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Exports and Economic Growth long Run Relation in Africa Countries



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ABSTRACT: The aim of this study is to analyze the effect of export economic growth in long run for Africa countries, controlling for foreign direct investment and gross fixed capital formation using panel cointegration framework. The panel unit root test showed a mixture of integration order, which implies panel ARDL cointegration test is the appropriate technique for cointegration test. The seven panel cointegration test indicates the presence of a cointegration relationship in the panel. Generalized method of moments (GMM) technique indicates error correction term being negative and significant in 16 countries at 5% and 10%. In the long run, export and gross fixed capital formation have a positive effect on economic growth while foreign direct investment has a negative effect. The panel causality test shows the existence of a bi-directional causal flow in the following relations; economic growth-export, export-foreign direct investment, foreign direct investment-gross fixed capital formation, gross fixed capital formation-export. Economic growth does not granger cause foreign direct investments and gross fixed capital formation. African countries need to formulate policies that will enhance international trade specifically exports, either within the continent and worldwide. At the same time, support to African countries from developed economies and international institutions should aim to maximize the potential in export trade.

KEYWORDS: Africa, Panel Cointegration, PMG, causal flow, GDP, exports

1 INTRODUCTION

Economic growth is defined as the increase in market value of goods and services that an economy produces at any given time. There are factors that contribute to economic growth, which according to economic development theories, includes labor, natural resources, capital accumulation, technology development and human capital. Other factors that have also been proved to impact economic growth are; foreign trade, energy consumption, health expenditure and urbanization. Export as described by Thirlwall model (1979), significantly influence economic growth in the long term. Export is described as source of foreign exchange revenue that may be used in an economy to finance domestic activities as well as imports within an economy. This results to an increase in economic activities, leading to economic growth. Accumulation of physical capital (Solow, 1957) results to economic growth due to increased production level. Capital accumulation in an economy is highly influenced by foreign direct investment, savings and interest rates. The intensity of the effect of capital accumulation is therefore dependent of the contribution of the three key identified factors. In an economy, foreign direct investment results to increased productivity, management skills and better technology. This results to increased economic growth due to increased domestic activities.

There are several empirical researches touching on the interactions of economic growth with macroeconomic variables such as foreign direct investment, export and gross fixed capital formation, either individually or as a combined set. Michelis and Zestos (2004) examined the causal relations among exports, economic growth and imports in Belgium, France, Greece, Germany, Netherlands and Italy. The study provided evidence of a strong causal link in all the six countries. There exists a bidirectional causal flow between exports and economic growth, as well as imports and economic growth. Adefabi (2011) examined the impact of human capital and foreign direct investment on economic growth in sub-Saharan Africa after controlling for income, and government consumption. Foreign direct investment has a significant effect of increasing economic growth. The study also provided evidence of a weak effect of differential human capital measures on economic growth. Acaravci and Ozturk (2012) studied the relationship among variables foreign direct investment, export and economic growth in new EU members. The study proved the existence of a long run relation and causality in four countries, namely Czech Republic, Slovak Republic, Latvia and Poland. They concluded that the main drivers of economic growth are foreign direct investment and export growth. Popescu (2014) analyzed central and eastern Europe foreign direct investment and economic growth. The aspect touched were the

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determinant of foreign direct investment, the effect of foreign direct investment and the role of export on economic growth. The study proved that the key factors affecting foreign direct investment are regional trade agreements, openness to trade, market magnitude and labor quality. The study showed that foreign direct investment plays a major role in economic development of the host country in ways such as privatization process, the living standards and production network. Were (2015) examined the differential effects of trade on foreign direct investment and economic growth across a panel of countries. The study showed that trade has varied effects on economic growth as per countries classification. Developed and developing countries experiences a significant positive effect of trade on economic growth. The least developed countries with majority countries in Africa falling in this category experienced an insignificant effect in economic growth. However, trade has a significant effect on foreign direct investment in all countries across the categories. Pegkas (2015) investigated the relationship between economic growth and foreign direct investment in Eurozone countries. The study showed the existence of a positive long run relationship between the two variables. Using fully modified OLS and dynamic OLS, they proved a long run GDP elasticity with respect to foreign direct investment. Sakyi and Egyir (2017) investigated the effect of foreign direct investment and trade on economic growth in African countries using generalized method of moments (GMM) technique. The study proved that foreign direct investment impact on economic growth is conditional to the country level of trade openness. It was also noted that the effect of trade on economic growth is subject to foreign direct investment inflows. The study on the global link between economic growth, energy consumption, gross capital formation and natural resources using panel vector autoregression method by Topcu et al. (2020), yielded a mixture of results. Considering the high-income countries, there is a positive significant effect of gross fixed capital formation, energy consumption and urbanization on economic growth. However, natural resources have insignificant effect on economic growth. In the middle income category, economic growth is spurred by increase in energy consumption, urbanization and natural resources. Low-income countries have energy consumption impacting economic growth positively while capital formation with a negative effect. Rahman and Alam (2021) explored the determinant of economic growth in twenty largest economies in the world using panel ARDL method. They considered factors such as human capital development, trade, foreign direct investment, energy use, capital and labor. The study provides sufficient evidence of a significant positive impact of all explanatory variables on economic growth in the long run. In short run, trade, energy and capital have a positive significant effect on economic growth where as human capital has a negative effect. There exists a bidirectional causal link between economic growth and capital, trade, human capital and labor. There is a unidirectional causal flow from economic growth to foreign direct investment and energy use. Aslan and Altinoz (2021) investigated gross fixed capital formation, globalization, natural resources and economic growth in developing countries in the world using panel vector autoregression. The study showed that developing countries in Europe, Asia, and America have globalization and natural resources positively impacting economic growth. Gross fixed capital formation in these countries has a negative effect on economic growth. In Africa, gross fixed capital formation and globalization tends to impact economic growth positively while the natural resources have a negative effect. Njenga (2023) analyzed a panel of world economies with explanatory variables as labor force, gross value addition, total natural resources and population. All the explanatory variables had a significant positive effect on economic growth. However, there was evidence of random component across countries that is large and significant. Iqbal et al. (2023) investigated the long run among exports, carbon emissions, foreign direct investment and economic growth, while controlling for interest rates, trade openness, labor force and gross domestic saving in BRICs countries. The study showed that export, savings and foreign direct investment have a positive effect on economic growth in the long run. The study also showed the existence of a bidirectional causal flow between foreign direct investment and economic growth, a unidirectional causal flow from export to economic growth.

2 METHODOLOGY

2.1 Data

This study investigates the long run relation between economic growth and exports controlling for foreign direct investment and gross fixed capital formation. Annual variable time series for the period 1990 to 2022, sourced from the WorldBank indicator database. The variables are denoted as follows; GDP for economic growth, EXP for export, FDI for foreign direct investment and GFCF for gross fixed capital formation. All the variable unit is in US dollars. A total of 36 countries with complete data for the observed variables. The sample comprise of; Algeria, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central Africa, Chad, Comoros, Congo DR, Congo Republic, Ivory coast, Egypt, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Madagascar, Mali, Mauritania, Mauritius, Morocco, Namibia, Niger, Rwanda, Seychelle, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda and Zimbabwe. Gross fixed capital formation has negative values, thus the all the variables were translated by a constant value of 1983178877, followed by a log transformation. The descriptive statistics for the transformed variables are detailed in table 1. GDP has the highest overall standard deviation of 1.21 among the variables, with a minimum GDP value of 21.56 and maximum value of 26.89. The GDP variability between group is high as compared to within the group. GDP has a high spread across countries

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with a slight change over years. Exports and Gross fixed capital formation shows a slightly higher variability across countries with little change over time. On the other hand, foreign direct investment shows low level variability across countries and over time.

Table 1: Descriptive statistics

Variable		Mean	sd	Min.	Max.	no. observations
GDP_{it}	overall	23.24	1.2076	21.56	26.89	1188
	within group		0.4653	22.62	23.95	33
	between group		1.1061	21.72	26.25	36
EXP_{it}	overall	22.40	0.9136	21.42	25.65	1188
	within group		0.3411	21.96	22.95	33
	between group		0.8274	21.44	24.90	36
FDI_{it}	overall	21.589	0.6466	2.303	24.476	1188
	within group		0.1532	21.13	21.77	33
	between group		0.2373	21.05	22.32	36
$GFCF_{it}$	overall	22.28	0.8717	21.41	25.27	1188
	within group		0.3295	21.89	22.73	33
	between group		0.7764	21.46	24.48	36

2.2 Panel Cointegration

To analyze the long run relation in panel data, the analysis framework entails first establishing the variables integration order. If the observed variables are of integration order one i.e $I(1)$, the best appropriate methods for analyzing the relations are either; Kao residual panel test, or Johansen Fisher test or Westerlund test. Otherwise, in the presence of mixed integration order, the panel Autoregressive distributed lag (ARDL) cointegration test is the most efficient and effective approach. The long run and short term dynamics parameters are estimated using pooled mean group (PMG) estimators

2.2.1 Panel unit root test

To determine the order of the variables, panel unit root tests are performed. A unit root test is the process of ascertaining whether an observed time series is stationary or not. A time series may be stationary in level or after removing the trend component by differencing. A first order autoregressive panel unit timeseries $I(1)$ process in basic form is expressed as;

$$Y_{it} = (1 - \alpha_i)\mu_i + \alpha_i Y_{i,t-1} + \varepsilon_{it} \quad (1)$$

Where the term ε_{it} is independent and identically distributed (iid) across t and i .

In the difference form, the panel AR(1) is expressed as;

$$\Delta Y_{it} = -\varphi_i \mu_i + \varphi_i Y_{i,t-1} + \varepsilon_{it} \quad (2)$$

For

$$\begin{aligned} \Delta Y_{it} &= Y_{it} - Y_{it-1} \\ \varphi_i &= \alpha_i - 1 \end{aligned}$$

From the difference AR(1) model in equation (2), the panel unit root test model is expressed as;

$$\Delta \hat{Y}_{it} = \phi_i Y_{i,t-1} + \varepsilon_{it} \quad (3)$$

For

$$\hat{Y}_{it} = \alpha_i Y_{i,t-1} + \varepsilon_{it}$$

The null hypothesis for the panel unit root test assumes there is a unit root in the panel, that is;

$$H_0: \phi_1 = \phi_2 = \dots = \phi_N = 0$$

The alternative hypothesis stipulates the existence of either a homogeneous alternative outcome or a heterogeneous alternative outcome. A homogeneous alternative outcome is where the autoregressive coefficients of the stationary panel unit are identical. The heterogeneous alternative outcome has specific individual stationary panel unit autoregressive coefficients.

- Homogeneous alternative

$$H_{1a}: \phi_1 = \phi_2 = \dots = \phi_N = \phi$$

and $\phi < 0$

- heterogeneous alternative

$$H_{1a}: \phi_1 < 0, \phi_2 < 0, \dots, \phi_N < 0$$

for $N_0 < N$

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There are several panel unit root tests developed that have been classified into two categories, namely the first-generation panel unit root and the second-generation panel unit root. Under the first-generation panel unit root test, the assumption is that the panel time series is independent across section. On the other hand, the second-generation panel unit root test assumes that the cross-section independence in the panel time series has been violated as a result of statistical complications such as residual interdependence, spatial spillover effect among others. The second-generation panel unit root test introduces a cross-sectional error to the model in equation (3), to obtain;

$$\Delta \hat{Y}_{it} = \mu_i \phi_i + \phi_i Y_{i,t-1} + \epsilon_{it} \quad (4)$$

To determine the type of between first generation and second-generation panel unit root test to use, cross sectional dependency test for panel as describe by Pesaran (2004 and 2015) is performed.

Table 2 cross sectional dependency test results

Variable	Statistics	Pvalue
GDP_{it}	131.36	0.0001
EXP_{it}	117.01	0.0001
FDI_{it}	62.465	0.0001
$GFCF_{it}$	114.29	0.0001

The result of panel cross sectional dependency test indicates the presence of cross-sectional dependence in all the observed variables shown in table 2. The second-generation panel unit root tests are applied in the study. The second-generation panel unit root test considered are Choi (2001) Z and modified Fisher statistic test. The null hypothesis is rejected if the p-value of the panel unit root test statistic is less than 0.05. Otherwise, the panel time series is stationary in level.

Table 3: Panel unit root test results

In level					
Variable	Test	Intercept	P-value	Trend	P-value
GDP_{it}	Choi Z-statistic	8.6229	1	-2.9323	0.0017
	Choi Fisher	9.314	1	-3.2989	0.0006
EXP_{it}	Choi Z-statistic	7.7381	1	-2.116	0.0171
	Choi Fisher	8.6815	1	-2.1961	0.0147
FDI_{it}	Choi Z-statistic	-4.0808	0.0001	-9.7512	0.0001
	Choi Fisher	-4.7214	0.0001	-12.765	0.0001
$GFCF_{it}$	Choi Z-statistic	7.297	1	0.0233	0.5093
	Choi Fisher	8.8161	1	0.3592	0.6401
1st difference					
Variable	Test	Intercept	P-value	Trend	P-value
ΔGDP_{it}	Choi Z-statistic	-27.1	0.0001		
	Choi Fisher	-45.31	0.0001		
ΔEXP_{it}	Choi Z-statistic	-26.956	0.0001		
	Choi Fisher	-43.945	0.0001		
$\Delta GFCF_{it}$	Choi Z-statistic	-28.227	0.0001	-27.314	0.0001
	Choi Fisher	-47.962	0.0001	-46.006	0.0001

The panel unit root test results for the variables in are shown in table 3. From the study provide evidence of foreign direct investment in African countries is stationary for both trend and intercept model component at a 5% level of significance. Across the countries from 1990 to 2022, foreign direct investment has a constant mean and variance. It's evident that GDP and export are stationary for the trend model component only. The trend component of GDP and export time series across African countries is not significantly affected by shocks. On the other hand, gross fixed capital formation is not stationary. Gross fixed capital formation is confirmed to be an integrated variable of order one ie I(1) for both the trend and intercept model

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components, at a 5% level of significance. Exports and GDP are integrated variables of order one for the intercept model component at a 5% level of significance. The variables are of mixed integration order, which implies that the most appropriate technique to apply is the panelARDL in level cointegration test.

2.2.2 Panel ARDL Cointegration test

Panel cointegration is defined as a linear combination of a set n , of observed cross sectional time series variables, such that the resulting cross-sectional time series is stationary ie $I(0)$. The linear combination may be greater than one. However, under panel cointegration the test is technically on the presence of the cointegration relation but not the cointegration rank. The panel ARDL cointegration test is as developed by Pedroni (2001, 2004), comprising of seven tests. These are classified in two sets, namely the within group and between group test. The within group tests assumes that the within dimensions have a common autoregressive coefficient. These within group test includes the panel V-statistic, panel PP-statistic, panel rho-statistic and ADF-statistic. On the other hand, the group test statistics assumes that the between dimensions have individual autoregressive coefficient. The group test includes; the group rho-statistic, group PP-statistics and group ADF-statistic. Under the null hypothesis for the seven test is an assumption of no long run relation for the observed. The alternative hypothesis assumes the presence of cointegration relation.

The test statistic for cointegration is given as;

- Panel

$$X_{pt} = \left(\hat{\sigma}_{NT}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{\mu}_{i,t-1}^2 \right)^{-1/2} \left(\sum_{i=1}^N \sum_{t=1}^T \hat{\mu}_{i,t-1} \hat{\mu}_{it} - T \sum_{i=1}^N \hat{\lambda}_i \right) \quad (5)$$

- Group mean

$$\hat{X}_{pt} = \sum_{i=1}^N \left(\hat{\sigma}_{ie}^2 \sum_{t=1}^T \hat{\mu}_{i,t-1}^2 \right)^{-1/2} \left(\sum_{t=1}^T \hat{\mu}_{i,t-1} \hat{\mu}_{it} - T \hat{\lambda}_i \right) \quad (6)$$

For

$$\begin{aligned} \hat{\lambda}_i &= \sum_{j=1}^{\infty} E(e_{it} e_{i,t-j}) \\ e_{it} &= \mu_{it} - \delta_i \mu_{i,t-1} \\ \delta_i &= \frac{E(\mu_{it} \mu_{i,t-1})}{E(\mu_{i,t-1}^2)} \\ \hat{\sigma}_{NT}^2 &= N^{-1} \sum_{i=1}^N \hat{\sigma}_{ie}^2 \end{aligned}$$

Where σ^2 is the estimator for the variance of e_{it} .

The test statistic incorporates either an intercept or deterministic component. The test statistic follows a normal distribution, thus reject the null hypothesis if the test statistic is greater than the critical value of ± 1.96 or the p-value is less than 0.05.

±

Table 4: Pedroni's cointegration test results

	Empirical	Standardized
panel v-statistic	0.07144	11.4375
panel rho-statistic panel PP -statistic panel	-41.2064	9.8158
ADF-statistic group rho-statistic group PP-	-7.6242	16.4755
statistic group ADF-statistic	-0.00087	-1.0541 × 10 ⁴
	-65.6140	10.1044
	-12.8547	-13.0435
	-13.0928	-12.7190

The Pedroni's cointegration test results in table 4 above indicated that presence of a long run relation, as all the calculated test statistics are greater than ± 1.96 . This is evidence of long run relation between export and economic growth nexus while accounting for foreign direct investment and gross capital formation. The confirmation of the existence of a long run relation by the Pedroni cointegration test implies that the pooled mean group (PMG) estimators are used to estimate the short-term dynamics parameters and long run parameters

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2.2.3 Pooled mean group (PMG) Estimators

A panel ARDL model in the basic form is expressed as;

$$Y_{it} = \sum_{j=i}^p \alpha_{ij} Y_{i,t-j} + \sum_{j=0}^q \delta_{ij} X_{i,t-j} + \mu_i + \epsilon_{it} \quad (7)$$

Where p and q are the order of the model, δ_{ij} is a vector of explanatory coefficients and μ_i is the fixed effect parameter. An error correction model (ECM) is obtained by Re-parameterization of equation (7), which is expressed as (Pesaran et al. 1999);

$$\Delta Y_{it} = \phi_i Y_{i,t-1} + \beta_i X_{it} + \sum_{j=1}^{p-1} \eta_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{q-1} \omega_{ij} \Delta X_{i,t-j} + \mu_i + \epsilon_{it} \quad (8)$$

Where

$$\phi_i = - \left(1 - \sum_{j=1}^p \alpha_{ij} \right)$$

$$\beta_i = - \sum_{j=0}^q \delta_{ij}$$

$$\eta_{ij} = - \sum_{m=j+1}^p \alpha_{im}$$

For $j=1,2,\dots,p-1$

$$\omega_{ij} = - \sum_{m=j+1}^q \delta_{im}$$

For $j=1,2,\dots,q-1$

The ECM model has both the short-term dynamic equation and long run component. Stacking the ECM model by the t component give the short-term dynamic equation as given in equation (9). The long run relation from the ECM model is shown in equation (10).

- Short term dynamics

$$\Delta Y_{it} = \phi_i Y_{i,t-1} + X_{it} \beta_i + \sum_{j=1}^{p-1} \eta_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{q-1} \Delta X_{i,t-j} \omega_{ij} + \mu_i + \epsilon_{it} \quad (9)$$

- Long run relation

$$Y_{it} = - \left(\frac{\beta_i}{\phi_i} \right) X_{it} + \xi_{it} \quad (10)$$

The maximum likelihood estimator technique is used to estimate the parameters of the PMG model. The short-term model must agree with the cointegration test where the error correction term (ECT) must be negative and significant. A negative and significant ECT indicates the rate of adjustment to equilibrium status following a shock. Otherwise, if the ECT is positive or insignificant, then there exists no long run relation. The long run parameters indicate the effect of the explanatory variable to obtain a stationary response variable.

Table 5: PMG model log likelihood results

combination	log likelihood
p = 1, q = 1	1850.853
p = 1, q = 2	190.433
p = 2, q = 1	1856.397
p = 2, q = 2	1962.525

The p and q in equation (8) gives the order of the model, where p is the number of lags for the dependent variable and q is the number of lags for the explanatory variables. They value of p and q are obtained by the model log likelihood statistic comparison, with the highest value indicating the best model that fit the observed data. The log likelihood statistic for different p and q PMG model combination are shown in table 5. The value of p and q is equal to 2, with this combination having the highest log likelihood statistic value of 1962.525. The second lag of GDP, exports, foreign direct export and gross fixed capital formation are

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considered in the short-term dynamic parameter and long run parameter estimation.

Table 6: PMG short-term dynamic results

country	ECT	Pvalue	intercept	Country	ECT	pvalue	intercept
Algeria	0.0132	0.1386	0.0135	Kenya	-0.0394	0.224	0.0007
Benin	-0.3909	0	0.1725	Madagascar	0.0331	0.5322	-0.0573
Botswana	-0.0562	0.0453	-0.0302	Mali	-0.6043	0	0.3194
Burkina Faso	-0.3044	0.0006	0.1397	Mauritania	-0.1454	0.008	0.0179
Burundi	-0.0962	0.0033	0.0416	Mauritius	-0.1455	0.098	0.0294
Cameroon	-0.0526	0.2572	0.0362	Morocco	-0.0256	0.2041	-0.0389
Central African	-0.0851	0.4315	0.0436	Namibia	-0.0545	0.4977	0.0109
Chad	0.0427	0.3409	-0.0147	Niger	0.0236	0.8006	-0.0142
Comoros	-0.1059	0.0001	0.0276	Rwanda	-0.3438	0.0004	0.2013
Congo DR.	-0.1098	0.0687	0.0961	Seychelles	-0.2997	0.0019	0.0799
Congo Rep.	0.0739	0.0496	0.0101	Sierra Leone	-0.0193	0.6389	-0.0128
Ivory coast	0.0029	0.9057	0.0028	South Africa	-0.028	0.1942	-0.0579
Egypt	0.0326	0.3989	-0.0043	Sudan	-0.1185	0.037	0.0433
Gabon	-0.0055	0.8606	-0.0065	Tanzania	-0.0018	0.8604	-0.0272
Gambia	-0.2138	0.0888	0.0898	Togo	-0.2096	0.0518	0.1135
Ghana	0.1832	0.0561	-0.0319	Tunisia	-0.053	0.2713	-0.0309
Guinea	-0.1693	0.0052	0.1409	Uganda	-0.043	0.1054	0.0059
Guinea-Bissau	-0.0732	0.2418	0.0174	Zimbabwe	-0.1566	0.033	0.0979

The PMG results for the short-term dynamics are shown in table 6, indicating the ECT term, its p-value and the constant term. From the results, there are 11 countries that have the ECT negative and significant at 5%. These includes; Benin, Botswana, Burkina Faso, Burundi, Comoros, Guinea, Mali, Mauritania, Rwanda, Sudan, and Seychelles. The rate of adjustment to equilibrium following a shock is highest in Mali with a rate of 60% and lowest in Botswana at a rate of 6%. The results also indicated that D.R Congo, Gambia, Mauritius, Togo and Zimbabwe have a negative ECT that's significant at 10% level. The rate of adjustment for the five countries with significant level of 10% fall within the earlier range. The ECT term is positive in the following countries; Algeria, Chad, Congo Re- public, Ivory coast, Egypt, Ghana, Madagascar, and Niger. a positive ECT terms means a shock result to a further deviation from equilibrium. The rest of the countries have a negative ECT though insignificant.

The long run parameter estimates for the PMG model are shown in table 7. In the long run, export and gross fixed capital formation have a significant positive effect on economic growth. The study proves that foreign direct investment in Africa countries tends to have a significant negative effect on economic growth.

Table 7: PMG long run results

variable	coefficient	p-value
EXP_t	0.4466	0.0001
FDI_t	-1.2334	0.0001
$GFCF_t$	1.7793	0.0001

The export, economic growth, gross fixed capital formation and foreign direct investment long run relation is as expressed in equation (15). This equation only holds true in the following countries: Benin, Botswana, Burkina Faso, Burundi, Comoros, Guinea, Mali, Mauritania, Rwanda, Sudan, Seychelles, D.R Congo, Gambia, Mauritius, Togo and Zimbabwe.

$$GDP_t = constant_i + 1.3571 EXP_t - 1.4987 FDI_t + 1.47 GFCF_t \quad (11)$$

An increase in export trade in Africa countries brings about economic growth after controlling for foreign direct investment and gross fixed capital formation. With the existence of dynamic equilibrium between economic growth and exports, then measures to increase export by African countries and as well as trade agree by the international community will foster economic growth. The effect of investment in Africa countries, which are largely developing countries category, is a decline in economic growth. This is an exceptional scenario as empirical research (Acaravci and Ozturk, 2012; Popescu, 2014; Pegkas, 2015) proved that foreign direct investment has a positive effect in long run on economic. The benefits of foreign direct investment

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in an economy my well felt in Africa countries, which may be attributed to political and administrative issues. There is need to address the foreign direct investment, its interaction with other macroeconomic variables as well as strength its economic value.

2.3 Panel causality test

Causality test is used to determine whether the variations observed in a variable X_t can be used to explain the variations observed in variable Y_t . There exists acausal link between variable X_t and Y_t , if and only if (Granger, 1969),

$$\sigma^2(Y|\mu) \leq \sigma^2(Y|\mu - X) \quad (12)$$

The causal link is denoted as

$$X_t \rightarrow Y_t$$

In case the observed variables are panel time series, the Granger causality testas extension as developed by Dumitrescu-Hurlin (2012). The panel causality is denoted as

$$X_{it} \rightarrow Y_{it}$$

The panel causality test model for the variables X_{it} and Y_{it} is expressed (Lopezand Weber 2017);

$$Y_{it} = \pi_i + \sum_{k=1}^k \rho_{ik} Y_{i,t-k} + \sum_{k=1}^k \tau_{ik} X_{i,t-k} + \varepsilon_{it} \quad (13)$$

The test statistic for the panel causality is the Wald test statistic that follows a normal distribution. The null hypothesis assumes no causality in the panel forall i 's, that's

$$H_0: \tau_{i1} = \dots = \tau_{ik} = 0$$

The alternative hypothesis assumes there exists causality in some i 's withinthe panel even if not for all i 's, that's

$$H_1: \tau_{i1} \neq 0, \text{ or } \dots \text{ or } \tau_{ik} \neq 0$$

There exists a causal link if the calculated test statistic is greater than thecritical values of (± 1.96) or the p-value is less than level of significance value of 0.05. Causal flow is either in one direction or two ways. A one direction causal

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Table 8: Causality test results

Causality directions	statistic	p-value
$GDP_{it} \rightarrow FDI_{it}$	1.4229	0.1548
$GDP_{it} \rightarrow GFCF_{it}$	1.2469	0.2124
$GDP_{it} \rightarrow EXP_{it}$	7.1085	0.0001
$EXP_{it} \rightarrow GDP_{it}$	5.4482	0.0001
$EXP_{it} \rightarrow FDI_{it}$	2.3742	0.01759
$EXP_{it} \rightarrow GFCF_{it}$	4.8747	0.0001
$FDI_{it} \rightarrow GDP_{it}$	15.849	0.0001
$FDI_{it} \rightarrow EXP_{it}$	16.18	0.0001
$FDI_{it} \rightarrow GFCF_{it}$	20.422	0.0001
$GFCF_{it} \rightarrow GDP_{it}$	9.6105	0.0001
$GFCF_{it} \rightarrow FDI_{it}$	3.8845	0.0001
$GFCF_{it} \rightarrow EXP_{it}$	16.15	0.0001

Flow is also referred to as unidirectional causal, which occurs if the flow from X_{it} to Y_{it} . If there exist a causal link from Y_{it} to X_{it} , then flow is two ways, which is known as bi-directional causal flow.The panel causality test results are shown in table (7). There exists a significant bidirectional causal flow between GDP and exports. As African economies grow, the value of exports increases. An increase in export result to growth in economies in Africa. However, economic growth does not granger cause foreigndirect investment and gross fixed capital formation. There exists a bidirectional causal link between export and the three observed variables. An increase in ex- ports tends to granger cause an increase in GDP, foreign direct investment and gross fixed capital formation. Foreign direct investment and gross fixed capital formation have the same causality characteristic as exports.

3 CONCLUSIONS

This study aim is to investigates the existence of a long run relation between export and economic growth in Africa countries, controlling for foreign direct investment and gross fixed capital formation. The study also sorts to determine causality among the macroeconomic variables. The sample comprised of 36 countries, with annual variable data from 1990 to 2022. The analysis utilized panel cointegration framework, with panel unit root test being the first step. Panel unit root test purpose was to ascertain the composition of the variable's integration order. The variables were of different integration order. Foreign direct investment is

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stationary, gross fixed capital formation is of integrated order one, export and GDP are trend stationary and their intercept component model are of integrated order one. Pedroni panel ARDL cointegration test is used to test for cointegration relationship. The seven ARDL panel cointegration test confirms the presence of a cointegration relation among economic growth, export, foreign direct investment and gross fixed capital formation at 5% level of significance. Pooled mean group (PMG) estimator with two lags for both dependent and independent variables is estimated. The PMG results indicate the presence of a significant negative error correction term in; Benin, Botswana, Burkina Faso, Burundi, Comoros, Guinea, Mali, Mauritania, Rwanda, Sudan, and Seychelles at 5% level. At 10% D.R Congo, Gambia, Mauritius, Togo and Zimbabwe have a significant negative at 10%. These results support the presence of cointegration relation, thus the long run relation equation holds in these 16 countries. In the long run, foreign direct investments have a negative effect on economic growth while export and gross fixed capital formation have a positive effect. The panel causality test showed the existence of a bi-directional causal flow among export and foreign direct investment, gross fixed capital formation and export, foreign direct investment and gross fixed capital formation, export and GDP. There is no causal flow between GDP and foreign direct investment, as well as gross fixed capital formation.

Appendix

The PMG short term dynamics results for other parameters are shown tables 9 and 10.

Table 9: PMG short term dynamics results

sno	country	ΔGDP_{t-1}	ΔGDP_{t-2}	ΔEXP	ΔEXP_{t-1}	ΔEXP_{t-2}
1	Algeria	-0.0263	-0.5999 ***	0.3555 ***	0.0481	0.2302 **
2	Benin	-0.4993 **	-0.3821 **	-0.0636	-0.4627 **	-0.0848
3	Botswana	-0.0306	-0.2471 *	0.4037 ***	-0.0187	-0.1472 *
4	Burkina Faso	-0.5315 **	-0.247	0.2194	0.0909	0.8901 **
5	Burundi	-0.2392	0.0865	1.8997 ***	1.2509 **	-0.0654
6	Cameroon	-0.1591	-0.4055 **	-0.1056	0.0711	-0.1727
7	Central African	-0.1202	-0.0216	1.2077 **	1.2959 **	-0.3885
8	Chad	-0.0889	-0.1479	0.5832 ***	0.2542 *	0.2413
9	Comoros	-0.4394 **	-0.5754 **	-0.1982	0.1449	0.5744 *
10	Congo DR.	-0.5202 **	-0.3542 **	0.5298 **	-0.0729	0.4941 *
11	Congo Rep.	0.0432	-0.2416	0.8629 ***	0.1223	0.2927 *
12	Ivory coast	0.0722	-0.0815	0.5095 **	0.0367	-0.3172
13	Egypt	0.287 *	-0.0017	-0.0548	0.2484 **	0.036
14	Gabon	0.1089	0.0576	0.5274 ***	-0.0867	-0.0556
15	Gambia	-0.0009	-0.0114	1.0876 **	0.4838	-0.1918
16	Ghana	0.0911	-0.5703 **	0.8344 **	0.1768	0.3948
17	Guinea	-0.0704	-0.2961 **	0.7705 ***	0.64 ***	0.2664
18	Guinea-Bissau	-0.1354	-0.1468	0.9416 ***	-0.0948	0.36
19	Kenya	-0.04	-0.0547	-0.1231	0.2683	-0.2382
20	Madagascar	-0.3367 *	-0.0092	0.139	0.3692 ***	-0.0915
21	Mali	-0.5435 **	-0.4912 **	0.3709 **	0.1945	0.3443 *
22	Mauritania	0.1353	-0.2827 **	0.5803 ***	-0.0118	0.2771 **
23	Mauritius	-0.0042	-0.2982	0.5277 ***	0.106	0.3965 **
24	Morocco	-0.4544 **	-0.1791	0.0878	0.0742	0.0747
25	Namibia	0.2427	-0.2064	0.8031 ***	-0.1875	0.005
26	Niger	0.0006	-0.2026	1.0697 **	-0.2733	0.1056
27	Rwanda	-0.4488 **	-0.1983	0.6666 **	0.6586 **	-0.2566
28	Seychelles	0.0656	-0.1925	0.5315 ***	0.1534	0.307 **
29	Sierra Leone	0.0525	-0.2864	0.1478	0.3504 **	0.2074
30	South Africa	0.4157 **	0.1062	-0.1538	-0.4366 **	-0.2367 *
31	Sudan	-0.1548	-0.137	0.3348 *	-0.1041	-0.1094
32	Tanzania	0.4234 **	-0.2459 *	0.1557	0.1225	0.3257 **
33	Togo	0.1094	-0.1158	0.812 ***	0.0568	-0.42
34	Tunisia	0.0855	-0.3836 *	0.3027 **	0.0501	0.2103

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sno	country	ΔGDP_{t-1}	ΔGDP_{t-2}	ΔEXP	ΔEXP_{t-1}	ΔEXP_{t-2}
35	Uganda	0.0474	-0.3028 **	0.2857 **	0.4051 **	-0.0517
36	Zimbabwe	-0.4271 **	-0.1396	0.505 **	0.0002	0.1745

Table 10: PMG short term dynamic results

Sno	Country	ΔFDI	ΔFDI_{t-1}	ΔFDI_{t-2}	$\Delta GFCF$	$\Delta GFCF_{t-1}$	$\Delta GFCF_{t-2}$
1	Algeria	-0.007	-0.0387	-0.0237	0.4998 ***	-0.0469	0.3133 **
2	Benin	-0.665 **	-0.1141	-0.1962	1.546 ***	1.0601 **	0.6691 *
3	Botswana	-0.0392	0.0676	0.0662	0.2906 **	0.1349	0.1295
4	Burkina Faso	-0.7804 **	-0.8989 **	-0.384	0.3358	1.2646 **	-0.452
5	Burundi	-0.1464	0.0694	1.2564 ***	0.7161 ***	0.4027 **	0.0244
6	Cameroon	0.0601	-0.013	-0.0923	1.5985 ***	0.2663	0.9358 ***
7	Central African	0.9296	1.7821 **	1.013	1.0149 ***	0.4351	0.4663 **
8	Chad	0.0659	0.0686	0.0266	0.2031	0.0082	0.2302 *
9	Comoros	1.2557	-2.5538 **	0.4042	2.9192 ***	1.4094 *	1.856 **
10	Congo DR.	-0.2366	0.1022	0.0703	0.5122 **	0.5565 ***	0.3052 *
11	Congo Rep.	0.0798 *	0.0751 *	0.0863 *	0.0201	0.0065	0.0445
12	Ivory coast	-0.1686	-0.5958 **	-0.4015 *	0.7264 ***	0.1166	0.2278
13	Egypt	0.0067	-0.0141	-0.0246	0.5348 ***	-0.0132	0.0479
14	Gabon	0.0588	0.0257	0.0048	0.4653 ***	0.001	-0.0828
15	Gambia	1.3153 **	0.6047	0.5156	0.5 *	-0.0094	-0.2374
16	Ghana	0.3411	0.3161	0.2939	0.4373 **	-0.2197	0.2799 *
17	Guinea	-0.5812 **	-0.377 **	-0.3944 **	0.8763 ***	0.412	0.2782
18	Guinea-Bissau	-1.2572 **	-0.7391	-0.4462	0.6542 ***	0.3344 **	0.3073 *
19	Kenya	-0.0883	-0.0311	-0.0531	0.9252 ***	0.2429	0.3212
20	Madagascar	-0.0583	0.7354 ***	0.1773	0.3588 ***	-0.49 ***	0.026
21	Mali	-0.3363 *	-0.2965 *	-0.0433	1.2721 ***	0.7962 ***	0.5369 **
22	Mauritania	-0.1314 **	-0.1336 **	-0.1098 ***	0.2587 ***	0.1223 *	0.058
23	Mauritius	-0.0288	-0.1343	-0.131	0.5962 ***	0.2406	0.139
24	Morocco	-0.0665	-0.0744	-0.015	0.7164 ***	0.2083	0.1116
25	Namibia	-0.1514	-0.2758 **	-0.2151 **	0.4166 **	-0.1674	0.3527 **
26	Niger	-0.2987	-0.0868	-0.3305	0.744 **	0.1716	0.3058
27	Rwanda	-0.9139 **	-1.2353 **	-0.8783	1.5354 ***	0.6359 **	0.4486
28	Seychelles	-0.349 **	-0.2525 **	-0.1959 **	0.793 ***	0.1174	-0.0762
29	Sierra Leone	-0.4053 *	0.139	0.3545	0.4318 **	0.2918	0.0084
30	South Africa	-0.0268	-0.0213	0.0206	0.9679 ***	-0.1546	0.071
31	Sudan	-0.1066	-0.1356	-0.0252	0.4217 *	0.3958	0.204
32	Tanzania	0.0808	-0.1076	-0.1331	0.1178	-0.0536	0.0016
33	Togo	-0.3578 **	-0.295 **	-0.065	0.7486 ***	0.0903	0.068
34	Tunisia	-0.1371 **	-0.0724	-0.0369	0.3472	-0.0524	0.1755
35	Uganda	0.3076 **	-0.6037 ***	0.0938	0.561 ***	0.1124	0.3337 **
36	Zimbabwe	-0.2696	0.8365 **	0.0614	0.776 ***	0.2225	0.2289

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