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

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Abstrac: 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 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.

Key words: Dynamic panel, trade openness, investment, economic growth, Nigeria

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 after 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: 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 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.

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, Onafowora and Owoye (1998), Foster (2008) and Yavari and Mohseni (2012) reported a positive long-run correlation between trade openness and economic growth. While Murthy *et al*. (1994), Levy (1988) 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), Ciftcioglu 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).

MATERIALS AND METHODS

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:

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

The logarithmic transformation of Eq. 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:

α_0 = $\ln A_0$
ith = The ith country
t = The time period under consideration

The parameters $\alpha_{1\text{-}4}$ 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 3 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 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.

RESULTS

Panel unit root tests: In this study, 4 unit root tests are used in determining the order of integration of the panel variables. These tests are: Levin *et al*. (2002), Im *et al*. (2003), Maddala and Wu (1999) and Choi (2006). Levin *et al*. (2002) is used in testing the null hypothesis of the existence of a unit root against the alternate hypothesis of no unit root. Im *et al*. (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 (1999), a Fisher-type test is explored which is nonparametric and also follows a Chi-square distribution. Maddala and Wu (1999) test, unlike Im *et al*. (2003) does not depend on the lag length in the individual Augmented Dickey Fuller (ADF) regressions. Lastly, the Choi test is also performed. The results of the 4 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.

Table 1: Panel unit root tests

Tests	LLC	Prob.	IPS	Prob.	MW	Prob.	Choi	Prob.
Model with constant and trend terms (Levels)								
ln PGDP	1.5862	0.8646	3.4482	1.0000	36.6925	0.8698	4.8003	1.0000
ln TOP	-1.0974	0.2814	-0.7565	0.1261	68.0237**	0.0342	-0.6537	0.1826
ln FDI	-1.2147	0.1726	-0.9621	1.0941	72.5675	0.1849	-0.8685	0.1446
ln DOI	2.6241	0.7994	0.4305	0.5824	66.7786	0.4186	0.7146	0.6873
ln GEX	2.0012	0.7410	1.4240	0.8784	54.8750	0.7024	2.1819	0.6542
Model with constant term only (First-difference)								
ln PGDP	-5.1485*	0.0000	-11.6150*	0.0000	258.7461*	0.0000	-8.6965*	0.0000
ln TOP	-18.0041*	0.0000	16.6781*	0.0001	394.6973*	0.0000	-12.2815*	0.0000
ln FDI	-21.3687*	0.0003	-22.6467*	0.0000	445.7252*	0.0000	-15.3981*	0.0000
ln DOI	-18.7619*	0.0001	-14.2034*	0.0000	513.6990*	0.0000	-19.7484**	0.0000
ln GEX	-16.2100*	0.0016	-22.5831*	0.0000	415.2060*	0.0000	-13.6210*	0.0005

*, **Significant at 1 and 5% level, respectively; Researchers calculation

Table 2: Panel cointegration test

Cointegrating equation	Fisher statistic (trace test)	Prob.	Fisher statistic (max. eigen value)	Prob.
Johansen cointegration test: Eq. 1				
None	461.6300*	0.0000	251.36*	0.0000
At most 1	206.4000*	0.0000	182.56*	0.0000
At most 2	164.8100*	0.0010	73.87*	0.0641
At most 3	89.9700*	0.0039	64.59	0.6815
Johansen cointegration test: Eq. 2				
None	301.6000*	0.0001	217.45*	0.0000
At most 1	162.3500*	0.0000	116.52*	0.0000
At most 2	215.0500*	0.0000	81.17*	0.0164
At most 3	96.7200**	0.0218	58.07*	0.5619
Kao ADF type test				
Test Statistic	-4.1364**			
Prob.	0.0000			

*, **Significant at 1 and 5% level, respectively; Researchers calculation

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 5 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:

$$\begin{bmatrix} \Delta \ln PGDP_{it} \\ \Delta \ln TOP_{it} \\ \Delta \ln FDI_{it} \\ \Delta \ln DOI_{it} \\ \Delta \ln GEX_{it} \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \end{bmatrix} + \sum_{K=1}^{P} \begin{bmatrix} \beta_{11k} & \beta_{12k} & \beta_{13k} & \beta_{14k} & \beta_{15k} \\ \beta_{21k} & \beta_{22k} & \beta_{23k} & \beta_{24k} & \beta_{25k} \\ \beta_{31k} & \beta_{32k} & \beta_{33k} & \beta_{34k} & \beta_{35k} \\ \beta_{41k} & \beta_{42k} & \beta_{43k} & \beta_{44k} & \beta_{45k} \\ \beta_{51k} & \beta_{52k} & \beta_{53k} & \beta_{54k} & \beta_{55k} \end{bmatrix}$$

$$\begin{bmatrix} \Delta \ln PGDP_{it-k} \\ \Delta \ln TOP_{it-k} \\ \Delta \ln FDI_{it-k} \\ \Delta \ln DOI_{it-k} \\ \Delta \ln GEX_{it-k} \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \end{bmatrix} ECM_{it-1} + \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \varepsilon_{3it} \\ \varepsilon_{4it} \\ \varepsilon_{5it} \end{bmatrix} \quad (3)$$

In Eq. 3, the C, β and λ's are the parameters in the model; i = 1, 2------n; △ stands for the first-difference in a variable; ECM_{it-1} represents the 1 period lagged error term derived from the cointegrating vector; ε'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 β_{21k}'s ∀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 β_{21k}'s ∀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-un elasticities: The following error correction model is estimated to examine the short-run elasticity of economic growth with respect to its determinants:

Table 3: Granger causality test

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

*, **Significant at 1, 5 and 10% level, respectively; researchers calculation

Table 4: Short-run elasticity coefficients

Tests	ΔIn TOP	ΔIn FDI	ΔIn DOI	ΔIn GEX	ECM
Coefficient	-0.0115	0.0129***	0.0100	-0.0189	-0.0038**
Prob.	0.5143	0.0020	0.1601	0.1287	0.0456

The reported values in parentheses are the probability-values of the test; **, ***Significant at 5 and 10% level, respectively; researcher calculation

Table 5: Long-run elasticity coefficients

Tests	ΔIn TOP	ΔIn FDI	ΔIn DOI	ΔIn GEX
Coefficient	0.2375***	-0.3455***	0.1271***	0.2380***
Prob.	0.0001	0.0000	0.0000	0.0010

The reported values in parentheses are the probability-values of the test; **, *** Significant at 5 and 10% level, respectively; researchers calculation

$$\Delta \text{In PGDP}_{it} = \beta_1 \Delta \text{In TOP}_{it} + \beta_2 \Delta \text{In FDI}_{it} + \beta_3 \Delta \text{In DOI}_{it} + \beta_4 \Delta \text{In GEX}_{it} + \lambda ECM_{it-1} + \varepsilon_{it} \quad (4)$$

Where, β_{1-4} 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 Eq. 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:

$$\text{In PGDP}_{it} = \beta_0 + \beta_1 \text{In TOP}_{it} + \beta_3 \text{In DOI}_{it} + \beta_4 \text{In GEX}_{it} + \sum_{j=1}^{p} \gamma_{ij} \Delta TOP_{it-j} + \sum_{j=1}^{p} \phi_{ij} \Delta \text{In FDI}_{it-j} + + \sum_{j=1}^{p} \delta_{ij} \Delta \text{InDOI}_{it-j} + \sum_{j=1}^{p} \omega_{ij} \Delta \text{InGEX}_{it-j} + \mu_{it} \quad (5)$$

In Eq. 5, μ_{it} is the random error; β_{1-4} 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 Eq. 4 and 5. The short-run and the long-run elasticity coefficients are reported in Table 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, >1 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.

DISCUSSION

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 study has also examined the short-run and long-run elasticities of economic growth with respect to its 4 potential determinants. The 4 unit root test results indicate that all the 5 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 and Dollar 2000; 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.

CONCLUSION

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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