Export Trade and Real Exchange Rate Dynamics in Sub-Saharan Africa: A Dynamic Panel Analysis

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I. INTRODUCTION

The effect of exchange rate variation on international trade becomes one of the critical issues for economic policy makers. Debates around this issue come to the fore because there is no consensus on whether variations in exchange rate affect foreign trade activity. In this direction, Khosa, Botha and Pretorius, (2015) argued that a cursory look at raw data without in-depth analysis, makes it difficult to establish the nature of the relationship between exchange rate variations and trade, while lack of clarity on this subject increases the risk of improper planning by international trade partners as well as implementation of economic policies. Hence, real exchange rate is widely considered an important macroeconomic measure which underlies the adoption of certain economic policies (Kurtovic, Halili & Maxhuni, 2017; Hunegnaw, 2017). Even though the study in this area is not yet conclusive, there is a general consensus among professionals that exchange rate influences trade balance in the long run (Chaudhary, Hashmi & Khan, 2016).

International trade generally relates to both physical goods and services. Although there has been a clear shift in the structure of global economic activity to services for all economies (Organisation for Economic Cooperation and Development [OECD], 2005), it accounts for a much lower share of total trade (United Nations Conference on Trade and Development [UNCTAD], 2018). Trade in intermediate goods equally creates an additional linkage across countries (European Central Bank [ECB], 2016). Moreover, a transition towards a more resource efficient circular economy has in recent times brought a whole new dimension to the international trade landscape. (OECD, 2019b) explain that evolving trade pattern takes the form of product value chain which may include second-hand goods, waste, scraps and trades in related services. Besides providing consumers with a range of goods and services, international trade also increases incomes and employment (Seyoum, 2009). Vijayasri (2013) observed that trade is basically an international transformation of inputs, technology and commodities which promote welfare by extending the market for the outputs of a country beyond national boundaries and may ensure better prices through exports.

Like other economic regions, there are significant variations in exchange rate regimes across Sub-Saharan African (SSA) over time. One distinguishing feature in relation to other developing regions of the world is the higher predominance of pegs. Nearly 60 percent of countries in SSA had a peg in 2014 compared with 47 percent in other emerging markets and developing economies (Hakura, 2015). By and large, it appears that some economies with pegs have less competitive real exchange rate positions compared to countries with floating and intermediate regimes. On the other hand, Dell'Ariccia (1999) observed that one of the arguments against flexible exchange rates has been that exchange rate fluctuation could have negative effects on trade and investment. If exchange rate movements are not fully anticipated, an increase in exchange rate volatility, which increases risk, will lead risk-averse agents to reduce their import/export activity and consequently reallocate production towards domestic markets. In the light of growing debate on the interaction between exchange rate and export position in developing countries, this study contributes to the discuss by examining how export of good and services responded to real exchange rate in a dynamic heterogeneous panel of the SSA.

II. REVIEW OF EMPIRICAL LITERATURE

Alege and Osabuohien (2015) explored international trade–exchange rate interaction in Sub-Saharan African countries using balanced panel estimation technique. Based on partial equilibrium analysis, the author developed two equations for export and import where exchange rate, real gross domestic product, stock of capital and technology were the regressors. The results from empirical analyses showed that import and export are inelastic to changes in exchange rate. It follows that depreciation of currencies in the region may not have had the expected outcomes in view of the structure of the economies and export compositions. Similarly, depreciation would not reduce imports but only aggravate balance of payments.

Serenis and Tsounis (2014) examined the effect of exchange rate variation for a set of 3 African countries: Malawi, Morocco and South Africa during the period of 1973: Q1-1990: Q1. The standard deviation of the moving average of the logarithm of exchange rate as a measure of exchange rate fluctuation was adopted while a new measure for volatility was proposed. Overall the results revealed significant negative effects from volatility on exports for all the countries in the sample when unexpected fluctuation measures were used.

Senadza and Diaba (2017) assessed the effect of exchange rate volatility on trade in Sub-Saharan Africa, using the pooled mean-group estimator of dynamic panel technique on data for eleven Sub-Saharan African economies over the period 1993 to 2014. The findings uncovered no significant effects of exchange rate volatility on imports. In the case of exports, however, the study found a negative effect of volatility in the short-run, but a positive effect in the long-run.

Chaudhary, Hashmi and Khan (2016) studied the relationship of exchange rate with exports and imports of major Southeast Asian and South-Asian economies. The Autoregressive Distributed Lag (ARDL) technique to co-integration as well as Error Correction technique was employed to ascertain the long run and short run relationship between the variables in the sample economies between 1979 and 2010. The results suggested that the long run relationship between exchange rate and exports exists in more than half of the sample economies. However, the relationship between exchange rate and imports was found only in one sample country. Moreover, the significant short-run relationship between the variables was not observed in majority of the sample countries.

Meniago and Eita (2017a) investigated the impact of exchange rate changes on imports in Sub-Saharan Africa using the panel OLS approach. The results indicated that there is a positive relation between exchange rate changes and imports, although the degree of responsiveness was very low. The author emphasized that this contradicts economic theory and can be attributed to the fact that many countries in the region largely depend on imports, and inclined to be invariant to exchange rate changes.

Genc and Arter (2014) examined the impact of exchange rates on exports and import of emerging economies. This study focused on establishing whether there exists a cointegrated relationship between exchange rates of selected emerging market countries, using the panel cointegration method for the period of 1985 to 2012. The results suggested that a cointegrated relationship exists between exchange rates and exports-imports of emerging economies in the long run.

Chamunorwa and Choga (2015) investigated the relationship between exchange rate volatility and export performance in South Africa. This relationship was determined using Generalised Autoreressive Conditional Heteroskadascity (GARCH) methods. The research aimed to establish whether exchange rate volatility impacts negatively on export in the manner suggested by most econometric models. The result revealed that exchange rate volatility had a negative and significant effect on South African exports in the period 2000-2011.

In contrast, Raddatz (2007) explored the impact of exchange rate volatility on trade and exports in South Africa using time series data and gravity equations models. The results did not show any evidence of a robust, first-order negative effect of exchange rate volatility on exports or bilateral trade flows.

In the Kenyan case, Meniago and Eita (2017b) examined the effects of exchange rate volatility on trade in selected Sub-Saharan African countries for the period 1995-2012. Export and import models were analysed using panel data econometric technique. The results revealed that exchange rate volatility depresses exports, suggesting that exporters in the region are susceptible to reduce their export activities when exchange rates are volatile. The results also indicate that exchange rate volatility is negatively related to imports.

III. DATA AND METHODOLOGY

Panel data set for this study were obtained from the World Bank's World Development Indicators (WDI) over the period 1990-2018 for 31 Sub-Saharan African (SSA) countries. Based on available data and dynamic panel function of the variables, the natural logarithm of real exchange rate is regressed against the ratio of total exports of goods and services to GDP. The technical approach employed is the Two-step System Generalized Methods of Moments (SGMM). The SGMM is as a dynamic panel estimator which takes care of the shortcomings associated with the traditional panel estimation technique. Thus, the SGMM controls for endogeneity as well as accounts for heteroscendasticity. Moreover, the GMM is generally designed for panel-data models with "small *T* and large *N*", meaning few time periods (*T*) and many cross-sections or individuals (*N*), and where the explanatory variables are not strictly exogenous. Hence, technically, further justification for our choice of this method is based on the fact that the variables of interest have mixed orders of integration – orders one and two, while the panel configuration displayed cross-sections (31) less than time (29 years).

3.1 Model Specification

Specifically, this study adopted and modified the model proposed by Alege and Osabuohien (2015) which explored international trade–exchange rate interaction in Sub-Saharan African (SSA) countries. The export equation is specified as:

$$\log(X_{it}) = \theta_0 + \theta_1 \log(EXR_{it}) + \theta_2 \log(IMP_{it}) + \theta_3 \log(RGDP_{it}) + \theta_4 \log(KAPI_{it}) + \theta_5 \log(TECH_t) + \epsilon_{it} \quad (1)$$

Where *i* and *t* denotes country and time, respectively. *Log(X)* = log of export of goods and services, *log(EXR)* = log of exchange rate, *log(IMP)* = log of import of goods and services, *log(RGDP)* = log of real gross domestic product, *log(KAPI)* = log of gross fixed capital formation, *log(TECH)* = log of aggregate value added in transport, storage and communication sectors, and ϵ_{it} = error term.

In constructing the model of the study, the study represented the explicit model for export in the following form:

$$EXP = f(InRER) \quad (2)$$

Where *EXP* is Exports of goods and services as ratio of GDP and *InRER* is Log of real exchange rate. With the addition of the dependent variable lag as a regressor to the model, the following baseline export function emerges:

$$EXP = f(EXP_{-1}, INRER) \quad (3)$$

This study modified Equation (3) to derive a dynamic panel specification which takes into account the selected variables. The SGMM dynamic heterogeneous panel is therefore represented thus:

$$EXP_{it} = \theta_0 + \theta_1 EXP_{-1it} + \theta_{2In}RER_{it} + \epsilon_{it} \quad (4)$$

Where *i* and *t* represents country and time, respectively

EXP = Exports of goods and services as percentage of GDP ratio

EXP_{-1} = One period lag of export

InRER = Log of Real exchange rate

$\theta_1 - \theta_2$ = Parameter estimates

θ_0 = Intercept

ϵ_{it} = Error term

IV. RESULTS AND DISCUSSION

Table 1. Descriptive Statistics

Variable	Mean	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Obs.
InRER	299.3905	8278.084	1.330542	815.7646	6.513308	52.66667	89749.85	817
EXP/GDP (%)	30.02774	98.88926	3.335026	18.23081	0.989190	3.522872	142.5456	817

Table 1 presents the descriptive statistics of this study's panel dataset which shows that, on the average, real exchange rate (RER) stood at 299.3905, and ranged between 1.330542 and 8,278.084. Exports (EXP) as a share of GDP averaged 30.03% between 1990 and 2018. Both variables are positively skewed while the normality and peakness of the study's curve as measured by the kurtosis shows that the data may not be normally distributed. This may be due to heterogeneity within the countries under study. It is better to trade when indices are positively skewed as negative skewness (longer tail to the left) implies increasing returns at a decreasing rate from 1990 to a peak and fall/decreases swiftly.

Table 2. Results of Panel unit root test

Variable	[a]Levin, Lin & Chu t	[b]ADF - Fisher Chi-square	Order of Integration
InRER	-13.6869***	251.233***	I(1)
EXP	-10.5385***	260.291***	I(1)

[a]Null: Unit root (assumes common unit root process),

[b]Null: Unit root (assumes individual unit root process)

***Significant at 1% and 5%

Table 2 above depicts the result of the stationarity tests of the study's variables. It shows the constant nature of the time series data and its usefulness in predicting the future. Therefore, the stochastic trend in time series is random, but predictable

The stationarity status of the variables was tested using 2 test criteria namely, Levin, Lin & Chu t and Augmented Dickey-Fuller (ADF). It is worthy to note that the above stationarity tests complement/support each order. In analyzing the model, trends and intercepts are taken into consideration (being a regression analysis) and this supports why we brought it in the analysis. As can be seen above, while Levin, Lin & Chu t assumes common (average) unit root process, ADF - Fisher Chi-square assumes individual unit root process and when all of them is stating stationarity at order 1(1), then they do not have unit root and prediction capacity of the study data is better. All the criteria confirmed stationarity at 5% significance level. From the general results, the study therefore concluded that the study's panel series have single order of integration at order one (I (1)).

Table 3 Endogeneity test result of the relationship between export and real exchange rate

Wald Test:			
Equation: EXP=*f*(INRER)			
Test Statistic	Value	Df	Probability
F-statistic	4.645389	(1, 174)	0.0001
Chi-square	20.647835	1	0.0024
Null Hypothesis: C(1)			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(1)		1.835634	0.357830

The study's estimation complied with the endogeneity problem assumption that the independent variables correlate with the error term. Based on the endogeneity test result in Table 3, there is evidence to reject the null hypothesis of no endogeneity with reported p-value (0.0001<0.05) and accept the alternate hypothesis that there is endogeneity which is a condition for the use of SGMM.

Table 4: Results of System Dynamic Panel-data Estimation

Dependent Variable: Export (EXP)

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System dynamic panel-data estimation            Number of obs      =        734
Group variable: Country                         Number of groups   =         31
Time variable: time
                                                Obs per group:
                                                             min =            6
                                                             avg =     23.67742
                                                             max =           28

Number of instruments =    393                  Wald chi2(2)       =     817.16
                                                Prob > chi2        =     0.0000
One-step results
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EXP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
EXP						
L1.	.7480108	.0272911	27.41	0.000	.6945213	.8015004
InRER	-3.954468	1.093509	-3.62	0.000	-6.097706	-1.81123
_cons	15.63345	2.468272	6.33	0.000	10.79572	20.47117

Model Equation: EXP = 15.63 + 0.75EXP_{-1} -3.95InRER and P = 0.000 (See Table 4).

Table 4 presents the results of the effect of exchange rate on exports based on the SGMM estimation. The result showed that one-period lag of export has positive and significant influence on current export. The parameter estimate indicates that one-unit change in lagged export led to about 0.75unit increase in current export. However, because of the use of log RER, the interpretation of the study results turns to elasticity of EXP to changes in RER. The results revealed that log of real exchange rate (RER) is significantly related to export, and suggests that 1% change in RER is associated with 0.0395-unit decrease in export, because this is export elasticity of demand and read in absolute terms, as the sign simply shows that Export and real exchange rate move in opposite directions, as RER increases/depreciates, EXP reduces. The intercept is positive, meaning that all other things being equal and without lag values of export and real exchange rate effect, current export will still be positive, not zero and not negative.

In summary, the SGMM results in table 4 revealed that the parameter estimate of the independent variable is significantly related to the explained variable; *p-value = 0.000<0.05*. This implies that this study rejects the null hypothesis of no significance and accepts the alternate hypothesis that exchange rate has significant effect on export in the Sub-Saharan Africa.

Analysis of Diagnostic Tests

To validate and confirm the assumption of the system dynamic panel regression, the Sargan test as presented in Table 5 below was employed to check the null hypothesis of correct model specification and validity of instruments employed in the estimation. The Sargan test is one of the most widely used diagnostic test in GMM estimation for determining the suitability of the model. Table 5 showed that the Sargan test of valid over-identifying restrictions (p-value 0.1675>0.05) accepted the null hypothesis that the model has valid instrumentation and is well specified. Although there are no clear rules regarding appropriate number of instruments, the number of instruments should not be greater than the number of observations (Roodman, 2007), which is the case of Table 4 (393 instruments < 734 observations).

Table 6 below presents the Arellano–Bond test for autocorrelation, at order 1 (AR1) and order 2 (AR2), with AR2 being the standard for confirmation of presence or absence of autocorrelation in a system GMM. From the results, the study accepted the null hypothesis of no autocorrelation in the estimation at AR2 (p-value =0.7290>0.05). Autocorrelation is the correlation between the like variables (dependent or independent)

In view of the above, SGMM estimations have basically satisfied all the basic assumptions of consistency and efficiency of the System GMM as the unbiased estimator.

Table 5: Results of Sargan Diagnostic Test of over identifying restrictions

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Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(329)    =  353.6538
        Prob > chi2  =    0.1675
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Table 6: Results of Arellano-bond test for zero Autocorrelation.

Arellano-Bond test for zero autocorrelation in first-differenced errors

Order	z	Prob > z
1	-2.5853	0.0097
2	.34645	0.7290

H0: no autocorrelation

V. CONCLUDING REMARKS AND RECOMMENDATION

Findings of this Panel analysis indicated that real exchange rate had negative and significant effect on export in the short run. This is an indication that Exchange rate depreciation cannot improve export in Sub-saharan Africa in the short-run. This outcome contradicted theoretical expectation (*apriori)* in terms of relationship (because of the negative sign), but this study is supported by the findings in Aye, Gupta, Moyo and Pillay (2015) which also found a negative significant relationship between exchange rate volatility and export in South Africa. Depreciation in exchange rate is expected to be positively associated with export, but it did not, though responsiveness is elastic and significant. A phenomenon (occurrence) is elastic when the elasticity (in absolute terms) is greater than one (1), unitary when elasticity is equal to one (1) and inelastic when elasticity is less than one (1) (Alege & Osabuohien, 2015).

In the above context, elasticity is 3.95, meaning that the relationship between export and real exchange rate is elastic, as depreciation will mean reduction in price (exchange rate) which makes exportable goods cheaper for foreign buyers and leads to increased export, so it should have a positive sign on the local economy's export. The implication is that the responsiveness of export to changes in real exchange rate is massive and this showed in the significance of the model (P = 0.000), therefore, while this is in line with *aprior* elasticity and significance wise, it is against *apriori* relationship wise.

Based on the main finding of this study, if the region wants to focus on Export to better their economy, we recommend that the currencies should be revaluated/appreciated because export has negative relationship with real exchange rate as depreciation will lead to further loss in revenue.

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