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On Export and Economic Growth: A Comparative Analysis of Selected West African Countries

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ABSTRACT

The effect of export on economic growth has attracted much attention amongst researchers and practitioners. Conventional theories posit that output growth is attainable if countries produce and export the goods in which they have comparative advantages or are resourcefully endowed. Available evidence, however, sometimes present negative or inconclusive results on export-growth nexus. The study applied the panel cointegration and panel corrected standard errors (PCSE) on a sample of thirteen selected West African countries for the period 1990-2018. The result shows existence of cointegration amongst the variables. The PCSE results indicate positive long run relationships between export and growth, on one hand and exchange rate and growth, on the other. The study recommends measures to improve trade and attain growth in region such as the complete removal all forms of export restrictions and tariff on primary products, as well as administrative tax exemptions for domestic firms that engage in production of export goods.

Keywords: Economic Growth, Export, Exchange Rate, Panel Cointegration
JEL Classification: I3, F10, F31, C10

1. INTRODUCTION

The need to achieve economic growth is indisputably the central objective of macroeconomic policy. Most countries employ several measures to pursue targeted growth for their economies due to dire economic shocks. The 1929 Great Depression caused global stock market crash and plummeted international trade by 30% for 1930-1932. To mitigate the effects many governments implemented the import industrialization by imposing import tariffs and quotas to safeguard their domestic industries. In wake of the Second World War, some Latin American countries deliberately adopted this inward-looking framework as a frontier development policy between 1950s and late 1970s. The trade restriction policy latter created commodity market distortions and substantially slow industrialization process (Frank et al., 1975; Krueger, 1979). The failure of this economic measure to generate sufficient growth led to its gradual abandonment for export promotion industrialization. The export promotion policy rose to prominence in 1980s with four main policy actions; reduction of the import substitution biases, a preferential (domestic) tax system, administrative supports for export promotion and subsidy allocation for export activities. This liberalization scheme becomes widespread among developing and transition economies for several decades till date.

The effects of export on growth have been subject to severe debates. Helpman and Krugman (1985) theorised that the export will only translate to economic progress for countries with comparative advantage in the production of “exportables.” As noted, (Federici and Marconi, 2002; Mao et al., 2019; Ozturk and Acaravci, 2010) the tremendous growth attained by four East Asian export dominated economies-south Korea, Taiwan, Hong Kong and Singapore-give credence to the export-led growth (ELG) hypothesis. Monetary authorities in these countries used an undervalued exchange rate to make their exports less expensive and more competitive. They encourage exporters to employ innovative technology in order to compete in auto manufacturing industries and ease access for international trade to meet up with global demand (Timmer et al., 2019; Salim and Hossain, 2011; Lee and Huang, 2002; Shafiullah and Navaratnam, 2016; Arteaga García et al., 2020; Kock, 2021). The need for export to stimulate growth depends on export demand. Since the financial crisis in 2008 developed nations have not regained strength for huge global demand, some evidence (Salim 2011; Tang et al., 2015; Shafiullah et al. 2016) note that the usefulness of the ELG paradigm may now be exhaustive. This raises concern on the efficacy of the ELG nexus (Li et al., 2015; Shafiullah et al., 2017; Felipe and Lanzafame, 2019; Tang and Abosedra, 2021).

A key aspect concerning early studies is related to both the methodology and the econometric technique used. The theoretical benchmark can be considered in general weak and based on bivariate and ad hoc production functions, while the empirical results derived from traditional econometrics have been highly criticized for being spurious. Therefore, early studies could have been misleading in that they advocated export expansion in an indiscriminate way. In fact, the evidence available is far from conclusive and this situation explains to some extent why this debate still exists in the economic literature. Consequently, the purpose of this study is to examine and test the ELGH, using the case of West Africa countries (most available studies focused on Sub-Saharan Africa (SSA) countries, and since West Africa shares dissimilar characteristics[1] from other regions of the SSA). The study is vital and timely for some reasons). The study has three distinctive features, in contrast to the hundreds of empirical studies on growth that have been published. First, we have gone beyond the traditional neoclassical theory of production by building on Mao et al. (2019) and Fumitaka (2018), which includes exports, using annual data for the period 1990-2018. The inclusion of exchange rate as a third input justified the volatility impact on export and growth. Secondly, the study focuses on similar nature countries, examining empirically the relationship between export expansion and economic growth. Thirdly, it has gone beyond the traditional short-term effects, and uses extensively modern time series to examine empirically the long-run relationship, employing several procedures to test for cointegration. Thus, the final aim of this study is to quantify the importance of exports in the economic performance of West African economies.

2. EMPIRICAL LITERATURE

Although the relationships between export and growth have been theoretically formulated, evidence so far produced mixed outcomes. The results obtained by empirical studies are largely influence by the estimation method (least square or Instrumental variable), the nature of data (time series, cross sectional or panel data), the treatment of variables (nominal or real), the transformation imposed on variables (logarithmic or percentage) and the model specification (linear or non-linear). All empirical papers on the ELG fall under one of three categorisations: studies based on cross-countries (cross-countries) analysis; studies based on time series analysis of a country (or of country-by-country) data; and studies based on panel data analysis.

Earlier works within the framework of neoclassical theories (Bhagwati, 1978; Balassa, 1985; Gonclave and Richtering, 1986; Heitger, 1987; Moschos, 1989; Fosu, 1990) were based on cross-sectional studies. These authors examine whether the ELG differ across spectrum of countries under the salient assumption that countries are similar in economic structure and production. They investigate the ELG nexus with correlation and ordinary least squares, OLS. Balassa (1985) found positive correlation between GDP growth rate and export growth rate. Moschos (1989) use static cross-country comparisons with correlation analyses to assert the impact of export on growth. Gonclave and Richtering (1986) use a sample of seventy countries to establish positive correlation between export/GDP ratio and GDP growth. Fosu (1990) examined the extent to which export growth affects the economic growth rate for twenty-eight less developed countries. He obtained a positive impact of export on growth. He notes that export effect for Africa is smaller than those for non-African less developed counterparts.

Several studies (Pesaran and Smith, 1995; Riezman et al., 1996; Shan and Sun, 1998; Abou-Stait, 2005; Ullah et al., 2009; Salim and Hossain, 2011; Barbara and Alberto, 2012; Ruba et al., 2014; Ogbokor and Meyer, 2016) investigated the short run and long run effect of exports on growth based on time series data. Abou-Stait (2005) examined the relationship for Egypt from 1977 to 2003. The paper used cointegration analysis and unit root tests. The finding was that GDP, exports and imports are cointegrated. Ullah et al. (2009) studied ELG hypothesis for Pakistan during 1970-2008. The finding show that export expansion leads to economic growth. They also report causality between economic growth, exports, and per capita income. Barbara and Alberto (2012) investigated ELG relationship for Italy with time series data from 1863 to 2004. Their results show existence of long-term causality between industrial export and economic growth. Ruba et al. (2014) examined ELG nexus for Jordan during the period 2000-2012. The study shows a causal relationship going from the economic growth to Export, and not vice versa.

Some panel data papers (Demetriades and James, 2011; Fowowe, 2011; Seabra and Galimberti, 2012; Fumitaka, 2018) examined inter and intra country using different fixed effects and random effects estimation. Fowowe (2011) investigated seventeen African countries and found the existence of a homogenous bi-directional causality between exporting financing and economic growth. Demetriades and James (2011) studied eighteen SSA countries for the period from 1975 to 2006 and observed the causality connexion between export finance and growth were significant. Since most available work focused on aforementioned regions, and a few attentions devoted to SSA region, this paper complements the literature on the ELG nexus by providing panel evidence for the West Africa sub-region, which has been scantily researched.

1 These include dependence on the exports of a few primary commodities; low per capita incomes; reliance on importation of technology and capital goods; and underdeveloped financial markets.

3. ESTIMATION AND MODEL SPECIFICATION

3.1. Panel Unit Root (PUR) Test

In panel data analysis, when the total number of time dimension, T is large relative to the total number of cross-section individual, n, the data is referred to as time-series cross-section (TSCS) data. PUR test is used to verify the stochastic characteristics of the data generating process (DGP) of a TSCS data and to ensure where necessary, that we differenced or induce trend to make the series non-integrated, denoted as I(0) We applied basic PUR tests (Levin, Lin and Chu, LLC-test; Im, Pesaran and Shin, IPS-test; Augmented Dickey Fuller, ADF-test; and Phillip Peron, PP-test) to test the null hypothesis that the TSCS data are integrated as against the alternative hypothesis that each series is stationary or trend stationary. For each test, the test statistics are obtained from assumption made to adjust the generic Fisher-ADF model specified below:

$$\Delta y_{it} = \alpha_i + \beta_i t + \delta_i y_{it-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{it-j} + \varepsilon_{it}, \tag{1}$$

$\{(H_0$: δ_i=0; for all i=1,2,…,n); $I(r>0)\}$

$\{(H_1$: δ_i<0; for all i=n+1, n+2,…,n);$I(r$=0)$\}$

The i (is a stationary non-zero fraction of the individual processes) denotes the cross-sectional individual and t denotes time. The LLC test adopts (1) and assumes that there is a common unit root process for these models, so that the autocorrelation coefficients (ρ=δ+1) is identical across units. The coefficient (δ_i=δ=ρ–1) is considered constant, while the lag order, p_i is allowed to very across individuals. For this test, first we carry out separate ADF regressions for each individual and generate two orthogonalized residuals. Next, we estimate the ratio of long run to short run innovation standard deviation, s for each unit. Finally, we compute the pooled t-statistics and use the ratio, to adjust (modify) the mean of the pooled t-statistics. The IPS test adopt (1) for each cross section and combines individual unit root tests to derive a panel-specific result, so that ρ_i may vary across cross-sections. After we estimate the separate ADF regressions and obtain the average of the t-statistics for δ_i and adjusted its value to arrive at the IPS test statistic.

3.2. Panel Cointegration Test

The procedure for evaluating cointegration of non-stationary TSCS data is different from those applied for integrated times series data. Cointegration checks whether the combination (via least squares or elsewise estimation) of two or more separately integrated TSCS data ($x_{i,t}$), ($y_{i,t}$) and ($z_{i,t}$) will be stationary. If the TSCS data is integrated, Kao (1999) posits a DF/ADF panel cointegration tests which is a unit root test of the residuals of a panel spurious regression.

To test panel cointegration, consider a panel spurious regression model:

$$y_{i,t} = x_{i,t}\beta + z_{i,t}\gamma + e_{i,t} \tag{2}$$

Where at least one of $y_{i,t}$ $x_{i,t}$ and $z_{i,t}$ is I (1), and $e_{i,t}$ is expected to be white noise.

Kao (1999) formulated that we obtain the $e_{i,t}$ from the OLS pooled regression and used it as data to estimate (3) and (4) below. The Fisher-DF regression is:

$$\hat{e}_{i,t} = \rho\hat{e}_{i,t-1} + v_{i,t} \qquad \left[\hat{e}_{i,t} = \tilde{y}_{i,t} - \tilde{x}_{i,t}\hat{\beta};\ \tilde{y}_{i,t} = y_{i,t} - \overline{y}_i\right] \tag{3}$$

The Fisher-ADF regression [which adds ($\sum_{j=1}^{p} \vartheta_j \Delta\hat{e}_{i,t-j}$) -difference of lagged of $e_{i,t}$ to (3)] is:

$$\hat{e}_{i,t} = \rho\hat{e}_{i,t-1} + \sum_{j=1}^{p} \vartheta_j \Delta\hat{e}_{i,t-j} + v_{i,t,p} \tag{4}$$

The Kao test is a test of significant for (ρ)- the coefficient of first order autoregressive AR(1) Markov scheme. ρ is estimated from the fixed effects OLS regression of $e_{i,t}$ on its own lagged, $\hat{e}_{i,t}$ and difference of lagged, $\Delta\hat{e}_{i,t-j}$ [(3) and (4)]. We use the Kao ADF-test for this paper.

To obtain the Kao ADF (residuals) test statistics, we first apply OLS on (4) and obtain:

$$\hat{\rho} = \left[\sum_{i=1}^{n}\sum_{t=2}^{T}\hat{e}_{i,t}\hat{e}_{i,t-1} + \sum_{i=1}^{n}\sum_{t=2}^{T}\sum_{j=1}^{p}\Delta\hat{e}_{i,t-i}.\Delta\hat{e}_{i,t-j}\right] / \sum_{t=1}^{T}\hat{e}_{i,t}^2$$

$$S_e = \frac{1}{nT}\left(\hat{e}_{i,t} - \rho\hat{e}_{i,t-1} - \sum_{j=1}^{p}\vartheta_j\Delta\hat{e}_{i,t-j}\right)^2 \tag{4.1}$$

$$t_{\rho*} = (\hat{\rho}-1)\sqrt{\left[\sum_{i=1}^{n}\sum_{t=2}^{T}\hat{e}_{i,t}\hat{e}_{i,t-1} + \sum_{i=1}^{n}\sum_{t=2}^{T}\sum_{j=1}^{p}\Delta\hat{e}_{i,t-i}.\Delta\hat{e}_{i,t-j}\right]} / S_e$$

The Kao approach uses $t_{\rho*}$ and $t_{\rho*}$ to test null hypothesis of no cointegration, H_0: $\rho=0$ against the alternative hypothesis, H_1: $\rho=1$. The ADF test statistics is computed as:

$$\mathrm{ADF\_stat} = \left(\mathrm{t}_{\tilde{n}*} + \frac{\sqrt{6n}\hat{\sigma}_v}{2\hat{\sigma}_v^2}\right) / \sqrt{\left[\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_{0v}^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}\right]} \tag{4.2}$$

Where $t_{\rho*}$ is the computed t-statistic of ρ in (4.1). $\hat{\sigma}_v$ is the estimate of the variance of the Gaussian white noise term ($v_{i,t,p}$) and S_e is the estimated standard error of regression for the integrated stochastic residuals, $\hat{e}_{i,t}$. Note that $e_{i,t}$ is not necessarily a white noise process. Second, since the asymptotic distributions of Fisher-ADF converge to a standard normal distribution [N(0,1)] by the sequential limit theory, the ADF_stat will be compared with the ADF critical value, at a given significance level.

3.3. The PCSE Estimation

To estimate a TSCS data, a major issue that defines which estimator to use is the handling of cross-sectional correlation[2] (i.e., the error-variance-covariance matrix, EVCM). Beck and Katz (1995) developed a FGLS-Parks estimator known as panel corrected standard errors (PCSE). To estimate the PCSE, we consider a generic (theoretical) matrix model:

$$y_{i,t} = x'_{i,t}\beta + \epsilon_{i,t} \qquad [i = 1,\ldots\ldots, n;\ t = 1,\ldots, T] \tag{5}$$

In (5), $y_{i,t}$ is the dependent variable and $x_{i,t}$ is a $(K + 1) \times 1$ vector of independent variables whose first element is 1, and β is a $(K + 1) \times 1$ vector of unknown coefficients (K). Both $y_{i,t}$ and $\varepsilon_{i,t}$ are scalars. When stacked $[y_{i,t}; x_{i,t}]$, we have:

$$y_{i,t} = [y_{1,t11}\ldots y_{1,T1}\ y_{2,t21}\ldots y_{2,T1}\ldots y_{n,tn}]'$$

$$X_{i,t} = [x_{1,t11}\ldots x_{1,T1}\ x_{2,t21}\ldots x_{2,T1}\ldots x_{n,tn}]' \tag{5.1}$$

This formulation (5.1) allows the panel to be unbalanced since for individual i only a subset: $[t_{i,1},\ldots,T_i$ with $1 \le t_{i,1} \le T_i \le T]$ observations may be available. We assume strict exogeneity, autocorrelated, heteroscedastic and cross-sectionally dependent of $\epsilon_{i,t}$ With these;

The OLS estimates of (5) denoted as β_{OLS} and residuals are:

$$\hat{\beta}_{OLS} = (X'X)^{-1}(X'y)\ \left[\varepsilon_{i,t} = y_{i,t} - x'_{i,t}\hat{\beta}_{OLS}\right] \tag{6}$$

The variance of β_{OLS} is the square roots of the diagonal terms of matrix:

$$\mathrm{Cov}\left(\hat{\beta}_{OLS}\right) = \left(X'X\right)^{-1}\left\{X'\Omega X\right\}\left(X'X\right)^{-1} \tag{7}$$

With spherical error assumption the EVCM $(\Omega) = \sigma^2 I$: where

I is an $nT \times nT$ identity matrix. Eq.7 in terms of estimate of error variance component, $\hat{\sigma}^2$ is $\left[Cov\left(\hat{\beta}_{OLS}\right) = \hat{\sigma}^2\left(X'X\right)^{-1}\right]$ is the panel (*incorrect*) standard errors for (1) in presence of cross-sectional correlation, autocorrelation and heteroskedasticity.

To account for the presence of cross-sectional dependence an estimator of the [ij]th cross-units covariance, $\hat{\sigma}_{ij}$ is used to adjust Ω in (7). Under the condition that $T > n$, a robust FGLS standard errors estimate used to adjust in $Cov\left(\hat{}_{OLS}\right)$ is: $\hat{\sigma}_{ij(FGLS)} = \widehat{\sum}_{i,j}$.

As noted, (Beck and Katz, 1995), when a robust standard error, is used to correct the OLS estimates of variance, we obtain the PCSE. The PCSE estimates is obtained from (7) as follows: first, we denote the EVCM which comprises all elements $\widehat{\sigma}_{ij}$ as; $\widehat{\sum}$. For with balanced data $\left[T_{i,j} = T; \forall i = 1,2,\ldots,N\right]$ or unbalanced data $[t_{i,1},\ldots T_i$ with $1 \le t_{i,1} \le T_i \le T]$, we use $\widehat{\sum}$ to form the estimator Ω by creating a block diagonal matrix with the $\widehat{\sum}$ matrices along the diagonal and obtain:

$$\widehat{\sum} = T^{-1}\left(\varepsilon'\varepsilon\right)\left[\varepsilon \text{ is } nT \times nT \text{ matrix of residuals}\right] \tag{8}$$

The variance structures take the following general form:

$$\underset{(nT\times nT)}{\Omega} = \begin{pmatrix} \sigma_{11}I_{(T\times T)} & \sigma_{12}I_{(T\times T)} & \cdots \sigma_{1n}I_{(T\times T)} \\ \sigma_{21}I_{(T\times T)} & \sigma_{22}I_{(T\times T)} & \sigma_{2n}I_{(T\times T)} \\ \vdots & & \vdots \\ \sigma_{n1}I_{(T\times T)} & \sigma_{n2}I_{(T\times T)} & \ldots \sigma_{nn}I_{(T\times T)} \end{pmatrix}$$

$$\text{where } \Sigma_{ij} = \Sigma = \begin{pmatrix} \sigma_{11} & \sigma_{12} & \cdots \sigma_{1n} \\ \sigma_{21} & \sigma_{22} & \sigma_{2n} \\ \vdots & \vdots & \\ \sigma_{nl} & \sigma_{n2} & \ldots \sigma_{nn} \end{pmatrix};$$

$$\text{and } \Omega^{-1} = \underset{(n\times n)}{\Sigma^{-1}} \otimes I_{(T\times T)}.$$

$$\hat{\Omega} = \sum\nolimits_{m\times m} \otimes I_{NT\times NT} \qquad [\otimes = \text{Kronecker product}] \tag{9}$$

We use $\hat{\Omega}$ in (9) to replace Ω in (7) and take the square root of the diagonal elements to obtain the PCSE estimate of variance (10) that is free from cross-sectional correlation:

$$PCSE = (X'X')^{1}X'\Omega X(X'X)^{1} \tag{10}$$

Next, we specify the empirical model employ to examine the ELG relationship. Building on the framework of Mao et al. (2010) and Fumitaka (2018), we formulate a simple model in which export impacts growth through a major determinate of export revenue - the value of national currency (exchange rate). In line with generic model (5), we use a fixed effect model:

$$GDPi,t = \alpha_{*+}\beta_1\, EXPORT_{i,t} + \beta_2\, EXCH_{i,t} + e_{i,t} \tag{11}$$

Where gross domestic product, GDP proxies for rate of change in economic growth, EXPORT is export and EXCH is exchange rate. The dependent variable, Y is the scalar (GDP) and X is the vector of regressors (EXPORT; EXCH).

The change in GDP data is used in order to checkmate exchange rate differences as a source of growth and control for the initial

2 There are three broad approaches: first is to model the EVCM with Seemingly Unrelated Regression Estimation (SURE) using the Feasible Generalized Least Squares, FGLS (Parks, 1967; Kmenta, 1986); second is to model the cross-units dependencies ‘spatially’ by specifying the EVCM as a function of distance in continuous or binary continuum (Baltagi et al., 2013; Bivand and Piras, 2015); third is to model the cross-sectional dependence as a function of time-specific common factors (Pesaran, 2006; Eberhardt et al., 2013). The parked (1967, modified by Kmenta, 1986) model has two problems: first, the FGLS estimator cannot be estimated when T < n, because the EVCM will not be invertible; Second even when T > n, some observations may cause the elements of the EVCM to be inaccurate leading to underestimation of coefficients of standard errors. To mitigate these problems Beck and Katz (1995) suggest we rely on the OLS estimates by simple correction of the standard errors in the panel.

Table 1: Panel unit root test (level and first difference)

Variable	LLC	IPS	ADF	PP
GDP	–1.01661* (0.1547) –5.45797** (0.0000)	–3.60205* (0.0002)	59.8631* (0.0004)	146.468* (0.0000)
EXCH	–46.9828* (0.0000)	–20.6387* (0.0000)	42.8483* (0.0360)	47.2114* (0.0130)
EXPORT	–8.87754* (0.00000)	–10.2752* (0.0000)	135.291* (0.0000)	145.464* (0.0000)

Source: Authors, 2022. Note: The * and ** show the rejection of the null hypothesis at level and first difference while the value in parenthesis shows the probability

development while EXCH is used to provides the need to analyse the dynamic impact of export and exchange rate on economic growth. The expected signs of the coefficients of EXPORT and EXCH are as follow: EXPORT is expected to be positive, while EXCH can be positive or negative. Li et al. (2015) observed through the rise in the price of international goods, a fall in exchange rate may enhance economic activity by producing excess demand for exports. Conversely, exchange rate appreciation may impair negatively on production and export of the country (Hooy et al., 2015)

Beck and Katz (1995) advised that we eliminate the autocorrelation by transforming the TSCS data using Prais-Winsten transformation to get $[y_{*i};X_{*i}]$ which is now used for estimation.

$$\mathbf{y}_{*i} = \begin{pmatrix} \sqrt{1-r_i^2}\,y_{i1} \\ y_{i2} - r_i y_{i1} \\ y_{i3} - r_i y_{i2} \\ \vdots \\ y_{iT} - r_i y_{iT-1} \end{pmatrix}, \quad \mathbf{X}_{*i} =$$

$$\begin{pmatrix} \sqrt{1-r_i^2} & \sqrt{1-r_i^2}\,x_{1i1} & \sqrt{1-r_i^2}\,x_{2i1} & \cdots & \sqrt{1-r_i^2}\,x_{ki1} \\ 1-r_i & x_{1i2} - r_i x_{1i1} & x_{2i2} - r_i x_{2i1} & & x_{ki2} - r_i x_{ki1} \\ 1-r_i & x_{1i3} - r_i x_{1i2} & x_{2i3} - r_i x_{2i2} & & x_{ki3} - r_i x_{ki2} \\ & \vdots & & \vdots & \\ 1-r_i & x_{1iT} - r_i x_{1iT-1} & x_{2iT} - r_i x_{2iT-1} & & x_{kiT} - r_i x_{kiT-1} \end{pmatrix}$$

$$= \begin{pmatrix} \sqrt{1-r_i^2}\,\mathbf{x}_{i1} \\ \mathbf{x}_{i2} - r_i \mathbf{x}_{i1} \\ \mathbf{x}_{i3} - r_i \mathbf{x}_{i2} \\ \vdots \\ \mathbf{x}_{iT} - r_i \mathbf{x}_{iT-1} \end{pmatrix}$$

From the (11), we obtain all residuals, $(e_{i,t} = \text{GDP}_{i,t} - \hat{\alpha}_* - \hat{\beta}_1\text{EXPORT}_{i,t} - \hat{\beta}_2\text{EXCH}_{i,t})$ and compute, r_i and r* used for the Prais-Winsten transformation below:

$$\bar{r} = \frac{1}{n}\sum_{i=1}^{n} r_i, \quad r = \frac{\sum_{i=1}^{n}\sum_{t=2}^{T} e_{it}e_{i(t-1)}}{\sum_{i=1}^{n}\sum_{t=1}^{T} e^2_{it}} \quad \text{or} \quad r^* = \text{Sample Corr}\left[e_{i,t-1}, e_{it}\right] \tag{12}$$

The transformed data $[y_{*i}; X_{*i}]$ are then used to analyse the heteroskedastic structures.

Table 2: Kao (residual) cointegration test

ADF	t-statistic	Prob.
	–5.214996	0.000
	Residual variance - 199.2706	
	HAC variance - 111.0465	

Source: Authors, 2022

Table 3: Cross-section weights PCSE (standard errors and covariance [d.f corrected])

Variable	Coefficient	Std. Error	t-statistic	Prob
EXPORT	0.320402	0.042092	7.611874	0.0000
EXCH	0.017345	0.007599	2.282703	0.0235
C	–2.643274	2.526439	–1.046245	0.2968
Summary of Effects Specification (Cross-section fixed)				
R-squared - 0.76847				
Mean dependent - 6.12235				
S.D. dependent Var - 38.00878				
S.E of regression - 7.44773				
Akaike info - 48.48093				
Hannan-Quinn - 8.199365				
F-statistic - 5.587679				
Prob (F-statistic) - 0.000000				

Source: Authors, 2022

The PCSE has proven popular and efficient in most macro panel studies, as evidenced by over 2000 citations on Web of Science (Eberhardt and Teal, 2011 and Moundigbaye et al., 2017). The PCSE provides robust result when applied for ELG on selected SSA countries (Federici and Marconi 2002; Lewer and Berg, 2003; Agrawal, 2014; Fumitaka, 2018). Before we estimate the model with PCSE, it is required to conduct panel unit root and cointegration tests since the PCSE is mainly compactable with stationary TSCS (Beck and Katz, 1995).

3.4. The Data

We employed annual time series data for thirteen selected West African countries: Benin, Burkina Faso, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierallone and Togo. Since most countries in this sub-region benefited from export-led growth only after 1990, we focus our scope on period from 1990 to 2018. All data are sourced from the International Financial Statistics (IFS) and World Development Indicator (WDI).

4. RESULTS

4.1. Panel Unit Root Test

The stationary properties of the variables (GDP, EXPORT and EXCH) are examined as a preliminary test. This is done to avoid presenting spurious estimates for our PCSE. As reported

(Table 1) the unit root test shows that both EXPORT and EXCH are stationary at level while GDP is stationary at first difference.

Table 4: Period weights PCSE (Swamy and Arora Estimator of Component Variances)

Variable	Coefficient	Std. Error	t-statistic	Prob.
EXPORT	0.334871	0.037144	9.015368	0.0000
EXCH	0.010121	0.004045	2.502387	0.0131
C	–0.595122	1.744351	–0.341171	0.7333
	Effect specification	**S.D.**	**Rho**	
	Cross-section random	2.656193	0.0436	
	Period random	0.00000	0.0000	
	Idiosyncratic random	12.4477	0.0544	

Source: Authors, 2022

Table 5: Cross-section weights PCSE (white diagonal standard errors and covariance)

Variable	Coefficient	Std. Error	t-statistic	Prob.
EXPORT	0.33999	0.092084	3.692129	0.0003
EXCH	0.00835	0.001737	4.812126	0.0000
		Summary of Effects Specification (Cross-section fixed)		
		R-squared - 0.86847		
		Mean dependent - 6.12235		
		S.D. dependent Var - 48.00878		
		S.E of regression - 6.24773		
		Akaike info - 7.96830		
		Hannan-Quinn - 7.95013		

Source: Authors, 2022

4.2. Kao Cointegration Test

Since the order of stationary has been established, we conduct the cointegration test using Kao (1999) to scrutinize whether the variables are cointegrated. The result (Table 2) reveals that the variables are cointegrated. This implies that the variables have a long-run relationship.

4.3. The PCSEs

Here, the PCSE estimates for the effect of export and exchange rate on growth is presented (Tables 3-5). The result in Table 3 reveals that export affect progress in the area directly. This infers that export has meaningly predisposed growth for selected West Africa countries which is consistent with previous empirical studies (Shafiullah and Navaratnam, 2016; Salim and Hossain, 2011; Mao, Ozturk and Acaravci, 2010; Federici and Marconi, 2002).

The outcome also show that exchange rate affects growth in the area favourably. This infers that exchange rate has contributed to the growth of these countries significantly. The standard errors (0.042092, 0.007599, and 2.526439) and standard dependent variance (38.00878) in Table 3 are very minimal with acceptable level of confidence.

In order to increase the minimal acceptable level of confidence, there is need to further carry out separate Period Weights PCSE (Table 4) and Cross-Section Weights PCSE (Table 5).

Table 6: Granger causality between EXPORT and GDP

Country	EXPORT does not Granger-Cause GDP	GDP does not Granger-Cause EXPORT	Results
Benin	2.1286 (0.1480)	1.4911 (0.2517)	≠
Burkina Faso	0.6208 (0.5487)	0.2293 (0.7973)	≠
Gambia	4.2428 (0.0309)	0.0652 (0.9371)	EXPORT→G
Ghana	0.0219 (0.9783)	0.5563 (0.5829)	≠
Guinea	0.4373 (0.6525)	0.5185 (0.6041)	≠
Guinea-Bissau	0.0925 (0.0345)	0.0047 (0.5231)	≠
Liberia	0.0171 (0.9831)	0.4869 (0.6223)	≠
Mali	0.9623 (0.4008)	0.6431 (0.5373)	≠
Mauritania	0.3247 (0.7269)	1.5568 (0.2379)	≠
Niger	0.3252 (0.7265)	2.5611 (0.1050)	≠
Nigeria	0.3161 (0.0336)	4.1703 (0.7332)	EXPORT→G
Sierallone	0.1856 (0.8321)	0.8029 (0.4634)	≠
Togo	0.4041 (0.6735)	0.3288 (0.7240)	≠

Source: Authors, 2022

Table 7: Granger causality between EXCH and GDP

Country	EXCH does not Granger-Cause GDP	GDP does not Granger-Cause EXCH	Results
Benin	0.9508 (0.4050)	0.3271 (0.7252)	≠
Burkina Faso	1.9066 (0.1774)	0.0561 (0.9457)	≠
Gambia	0.1272 (0.8813)	1.2406 (0.3128)	≠
Ghana	0.0219 (0.0112)	1.9588 (0.1699)	EXCH→G
Guinea	0.0733 (0.9296)	0.6988 (0.5102)	≠
Guinea-Bissau	2.7441 (0.031)	3.6512 (0.3456)	EXCH→G
Liberia	0.0171 (0.9831)	0.4869 (0.6223)	≠
Mali	6.3711 (0.0081)	1.6671 (0.2167)	EXCH→G
Niger	1.5458 (0.2401)	0.0756 (0.9275)	≠
Nigeria	2.0123 (0.1923)	0.0463 (0.0049)	G→EXCH
Senegal	2.4050 (0.0413)	0.9382 (0.4096)	EXCH→G
Sierallone	8.4574 (0.0026)	1.2843 (0.3010)	EXCH→G
Togo	0.0873 (0.9168)	3.8729 (0.0399)	EXCH→G

Source: Authors, 2022. Note: The numbers given in () are *P* values, * denotes the rejection of null hypothesis at 5% levels

Tables 4 and 5 indicate a direct substantial effect of export and exchange rate on growth for our selected with low deviation from the expected of the model.

4.4. The Granger Causality Test Results

The results of the causality test (Tables 6 and 7) revealed the existence of unidirectional causality running from export to growth in two (Gambia and Nigeria) of thirteen countries. There is no evidence of causality between export and growth in the rest eleven countries. One possible explanation for this result for the other eleven countries could be that the presence of high growth could cause inflationary pressures making these African countries export less competitive. Higher growth may lead to higher interest rates. Higher interest rates could cause an appreciation in the exchange rate which makes exports less competitive. In Table 7, the granger causality tests reveal the existence of unidirectional causality running from exchange rate to growth in six (Ghana, Guinea-Bissau, Mali, Nigeria, Senegal, Sierallone and Togo) of thirteen countries. There is no evidence of causality between the between export and growth in six other countries.

5. CONCLUSION

This paper considers the ELG nexus in West Africa. Using the PCSE approach, a sample of thirteen countries was examined over the period 1990-2018. The PCSE produced evidence of a significant positive effect between export, exchange rate and economic growth. This suggests that export and exchange rate play pivotal role in influencing growth in these countries. That is export and exchange rate management not only affect growth but plays a pivotal role to forestall external shock. Our findings further suggest that proper management of export and exchange rate fluctuation is likely to have growth promoting effects in these countries. This conclusion has important implications for policy to promote exports activities. Firstly, the policy makers in the county should design system of attracting external investments and encourage more openness. Secondly, a distinct tax immunity to overseas and local businesspersons involved in global trade serves as incentives for increase production of export goods. Lastly, authorities in these countries should adopt guidelines targeted at achieving a steady and justifiable connection between export, exchange rate and economic growth.

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