A Dynamic Macro-Panel Autoregressive Distributed Lag (ARDL) Approach to the Determinants of Cocoa Export among West African Countries

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Abstract

The influence of agricultural export on economic of West African Countries has been a relevant topic over the past decades. This study investigate the determinants of cocoa export among the West African Countries for the period of 1970-2020 using a pooled mean group (PMG) dynamic macro-panel ARDL estimators, comprising both the long and short-run impact of some selected macro variables on cocoa export. Annual data on quantity of cocoa export, exchange rate, cocoa producers' own price, area of cocoa harvested and the volume of cocoa production from the major cocoa producing countries of West Africa were sourced from Food and Agriculture Organisation statistics (FAOSTAT). Regionally, findings of this study indicate a significant positive relationship between own price ($p<0.01$), volume of cocoa production ($p<0.01$) and quantity of cocoa export of West African region over the long term. In the short run, area harvested, exchange rate and volume of cocoa production were positively significant, at various lags, in determining quantity of cocoa export in West African countries. The error correction mechanism is -0.59 and significant at 5%, implying that the speed of adjustment towards the long run equilibrium is 59%. In country wise, the result of cross-section short run coefficient shows that: (1) Cameroon cocoa export was positively and significantly influenced by lag one of area harvested, current production volume and lag one, lag two and lag three of volume of cocoa production. Lag one of export quantity, current harvested area and lag three of area harvested had negative significant influence on the quantity of cocoa export. (2) Côte d'Ivoire export quantity was positively and significantly determined by lag one, lag two and lag three of volume of production but negatively affected by lag one of export quantity and lag one

to lag three of area of cocoa harvested.(3) Ghana cocoa export was positively and significantly affected by lag one quantity of cocoa export, lag two and three of the volume of cocoa production. The present harvested area and lag one to lag three of previous harvested area negatively and significantly affect cocoa export. (4) Nigeria cocoa export quantity was positively influenced by lag two and lag three of the area harvested and lag three of production volume. While the previous export quantity and current area harvested had negative influence. The study suggests the need for regional collaboration among the West African cocoa producing countries to develop mechanisms that will improve the existing level of cocoa production so as to maintain their position as the world leading cocoa exporters.

Keywords*:* Autoregressive Distributed lag approach, dynamic macro-panel, Cocoa export, West African Countries.

1. Introduction

Cocoa is one of the major cash crops in West Africa generating substantial export led revenue for the producing countries and creating a source of income for approximately 20 million people in the region (USAID, 2021). The International Cocoa Organisation (ICCO) (2021) reported that about three-quarters of the world's cocoa comes from Africa, accounting for about 3,600,000 tonnes of cocoa in 2020 season out of the global total of 4,697,000 tonnes. Other producing countries with meagre production level are found in Asia and South America. Virtually all the

cocoa produced in Africa are more concentrated in the Western region, majorly from Côte d'Ivoire and Ghana, representing the top two world's cocoa producers with a joint contribution of 62% of global cocoa output (USAID, 2021). The region frequently brags of the four top cocoa producers, with Nigeria and Cameroon taking the third and fourth position respectively, each with about 7% to 8% of global production (FAO,2020). Other countries in the region also contribute smaller output, including Liberia, which is gradually looking to cash crops such as cocoa to alternatively restore its economy.

Globally, cocoa sector is an important source of livelihoods for people in both the exporting and importing countries. According to Tridge (2019), about 5 million farming households are estimated to depend on cocoa as a cash crop, and 70% of cocoa is produced by smallholder farmers living on less than US$ 2 per day and relying deeply on cocoa for 60 to 90% of their livelihood income. The cocoa and chocolate industry also generate jobs in importing countries, where cocoa beans are often exported for processing and sale to end consumers.

Cocoa trade is projected to continue growing, driven principally by its extensive appeal and wide use in the food and beverage industries, most especially in Western Europe and North American which are considered to be the traditional chocolate consuming markets (Euromonitor International, 2016). Demand for cocoa products is also growing in emerging economies as chocolate sales are projected to grow in countries experiencing increases in GDP per capita such as China, Indonesia, Mexico, India and Turkey as end users in these countries have greater disposable income to expend on such products. According to International Institute for

Sustainable Development (IISD) (2019), the exported cocoa beans, be it whole or broken, raw or roasted, were estimated at a combined value of USD 8.6 billion. In 2016, the largest exporter of cocoa beans was Côte d'Ivoire (USD 3.9 billion), followed by Ghana (USD 2.5 billion) and Nigeria (USD 0.8 billion) while Netherlands (USD 2.6 billion), Germany (USD 1.5 billion) and the United States (USD 1.3 billion) occupied the global top three cocoa importers (Trige, 2019).

Even though West African region remains the largest producer and exporter of cocoa produce in the world (FAO,2020), the factors determining the level of the export in the region has not been well examined in the literature. The little available literatures focused on countrywide analysis of cocoa export determinant of some West African countries and other cocoa exporting countries of the world (Grafoute & Yao, 2013; Medha &Fauzul, 2018; Bekoe *et al*., 2019). For instance, Grafoute and Yao (2012) conducted a study on determinants of cocoa and rubber export in Cote d'Ivoire where they used cocoa export quantity as dependent variable and average producer price of cocoa, average world market price of cocoa, cocoa output, exchange rate, annual rainfall and domestic consumption of cocoa as the independent variables. The result indicates that cocoa output, domestic consumption and rainfall significantly influence cocoa export. Similarly, Medha and Fauzul (2018) analysed determinant of cocoa export in Indonesia**.** The authors used total export volume of Indonesian cocoa beans as dependent variable, while the domestic cocoa prices, international cocoa prices, the rupiah exchange rate to US Dollar and level of cocoa production as the independent variables in their study. More so, Nwachuku *et al.* (2010) in their study on competitiveness and determinants of cocoa export from Nigeria revealed that the coefficients of total world volume of cocoa, exchange rate of the Nigerian currency (Naira)

against the dollar and Nigerian cocoa production (output) are statistically significant in the export of cocoa from Nigeria. However, most of the analysis of the studies were based on ordinary least square approach without any panel analytical technique that could explicate both the short run and long run dynamic effects of the explanatory macro variables on the explained variable. This study will therefore fill in the gap by investigating the determinant of cocoa export in the West African region using a pooled mean group (PMG) dynamic macro-panel ARDL estimators, comprising both the long and short-run impact of some selected macro variables on cocoa export. We applied the panel ARDL technique as the best econometric method for this study for some reasons earlier advanced in previous studies (Frimpong and Oteng, 2006, Ambali and Ayinde, 2020). Firstly, ARDL is applicable to a situation where the time series variables of interest are stationary at level, first difference or both. In other words, the series are integrated order of 1[0] and 1[1]. Secondly, the technique is suitable for small data sample and it can generate both the short run and long run coefficient concurrently. Thirdly, ARDL adopts Ordinary Least Square procedure for cointegration among variables and provides flexibility regarding the order of integration of the variables. However, the technique fails in the presence of any variable of integrated order of 1[2].

The paper is divided into different sections as follows. Section 2 reviews the theoretical framework, research methodology is discussed in section 3, results and discussion are presented in section 4. Section 5 provides the conclusion from the study.

2. Theoretical Framework

We premised our work on production theory approach to export supply function and we assumed that domestic and international demand supply decision are made by profit maximising firm operating under perfect competition in all commodity and factor market. The exporting firm is challenged by vectors of domestic and international prices and a vector of exchange rate with the importing country and make decision about domestic and international input demand and production.

Assuming the traditional framework of supply theory where producers is maximising profit while satisfying the input constraint, the export supply function follow as:

$$D^s = f\left(Y_t, P_t, E_t\right) \text{----------(1)}$$

Where demand supply of a commodity is a function of Y_t; domestic production level, P_t; own price of the commodity at international market and E_t, exchange rate of currency between exporting country and importing country. While Modelling the demand functions for this study, we included another one variables; area of cocoa harvested that is aslo essential in cocoa export in West African countries and we thus modify equation (1) to include area harvested as :

$$D^s = f\left(Y_t, P_t, E_t, A_h\right) \text{----------(2)}$$

Where A_h is the area harvested and other variables are as previously defined

Apparently, export supply increases when there is price incentives at international market, and the level of production is encouraged when demand for the commodity keep increasing. According to Deaton and Muellbauer (1980), the demand function is homogeneous degree of zero in price which implies that if price increased by a constant value, then the export demand is

increased by the value raised to the power of 0. This also implies that there is absence of money illusion in the market.

3. Methodology`

3.1. Data Source

The study made use of important factors that are responsible for cocoa export from West Africa. Annual data covering the period from 1970 to 2020 for quantity of cocoa export, exchange rate, cocoa export price, area of cocoa harvested and the volume of cocoa production from the major cocoa producing countries of West Africa, namely Côte d'Ivoire, Ghana, Nigeria and Cameroon, were sourced from Food and Agriculture Organisation statistics (FAOSTAT).

3.2.Analytical Procedure and Model specification

The procedure for using PMG dynamic macro-panel ARDL estimators as elucidated by Gujarati and et.al (2013) includes carrying out correlation matrix analysis to rule out the possibility of multicollinearity among the time series variables along the cross sectional component of panel data analysis, preparing the unit test to establish the variables' order of integration, running the cointegration to find out the existence of long run association among the variables of interest, performing the Hausman test to select the best estimator, estimating the model and carrying out the necessary diagnostic test to establish the robustness and reliability of the estimate.

3.3. The Unit Root Test

The unit root test provides the information about the stationarity of time series variables. The presence of unit root in the time series data generates unreliable results regarding the hypothesis testing. To run the unit root test for this study, we considered Levin, Lin, and Chu (2002), Im, Pesaran, and Shin (2003), ADF Fisher and PP-Fisher techniques. These techniques according Maddala and Shaowen (1999) are more pertinent for panel data analysis since the commonly used unit root tests like the Dickey-Fuller (DF), augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests lack power in distinguishing the unit root null from stationary alternatives. Thus using panel data unit root tests is one way of increasing the power of unit root tests based on a single time series. Generally the structure used by most panel unit root testing procedures is:

$$\Delta y_{it} = \rho_{\mathrm{i}} y_{i,}\mathrm{t}-1 \sum_{l=1}^{p_i} \varphi_{i,}+l\,\Delta y_{i,}\mathrm{t}-1+\propto d_{it}+\ \varepsilon_{it} \text{ ---------- (3)}$$

Where the d_{it} represents the deterministic components. $\rho_{\mathrm{i}} = 0$ implies the y process has a unit root for individual i, while ρi < 0 means the stationarity of the process around the deterministic part.

3.4. Cointegration Test

Here, we considered cointegration as the relationships that could contain long run relationship between variables from different cross section units as well as amongst the different variables specific to a particular cross section unit. We employed Pedroni cointegration technique to establish the long run relationship among the macro variables of this study.

Let the OLS residual of the cointegration regression be expressed as:

$$U_{it} = y_{it} - \delta_i d_{it} - \beta_i x_{it} \quad \text{----------} \quad (4)$$

Following Pedroni (2004), two different classes of test statistics can be performed to ascertain the cointegration of a panel data: first, the panel statistic that is analogous to the unit root statistic against homogeneous alternatives and second, the group mean statistic that is equivalent to the panel unit root tests against heterogeneous alternatives . These are modelled as:

$$Panel \qquad Z_{pt} = \left(\delta_{NT}^2 \sum_{i=1}^{N} \sum_{t-1}^{T} u_{i,t-1}^2 \right)^{-1/2} \left(\sum_{i=1}^{N} \sum_{t-1}^{T} u_{i,t-1}\, u_{it} - T \sum_{i=1}^{N} \lambda\!\!\!^{-}_1 \right)$$

----------(5)

$$Group-mean \quad \tilde{Z}_{pt} = \sum_{i=1}^{N} \left(\delta_{ie}^2 \sum_{t=1}^{T} u_{i,t-1}^2 \right)^{-1/2} \left(\sum_{i=1}^{T} u_{i,t-1}\, u_{i,t} - T \lambda\!\!\!^{-}_1 \right)$$

----------(6)

where $\lambda\!\!\!^{-}_1$ is a consistent estimator of the one-sided long run variance, δ_{ie}^2 denotes the estimated variance of $e_{it} = u_{it} - \delta_i u_{i,t-1}$, $\delta_i = E\left(u_{it} u_{i,t-1}\right) / E(u_{i,t-1}^2)$ and $\delta_{NT}^2 = N_{NT}^2 = N^{-1} \sum_{i=1}^{N} \delta_{ie}^2$.

3.5. Pooled Mean Group/Autoregressive Distributed Lag (ARDL) Model

As asserted by Pesaran *et al*. (1999) dynamic heterogeneous panel could be incorporated into ARDL (p,q) technique, with p and q representing the lag of explained and explanatory variables respectively. Hence, the general model for this study can be specified accordingly as follows:

$$\Delta \ln Y_{it} = \sum_{j=1}^{p-1} \gamma_j^i \ \Delta \ln Y_{it-j} + \sum_{j=0}^{q-1} \beta_j^i \ \Delta \ln X_{it-j} + \rho^i \left[\ln Y_{it-1} - \left\{ \theta_0^i - \theta_1^i \ln X_{it-1} \right\} \right] + \varepsilon_{it}$$

------- (7)

where

Y is the dependent variable, X is the vector of all set of independent variables included in the model and the interaction term, γ and β are the respective short-run dynamic coefficients of lagged explained and explanatory variables. θ stands for the coefficients of the long-run, ρ represents the coefficient of the speed of adjustment towards the long run equilibrium, i connotes the individual countries, t stands for years in the series, and ε_{it} is the stochastic error term.

For simplicity, equation 1 can be expressed in other way as:

$$\Delta \ln Y_{it} = \sum_{j=1}^{p-1} \gamma_j^i \ \Delta \ln Y_{it-j} + \sum_{j=0}^{q-1} \beta_j^i \ \Delta \ln X_{it-j} + \rho ECM_{t-1} + \varepsilon_{it}$$

----------(8)

The specific model for cocoa export quantity and its determinants is explicitly presented in equation 9.

$$\Delta LnEXPQtt = \beta_0 + \sum \Delta LnExpQtt_{t-1} + \sum \beta_1 \Delta LnExpPrice_{t-1} \sum \beta_2 \Delta LnExchRate_{t-1} + \sum \beta_3 \Delta LnAreaHarv_{t-1} + \sum \beta_4 \Delta LnProdVol_{t-1} + \rho ECM_{t-1} + \varepsilon_{it}$$

……(9)

Where

$LnEXPQtt$ = Natural logarithm of cocoa export quantity (tons/annum)

$\Delta LnExpPrice$ = Natural logarithm of cocoa export own price ($/tons)

$LnExchRate$ = Natural logarithm of exchange rate in local currency to U.S. dollar

$LnAreaHarv$ = Natural logarithm of area harvested (hectare/annum)

$\Delta LnProdVol$ = Natural logarithm of volume of cocoa production

ECM_{t-1} = Error correction model

$\gamma, \beta, \rho \text{ and } \varepsilon_{it}$ = as defined in equation 1

Three main estimators viz: the mean group (MG), pooled mean group (PMG) and dynamic fixed effect (DFE) were run for the estimation of the model and based on Hausman h-test, we selected PMG as the most consistent and efficient estimator. The advantage of PMG over the other estimators is that it mediates between the MG and DFE which allows both slope and intercepts to vary among groups and fixed effect modelling where only slopes are fixed and the intercept is allowed to differ among groups. Thus for this study, PMG allows for the dynamic specification to differ among Countries of interest in the short run.

4. Results and Discussion

4.1. Results of Unit Root Test

In order to establish the order of integration of the macro variables, a unit root test was conducted and are the results presented in Table 1. Export quantity of cocoa is stationary at level based on PP Fisher criterion only, export price is also stationary at level based on Levin, Lin and Chu, Im, Pesaran and Shin, ADF Fisher while other variables are stationary at first difference based on the four criteria. Therefore, the order of integration of the variables is said to be a mixture of order I(0) and I(1) and this appropriately fits the application of panel ARDL.

4.2. Results of Pedroni Cointegration Test

The long-run relationship among the variables was tested using Pedroni (1999) cointegration test based on the assumption that the data exhibits deterministic intercept and trend. From Table 2, the analysis indicates that within-dimension of panel data there is long run cointegration between quantity of cocoa export and its determinants as the majority (Panel rho-Statistic, Panel PP-Statistic, Panel ADF-Statistic) of the statistic are significant at 1% for both weighted statistic and unweighted statistic. Likewise between-dimension of panel data, there is existence of long run relationship among the variable (see Table3). This implies that the variables are not drifting apart in the long run and as such the use of ARDL would be appropriate for the analysis.

. Results of PMG/ARDL (2,4,4,4,4) for the Determinants of West Africa Cocoa Export

Result of cocoa export determinants from regional point of view is presented in Table 4. Over the long term, the parameter estimate of the PMG model indicates a significant ($p<0.01$) positive relationship between the cocoa export own price and quantity of cocoa export of West African region. By implication, an increase in cocoa export price in the world market, increases the

quantity of cocoa export supply of West African region by 47.42 metric tonnes. Likewise, volume of cocoa production significantly has positive impact on export quantity at 1%. In the short run, the quantity of cocoa export is positively affected by the current size of area harvested at 5%, the previous 2 years of exchange rate at 5% and the volume of cocoa production in last 3 years at 10%. The error correction mechanism is -0.59 and significant at 5%, implying that the speed of adjustment towards the long run equilibrium is 59%.

4.4. Short Run Coefficient for Determinant of Cocoa Export from West African Countries

In country wise, the result of cross-section short run coefficient of cocoa export determinant for Cameroon, Côte d'Ivoire, Ghana and Nigeria are presented in Table 5, 6, 7 and 8 respectively: Cameroon cocoa export is positively and significantly influenced by lag one of area harvested, current production volume and lag one, lag two and lag three of volume of cocoa production all at 1% level of significance. Previous quantity of cocoa export, current harvested area of cocoa plantation and lag three of area harvested has negative significant influence on the quantity of cocoa export. (See Table 5)

Côte d'Ivoire export quantity is positively and significantly determined by lag one, lag two and lag three of volume of production at 1% significant level but negatively affected by lag one of export quantity, lag one to lag three of area of cocoa harvested at 1% level. Only current production level of cocoa has a negative significant impact at 10% level. (See Table 6)

Ghana cocoa export is positively and significantly affected by lag one quantity of cocoa export 1% level, lag two (1%) and lag three (10%) of the volume of cocoa production. The present harvested area, lag three of harvested area and present production volume negatively and

significantly affect cocoa export at 5% level, area harvested in the two to three years and the production level of the last 2 years have negative significant effect at 1% probability level. (See Table 7)

Nigeria cocoa export quantity was positively influenced by lag two to lag three of the area harvested at 1% probability and lag three of production volume at 10% level of significant. The previous year export quantity, the current area harvested, the current production volume and lag one to two of production volume have negative influence at 1% probability level. (See Table 8)

Recommendation

Given the fact that the level of production remain the major significant determinant of cocoa export cutting across all the West African countries under investigation, both in the long run and short run, the study thus suggests the need for regional collaboration among the West African cocoa producing countries to develop mechanisms that will improve the existing level of cocoa production so as to generate more foreign earnings from cocoa trade and retain their status of being the world leading cocoa exporters.

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Table 1. Results of unit root tests.

	Levin Lin & Chu	Im Pesaran & Shin	ADF Fisher	PP-Fisher
Series		Level		
AreaHarv	3.3816	3.5414	1.5034	1.6446
	(0.9996)	(0.9996)	(0.9927)	(0.9900)
ExchRate	4.1688	3.5372	3.8553	3.7919
	(1.0000)	(0.9998)	(0.8699)	(0.8754)

EXPQtt	-0.7379	-0.3896	9.0414	21.2518
	(0.2303)	(0.3484)	(0.3388)	(0.0065)***
ExpPrice	-1.8702	-1.9284	15.1556	8.6324
	(0.0307) ***	(0.0269) ***	(0.0562)*	(0.3742)
ProdVol	-1.6557	-0.2242	7.2292	12.2378
	(0.0489) *	(0.4113)	(0.5121)	(0.1409)
		First Difference		
AreaHarv	-8.3515	-7.5209	61.9266	136.7820
	(0.0000) ***	(0.0000) ***	(0.0000) ***	(0.0000) ***
ExchRate	-4.9436	-6.1043	48.7165	63.8425
	(0.0000) ***	(0.0000) ***	(0.0000) ***	(0.0000) ***
EXPQtt	-7.2515	-12.9325	119.3960	559.7200
	(0.0000) ***	(0.0000) ***	(0.0000) ***	(0.0000) ***
ExpPrice	-9.2595	-6.8565	55.0023	70.1567
	(0.0000) ***	(0.0000) ***	(0.0000) ***	(0.0000) ***
ProdVol	-9.5193	-9.7212	84.4904	186.129
	(0.0000) ***	(0.0000) ***	(0.0000) ***	(0.0000) ***

Notes: * p<0.1, ** p<0.05, *** p<0.01

Table 2: Pedroni Residual Cointegration Test Within-dimension

	Statistic	Probability	Weighted Statistic	Probability

Panel v-Statistic	-0.3192	0.6252	-0.4648	0.6790
Panel rho-Statistic	-5.4287	0.0000	-4.3205	0.0000
Panel PP-Statistic	-11.8703	0.0000	-12.4220	0.0000
Panel ADF-Statistic	-6.4387	0.0000	-6.7436	0.0000

Table 3: Pedroni Residual Cointegration Test Between-dimension

	Statistic	Probability
Group rho-Statistic	-5.4287	0.0001
Group PP-Statistic	-11.8703	0.0000
Group ADF-Statistic	-6.4387	0.0000

Table 4: PMG/ARDL (2,4,4,4,4) Results for the Determinants of West Africa Region Cocoa Export.

Variable	Coefficient	Standard Error	t-Statistics	Prob.
		Long-run coefficient		
$ExpPrice$	47.4208	12.9534	3.6608	0.0003***
$AreaHarv$	0.0327	0.0363	0.8994	0.3702
$ExchRate$	58.2397	103.3706	0.5634	0.5741
$ProdVol$	0.6759	0.0709	9.5218	0.0001***
		Short-run coefficient		
$D(EXPQtt(-1))$	-0.1978	0.1583	-1.2488	0.2141
$D(ExpPrice)$	-12.4663	16.5009	-0.7554	0.4514
$D(ExpPrice(-1))$	4.2915	9.9983	0.4292	0.6685
$D(ExpPrice(-2))$	4.3172	7.2153	0.5983	0.5507
$D(ExpPrice(-3))$	-19.2941	24.1012	-0.8005	0.4249

$D(AreaHarv)$	0.0476	0.0204	2.3771	0.0189**
$D(AreaHarv(-1))$	0.0648	0.0819	-0. 7917	0.4300
$D(AreaHarv(-2))$	-0.1626	0.1096	-1.4831	0.1406
$D(AreaHarv(-3))$	0.0876	0.0579	-1.5113	0.1332
$D(ProdVol)$	-0.1065	0.1352	-0.7878	0.4322
$D(ProdVol(-1))$	0.1562	0.2209	0.7067	0.4810
$D(ProdVol(-2))$	0.3966	0.2031	1.9527	0.0530*
$D(ProdVol(-3))$	0.2168	0.1076	2.0146	0.0461*
$D(ExchRate)$	-8323.40	8555.2728	-0.9772	0.3302
$D(ExchRate(-1))$	-1809.66	1888.58	-0.9581	0.3398
$D(ExchRate(-2))$	21409.50	10938.243	1.9573	0.0298**
$D(ExchRate(-3))$	13298.88	36634.689	1.6303	0.1056
ECT	-0.5939	0.3568	-1.6643	0.0986*

Note * p<0.1, ** p<0.05, *** p<0.01

Table 5: Cross Sectional Short Run Coefficient for Determinant of Cocoa Export from Cameroon

Variables	Coefficient	Std. Error	t- Statistic	Prob.
$D(EXPQtt(-1))$	-0.419007	0.020610	-20.33062	0.0003***
$D(ExpPrice)$	-14.79868	44.66674	-0.331313	0.7622
$D(ExpPrice(-1))$	13.07075	44.61188	0.292988	0.7886
$D(ExpPrice(-2))$	-8.933535	51.31553	-0.174090	0.8729
$D(ExpPrice(-3))$	-18.65766	55.03709	-0.339002	0.7570
$D(AreaHarv)$	-0.082476	0.008920	-9.246054	0.0027***
$D(AreaHarv(-1))$	0.081745	0.009440	8.659120	0.0032***
$D(AreaHarv(-2))$	-0.004164	0.009113	-0.456923	0.6788
$D(AreaHarv(-3))$	-0.167947	0.008186	-20.51742	0.0003***
$D(ProdVol)$	0.241068	0.039187	6.151702	0.0086***
$D(ProdVol(-1))$	0.274225	0.040843	6.714175	0.0067***
$D(ProdVol(-2))$	0.362066	0.040892	8.854100	0.0030***
$D(ProdVol(-3))$	0.132813	0.038775	3.425217	0.0417**
$D(ExchRate)$	16.22313	1981.127	0.008189	0.9940
$D(ExchRate(-1))$	-37.25531	2218.731	-0.016791	0.9877
$D(ExchRate(-2))$	20.32265	2274.903	0.008933	0.9934
$D(ExchRate(-3))$	-5.771094	1954.398	-0.002953	0.9978
ECT	-0.139217	0.006350	-21.92247	0.0002***

* p<0.1, ** p<0.05, *** p<0.01

Table 6: Cross Sectional Short Run Coefficient for Determinant of Cocoa Export from Cote d'Ivoire

Variables	Coefficient	Std. Error	t- Statistic	Prob.
$D(EXPQtt(-1))$	-0.110193	0.014617	-7.538471	0.0048***
$D(ExpPrice)$	-50.02097	1062.805	-0.047065	0.9654
$D(ExpPrice(-1))$	27.90645	1216.061	0.022948	0.9831
$D(ExpPrice(-2))$	3.564704	1340.099	0.002660	0.9980
$D(ExpPrice(-3))$	-83.06651	1126.396	-0.073745	0.9459
$D(AreaHarv)$	0.009598	0.009349	1.026606	0.3801
$D(AreaHarv(-1))$	-0.292164	0.011804	-24.75118	0.0001***
$D(AreaHarv(-2))$	-0.389331	0.014725	-26.43985	0.0001***
$D(AreaHarv(-3))$	-0.194766	0.010952	-17.78340	0.0004***
$D(ProdVol)$	-0.135395	0.043749	-3.094787	0.0535*
$D(ProdVol(-1))$	0.727929	0.049383	14.74050	0.0007***
$D(ProdVol(-2))$	0.829525	0.052602	15.76992	0.0006***
$D(ProdVol(-3))$	0.536105	0.030566	17.53900	0.0004***
$D(ExchRate)$	460.8309	30871.52	0.014927	0.9890
$D(ExchRate(-1))$	-271.7607	33077.66	-0.008216	0.9940
$D(ExchRate(-2))$	330.2016	34079.80	0.009689	0.9929
$D(ExchRate(-3))$	-17.17611	39548.01	-0.000434	0.9997
ECT	-0.971947	0.030248	-32.13313	0.0001***

* p<0.1, ** p<0.05, *** p<0.01

Table 7: Cross Sectional Short Run Coefficient for Determinant of Cocoa Export from Ghana

Variables	Coefficient	Std. Error	t-Statistic	Prob.
$D(EXPQtt(-1))$	0.2122	0.0229	9.2636	0.0027***

$D(ExpPrice)$	30.4565	668.3162	0.0456	0.9665
$D(ExpPrice(-1))$	-7.4252	816.8249	0.0091	0.9933
$D(ExpPrice(-2))$	24.5578	784.2236	0.0313	0.9770
$D(ExpPrice(-3))$	33.6054	795.3778	0.0423	0.9690
$D(AreaHarv)$	-0.0525	0.0123	-4.2539	0.0238**
$D(AreaHarv(-1))$	-0.0698	0.0113	-6.1788	0.0085***
$D(AreaHarv(-2))$	-0.3097	0.0113	-27.4412	0.0001***
$D(AreaHarv(-3))$	-0.0429	0.0097	-4.4270	0.0214**
$D(ProdVol)$	-0.4192	0.0737	-5.6898	0.0108**
$D(ProdVol(-1))$	-0.1288	0.0665	-1.9363	0.1482
$D(ProdVol(-2))$	0.5346	0.0561	9.5265	0.0025***
$D(ProdVol(-3))$	0.1330	0.0496	2.6797	0.0751*
$D(ExchRate)$	-523.6145	48364.98	-0.0108	0.9892
$D(ExchRate(-1))$	22.3326	227.903	0.0979	0.8934
$D(ExchRate(-2))$	-90.6786	125.2265	-0.7241	0.9678
$D(ExchRate(-3))$	47.08207	3087.142	0.0152	0.9970
ECT	-1.3978	0.0479	-29.2052	0.0001***

* p<0.1, ** p<0.05, *** p<0.01

Table 8: Cross Sectional Short Run Coefficient for Determinant of Cocoa Export from Nigeria

Variables	Coefficient	Std. Error	t-Statistic	Prob.
$\boldsymbol{D(EXPQtt(-1))}$	-0.474150	0.018379	-25.79914	0.0001***
$\boldsymbol{D(ExpPrice)}$	-15.50209	148.1998	-0.104603	0.9233
$\boldsymbol{D(ExpPrice(-1))}$	-16.38612	136.8565	-0.119732	0.9123

$D(ExpPrice(-2))$	-1.920150	132.3406	-0.014509	0.9893
$D(ExpPrice(-3))$	-9.057960	127.3364	-0.071134	0.9478
$D(AreaHarv)$	-0.065228	0.007687	-8.485653	0.0034***
$D(AreaHarv(-1))$	0.020761	0.008909	2.330255	0.0213**
$D(AreaHarv(-2))$	0.052439	0.009279	5.651175	0.0110***
$D(AreaHarv(-3))$	0.055149	0.009247	5.963847	0.0094***
$D(ProdVol)$	-0.112649	0.020985	-5.368123	0.0127***
$D(ProdVol(-1))$	-0.248627	0.023164	-10.73352	0.0017***
$D(ProdVol(-2))$	-0.139556	0.025990	-5.369562	0.0126***
$D(ProdVol(-3))$	0.065312	0.019603	3.331744	0.0447*
$D(ExchRate)$	217.1151	248918.0	0.000872	0.9994
$D(ExchRate(-1))$	523.6145	483649.8	0.001083	0.9992
$D(ExchRate(-2))$	1069.912	504545.1	0.002121	0.9984
$D(ExchRate(-3))$	-898.8852	360768.7	-0.002492	0.9982
ECT	-0.145093	0.008282	-17.51837	0.0004***

* p<0.1, ** p<0.05, *** p<0.01