxy for economic growth. Trade openness index measures the degree of trade liberalization and the index is constructed by dividing the sum of exports and imports of a region by the nominal GDP of that region (trade-to-GDP ratio). Foreign direct investment indicates cash flows as "net" disbursements received. Government expenditure is the overall government final consumption expenditure. Except per-capital real GDP, all the variables are measured in US dollars at current prices and current exchange rates and expressed as a percentage of nominal GDP. The data sources for all the variables are WDI, 2011 and UNCTAD Statistics, various issues.

The impact of trade openness, foreign direct investment, domestic investment, and government expenditure on economic growth for the panel of 17 Sub Sahara African countries is examined through the following model:

$$PGDP_{it} = A_0 TOP_{it}^{\alpha_1} FDI_{it}^{\alpha_2} DOI_{it}^{\alpha_3} GEX_{it}^{\alpha_4} e^{\varepsilon it} \qquad (1)$$

The logarithmic transformation of equation (1) is given by:
$$\ln PGDP_{it} = \alpha_0 + \alpha_1 \ln TOP_{it} + \alpha_2 \ln FDI_{it} + \alpha_3 \ln DOI_{it} + \alpha_4 \ln GEX_{it} + \varepsilon_{it} \quad (2)$$

Where, $\alpha_0 = \ln A_0$; i represents the ith country and t represents the time period under consideration. The parameters $\alpha_1, \alpha_2, \alpha_3 \text{ and } \alpha_4$ represent the long-run elasticities of PGDP with respect to TOP, FDI, DOI and GEX.

The dynamic relationship between trade openness, foreign direct investment, domestic investment, government expenditure and economic growth is examined in three stages. In the first stage, the stationarity of each panel variable is tested. If the variables are found to contain a unit root, then the long-run cointegrating relationship between the panel

Table 1. Panel Unit root tests

MODEL WITH CONSTANT AND TREND TERMS (AT LEVELS)								
	LLC	Prob.	IPS	Prob.	MW	Prob.	Choi	Prob.
lnPGDP	1.5862	0.8646	3.4482	1.0000	36.6925	0.8698	4.8003	1.0000
lnTOP	-1.0974	0.2814	-0.7565	0.1261	68.0237**	0.0342	-0.6537	0.1826
lnFDI	-12147	0.1726	-0.9621	1.0941	72.5675	0.1849	-0.8685	0.1446
lnDOI	2.6241	0.7994	0.4305	0.5824	66.7786	0.4186	0.7146	0.6873
lnGEX	2.0012	0.7410	1.4240	0.8784	54.8750	0.7024	2.1819	0.6542
MODEL WITH CONSTANT TERM ONLY (AT FIRST-DIFFERENCE)								
	LLC	Prob.	IPS	Prob.	MW	Prob.	Choi	Prob.
lnPGDP	-5.1485*	0.0000	-11.6150*	0.0000	258.7461*	0.0000	-8.6965*	0.0000
lnTOP	-18.0041*	0.0000	16.6781*	0.0001	394.6973*	0.0000	-12.2815*	0.0000
lnFDI	-21.3687*	0.0003	-22.6467*	0.0000	445.7252*	0.0000	-15.3981*	0.0000
lnDOI	-18.7619*	0.0001	-14.2034*	0.0000	513.6990*	0.0000	-19.7484**	0.0000
lnGEX	-16.2100*	0.0016	-22.5831*	0.0000	415.2060*	0.0000	-13.6210*	0.0005

Note: * and ** indicate significant at 1% level and 5% level, respectively.
Source: Author's calculation

Table 2. Panel Cointegration Test

Kao ADF Type Test				
	Test Statistic -4.1364**			Prob. 0.0000
Johansen Cointegration Test: Equation 1				
Cointegrating Equation	Fisher Statistic (Trace Test)	Prob.	Fisher Statistic (Max. Eigenvalue)	Prob.
none	461.63*	0.0000	251.36*	0.0000
at most 1	206.40*	0.0000	182.56*	0.0000
at most 2	164.81*	0.0010	73.87*	0.0641
at most 3	89.97*	0.0039	64.59	0.6815
Johansen Cointegration Test: Equation 2				
Cointegrating Equation	Fisher Statistic (Trace Test)	Prob.	Fisher Statistic (Max. Eigenvalue)	Prob.
none	301.60*	0.0001	217.45*	0.0000
at most 1	162.35*	0.0000	116.52*	0.0000
at most 2	215.05*	0.0000	81.17*	0.0164
at most 3	96.72**	0.0218	58.07*	0.5619

Note: * and ** indicate significant at 1% level and 5% level, respectively.
Source: Author's calculation.

variables is then examined. If a long-run relationship between the panel variables is found to exist, a panel vector error correction model is then estimated in order to determine the causal relationships between the variables. In the last stage, the short-run and the long-run elasticities of economic growth with respect to trade openness, foreign direct investment, domestic investment and government expenditure are also examined.

Dynamic Panel Analysis

Panel Unit Root Tests

In this study, four unit root tests are used in determining

the order of integration of the panel variables. These tests are: Levin, Lin and Chu (LLC, 2002), Im, Peasaran and Shin (IPS, 2003), Maddala and Wu (MW, 1999), and Choi (2006). Levin, Lin and Chu (LLC, 2002) is used in testing the null hypothesis of the existence of a unit root against the alternate hypothesis of no unit root. Im, Pesaran and Shin (IPS, 2003) is employed in testing the null hypothesis of the existence of a unit root in each series in the panel against the alternate hypothesis that some of the individual series may contain a unit root. However, in Maddala and Wu (MW, 1999), a Fisher-type test is explored which is nonparametric and also follows a chi-square distribution. The Maddala and Wu (MW, 1999) test, unlike IPS (2003), does not depend on the lag length in the individual Augmented Dickey Fuller (ADF)

Table 3. Granger Causality Test

	$\Delta\ln PGDP$	$\Delta\ln TOP$	$\Delta\ln FDI$	$\Delta\ln DOI$	$\Delta\ln GEX$	ECM
$\Delta\ln PGDP$	-	11.1215*** (0.0012)	2.6521 (0.1215)	0.4574 (0.3514)	1.1089 (0.2851)	2.7467*** (0.0173)
$\Delta\ln TOP$	9.3651*** (0.0031)	-	0.0172 (0.7928)	3.1387 (0.1326)	0.6475 (0.2810)	-2.5428 (0.0016)
$\Delta\ln FDI$	2.3490 (0.0483)	3.7577 (0.0895)	-	0.2478 (0.3525)	0.5130 (0.5838)	1.6149 (0.0748)
$\Delta\ln DOI$	1.4634 (0.1014)	11.8913*** (0.0002)	4.7710** (0.0454)	-	0.2152 (0.7403)	-2.7292** (0.0130)
$\Delta\ln GEX$	1.5714 (0.1096)	2.9817*** (0.0346)	0.1094 (0.5789)	0.3146 (0.2594)	-	-3.9829** (0.0028)

Source: Author's calculation.

Table 4. Short-Run Elasticity Coefficients

	$\Delta\ln TOP$	$\Delta\ln FDI$	$\Delta\ln DOI$	$\Delta\ln GEX$	ECM
Coefficient	-0.0115	0.0129***	0.0100	-0.0189	-0.0038**
Prob.	0.5143	0.0020	0.1601	0.1287	0.0456

Note: The reported values in parentheses are the probability-values of the test. ** and ***indicate significant at 5% level and at 10% level, respectively.
Source: Author's calculation.

regressions. Lastly, the Choi test is also performed. The results of the four panel unit root tests for each variable at both levels (constant and with trend) and first-difference (constant only) are shown in Table 1. It is evident in the result that all the panel variables are integrated of order one.

Panel Cointegration Analysis

Stemming from the unit root tests results that the panel variables are integrated of order one, the Kao (1999) ADF type test and the Johansen Fisher panel cointegration test as proposed by Maddala and Wu (1999) are performed to identify the cointegrating relationships between the panel variables. The tests are performed with one lag, and the results of the cointegration tests are presented in Table 2. Both the Kao ADF type test and the Johansen Fisher panel cointegration test results confirm cointegrating relationships between the five panel variables.

Granger Causality

The direction of causality between the panel variables is investigated by performing the Engle and Granger (1987) test on the first-differenced variables. In order to examine the long-run relationships, an error correction mechanism

(ECM) is added to the modelling and the error correction term is included in the VAR system. Equation (3) presents an augmented form of the Granger causality test in a multivariate vector error correction model (VECM) framework:

$$\begin{bmatrix} \Delta\ln PGDP_{it} \\ \Delta\ln TOP_{it} \\ \Delta\ln FDI_{it} \\ \Delta\ln DOI_{it} \\ \Delta\ln GEX_{it} \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \end{bmatrix} + \sum_{k=1}^{P} \begin{bmatrix} \beta_{1k} & \beta_{2k} & \beta_{3k} & \beta_{4k} & \beta_{5k} \\ \beta_{21k} & \beta_{22k} & \beta_{23k} & \beta_{24k} & \beta_{25k} \\ \beta_{31k} & \beta_{32k} & \beta_{33k} & \beta_{34} & \beta_{35k} \\ \beta_{41k} & \beta_{42k} & \beta_{43k} & \beta_{44k} & \beta_{45k} \\ \beta_{51k} & \beta_{52k} & \beta_{53k} & \beta_{54k} & \beta_{55k} \end{bmatrix} \begin{bmatrix} \Delta\ln PGDP_{it-k} \\ \Delta\ln TOP_{it-k} \\ \Delta\ln FDI_{it-k} \\ \Delta\ln DOI_{it-k} \\ \Delta\ln GEX_{it-k} \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \end{bmatrix} ECM_{it-1} + \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \varepsilon_{3it} \\ \varepsilon_{4it} \\ \varepsilon_{5it} \end{bmatrix} \quad (3)$$

In equation (3), the $C's, \beta's \ and \ \lambda's$ are the parameters in the model; $i = 1, 2 ------ n$; Δ stands for the first-difference in a variable; ECM_{it-1} represents the one period lagged error term derived from the cointegrating vector; $\varepsilon's$ are the disturbance terms which are serially independent with mean zero.

In addition, the F-test is applied to determine the direction of causality between the variables. For example, trade openness does not Granger cause economic growth in the short-run, if and only if all the coefficients $\beta_{21k}'s \ \forall k$ are not significantly different from zero. Similarly, economic growth does not Granger cause trade openness in the short-run, if and only if all the coefficients

Table 5. Long-Run Elasticity Coefficients

	$\ln TOP$	$\ln FDI$	$\ln DOI$	$\ln GEX$
Coefficient	0.2375***	-0.3455***	0.1271***	0.2380***
Prob.	0.0001	0.0000	0.0000	0.0010

Note: The reported values in parentheses are the probability-values of the test. ** and ***indicate significant at 5% level and at 10% level respectively.
Source: Author's calculation.

β_{21k}'s $\forall k$ are not significantly different from zero. The ECM coefficient indicates the speed of adjustment toward long-run equilibrium. The significance of ECM also explains the channel of causality between the panel variables. The short-run and the long-run Granger causality tests results are presented in Table 3.

The Granger causality test results indicate short-run bidirectional causality between economic growth and trade openness. Unidirectional causality is observed from trade openness, foreign direct investment to domestic investment, and from trade openness to government expenditure. Long-run causal link is observed from economic growth to trade openness, domestic investment and government expenditure.

Short-Run and Long-Run Elasticities

The following error correction model is estimated to examine the short-run elasticity of economic growth with respect to its determinants:

$$\Delta \ln PGDP_{it} = \beta_1 \Delta \ln TOP_{it} + \beta_2 \Delta \ln FDI_{it} + \beta_3 \Delta \ln DOI_{it} + \beta_4 \Delta \ln GEX_{it} + \lambda ECM_{it-1} + \varepsilon_{it} \quad (4)$$

Where $\beta_1, \beta_2, \beta_3$ and β_4 are the short-run elasticity coefficients of trade openness, foreign direct investment, domestic investment and government expenditure, respectively. The variables are integrated of order one and they are represented in first-differenced form in the model, hence, lags are not imposed in (4). The coefficient of ECM_{it-1} measures the speed of adjustment toward long-run equilibrium.

The sensitivity of the long-run impact is examined by estimating the following model:

$$\ln PGDP_{it} = \beta_0 + \beta_1 \ln TOP_{it} + \beta_2 \ln FDI_{it} + \beta_3 \ln DOI_{it} + \beta_4 \ln GEX_{it} + \sum_{j=1}^{p} \gamma_{ij} \Delta \ln TOP_{it-j} +$$
$$\sum_{j=1}^{p} \phi_{ij} \Delta \ln FDI_{it-j} + \sum_{j=1}^{p} \delta_{ij} \Delta \ln DOI_{it-j} + \sum_{j=1}^{p} \omega_{ij} \Delta \ln GEX_{it-j} + \mu_{it} \quad (5)$$

In equation (5) μ_{it} is the random error; $\beta_1, \beta_2, \beta_3$ and β_4 are the long-run elasticity coefficients of trade openness, foreign direct investment, domestic investment, and government expenditure, respectively. The optimal lag-length for estimating the long-run coefficients is determined by both Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBIC). The Generalised Method of Moment (GMM) technique is used to estimate equations (4) and (5). The short-run and the long-run elasticity coefficients are reported in Tables 4 and 5, respectively.

The short-run elasticity of economic growth with respect to foreign direct investment is positive and statistically significant. The effect of domestic investment is positive but insignificant. With respect to trade openness and government expenditure, the short-run effects are negative and insignificant. The ECM term is positive and statistically significant at 5% level.

A closer examination of Table 4 shows that the criteria for the validity of ECM are satisfied. That is, the coefficient of the ECM term is negative, less than one and statistically significant.

The long-run elasticity coefficients of trade openness, domestic investment and government expenditure are significantly positive while that of foreign direct investment is significantly negative. Since the long-run elasticities of economic growth with respect to trade openness, domestic investment and government expenditure are greater than the short-run elasticities, then over time, greater openness to international trade and increases in domestic investment and government expenditure will expectedly raise the economic growth of the Sub Sahara African countries.

CONCLUSION AND POLICY IMPLICATIONS

This study has examined the short-run and long-run cointegrating and causal relationships between economic growth, trade openness, foreign direct investment, domestic investment and government expenditure for a panel of 17 Sub Sahara African countries using time-series data for the period 1975-2010. The paper has also examined the short-run and long-run elasticities of economic growth with respect to its four potential determinants. The four unit root test results indicate that all the five variables are integrated of order one. The Kao

and the Johansen-Fisher panel cointegration tests identify cointegrating relationships between the panel variables.

The results of the Granger F test indicate short-run bidirectional causality between economic growth and trade openness. In the short-run, although no causal relationship is found to exist between economic growth and foreign direct investment, unidirectional causalities are also observed from trade openness, foreign direct investment to domestic investment and from trade openness to government expenditure. Long-run causal relationships from economic growth to trade openness, domestic investment and government expenditure are found to exist.

The significantly negative long-run effect of foreign direct investment on economic growth could possibly be due to a 'bad policy' environment (Burnside-Dollar 2000 and Boone 1996). According to Kosack and Tobin (2006), foreign direct investment is found to be less effective for countries with very low levels of human capital, and most of the 17 Sub Sahara African countries under study have a very low human development index. A larger fraction of foreign direct investment received by these countries is used primarily for unproductive and unsustainable investment rather than for the expansion of production capacities.

Following the results of this empirical enquiry, the implication of studies of this sort is that, a policy framework aimed at increasing domestic savings might help reduce dependency on foreign direct investment. The incremental savings can also be utilized for developmental purposes and expansion of production capacity in the manufacturing and service sectors. Finally, greater participation in international trade and an increase in government expenditure will expectedly raise economic growth of the selected 17 Sub Sahara African countries.

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