Re-Directing African Cocoa Bean Export Performance in the Face of Global Cocoa Trade

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Abstract: *The performance of African cocoa in the global market has not been impressive with ample gain been lost despite its exportation lead position in the world. It is against this background that the present research looks into the possibility of re-directing the African cocoa export in the global market in order to increase its gain due to its position as the largest exporter of the product in the world. Annual time series data which covered cocoa export and import both in physical and monetary terms for the World, Africa, other continents and macro-economic indicators sourced from the FAO and UNCTAD data banks spanning from 1991 to 2017 were used. The data were analyzed using both descriptive and inferential statistics. Evidenced showed that African cocoa has competitive advantage and its geographical trade concentration can be increase if the continent increases its current export by 41.73%, thus spurring an export value gain of 40.82% over the current average export value recorded for the study period. Furthermore, it was observed that the African cocoa exporters respond to any innovation that induced deviation from the equilibrium in a manner that the current export quantity of cocoa will converge towards the equilibrium. The major factor affecting export decision cum export performance of African cocoa in the global cocoa trade market is the price factor. Therefore, the regional bloc organization (AU) and the major exporting economies should checkmate the oligopsony power of the importing countries through pricing efficiency. In addition, there is a need to enhance the quality of the product too.*

Keywords: African export, Cocoa bean, Cocoa trade, Global market

1. Introduction

The trade theories succinctly advocated that nations should specialize in the production and exportation of those commodities they have comparative advantage among the comity of nations. African has taken the comparative advantage of being the largest producer and exporter of cocoa bean accounting for almost 70% of the total world export for almost a decade (FAOSTAT, 2018). Agricultural trade has been identified as one of the key drivers of economic growth and development in developing countries that are willing to take advantage of the trade liberalization in the era of globalization.

Africa for a while now has not been getting remunerative returns in the global cocoa trade due to some challenges, which ranges from quality standard, collusive effect of oligopolistic intermediaries, oligopsony power of importing economies etc. The poor performance of this commodity in the international market has spurred many researchers across the sub-Saharan Africa to evaluate the performance of the commodity. However, the crux is that all the research works limited their scope to individual economies (Syrovatka and Darkwah, 2008; Syrovatka, 2009; Ndubuto *et al.*, 2010; Daramola, 2011; Amoro and Shen, 2013; Okon and Ajene, 2014; Verter and Bečvařova, 2014 a, b; Verter, 2016) rather than studying the export performance from the perspective of the African economy as a whole. This is because the continent maintains a lead in both production and exportation of cocoa in the world. In addition, none of the documented studies makes an empirical attempt in re-directing export performance of cocoa even at the individual economies more or less African economy as an entity.

Evidence from FAOSTAT (2018) showed that the global production of cocoa bean has been on the increase from 1.2 million MT in 1961 to 4.6million MT in 2013 while the export maintained a rise from 1.03 million MT in the year 1961 to 3.04 million MT in the year 2004, and thereafter plummeted to 2.73 million MT in 2013. However, the production and export trend of African cocoa bean has been exhibiting an oscillating swing (up and downswings) more than six decades. This performance is largely due to the high demand for the crop by the consuming economies, especially North America and Europe, and recently the emerging economies e.g. China, India and Malaysia. In the light of the above challenges this study aimed at looking into the possibility of re-directing export performance of African cocoa bean empirically and suggesting the way forward for the commodity in the global trade.

2. Research Methodology

Annual time series data, which covered cocoa export, and import both in physical and monetary terms for the World, Africa, other continents and macro-economic indicators sourced from the FAO and UNCTAD data banks spanning from 1991 to 2017 were used. The data were analyzed using descriptive statistics, growth model, instability index, Gini coefficient index in conjunction with Lorenz curve, simulation model (Linear programming Algorithm), unit root tests and Engel-Granger two step procedures.

Empirical model

Growth rate: The compound annual growth rate was calculated using the exponential model given below:

$$\gamma = \alpha\beta^t \quad [1]$$

$$ln\gamma = ln\alpha + tln\beta \quad [2]$$

$$CAGR = [Antilog\beta - 1] \times 100 \quad [3]$$

Where,

CAGR = Compound growth rate
t = time period in year
γ = export quantity/value
α = intercept
β = estimated parameter coefficient

Instability index: The simple coefficient of variation (CV) over-estimates the level of instability in time series data characterized by long-term trends, whereas the Cuddy-Della Valle Index corrects the coefficient of variation by instability index which is given below.

$$II = CV*(1-R^2)^{0.5} \quad [4]$$

Where,

II = the Instability index;
CV = Coefficient of Variation; and,
R^2 = Coefficient of multiple determinations

The instability index was classified as low instability (≤ 20%) and high instability (> 20%).

Gini coefficient index: The Gini coefficient index is defined as a ratio of the areas on the Lorenz curve and the formula is given as:

$$G = A/0.5 = 2A=1-2B \quad [5]$$

If the area between the line of perfect equality and Lorenz curve is A, and the area under the Lorenz curve is B, then the Gini index G =A/ (A+B), since A +B = 0.5

Where,

A = 0.25
B = 0.25

Linear programming model: The linear programming model is given as follows:

$$\text{Maximize } Z = \sum_{i=1}^{n} P_i * Q_i \quad [6]$$

Subject to

$$\sum_{i=1}^{n} Q_i \leq b_i \quad [7]$$

$$\sum_{i=1}^{n} P_i * Q_i \; and \; Q_i \geq 0;$$

Where,

Z = total export value of cocoa from Africa
P_i = unit price ($/ton) of exported cocoa from Africa to continent *i*
Q_i = quantity in tons of exported cocoa from Africa to continent *i*
b_i = maximum quantity of exported cocoa from Africa to continent *I*, and
i = number of importing continents

Augmented Dickey Fuller Test

Following Blay *et al.* (2015), Singh *et al.* (2016) and Sadiq *et al.* (2016) the Augmented Dickey-Fuller test (ADF) used as indicated below:

$$\Delta P_t = \alpha + P_{t-1} + \sum_{j=2}^{it} \beta_i \Delta P_{it-j+t} + \varepsilon \quad [8]$$

Where,

P_{it} = the i^{th} variable at the time *t,*

$\Delta P_{it}(P_{it} - P_{t-1})$ *and* α = intercept or trend term

Engel-Granger two-step procedure model:

Long-run dynamic model:

$$EXPQ_t = \beta_0 + \beta_1 TOP_{t-1} + \beta_2 CPQ_{t-1} + \beta_3 EXR_{t-1} + \beta_4 INF_{t-1} + \beta_5 AMGDP_{t-1} + \beta_6 ASGDP_{t-1} + \beta_7 WP_{t-1} + \beta_8 AC_{t-1} + \beta_9 DFI_{t-1} + \beta_{10} EXPQ_{t-1} + \varepsilon_i \quad [9]$$

Short-run dynamic model:

$$\Delta EXPQ_t = \beta_0 + \beta_1 \Delta TOP_{t-1} + \beta_2 \Delta CPQ_{t-1} + \beta_3 \Delta EXR_{t-1} + \beta_4 \Delta INF_{t-1} + \beta_5 \Delta AMGDP_{t-1} + \beta_6 \Delta ASGDP_{t-1} + \beta_7 \Delta WP_{t-1} + \beta_8 \Delta ACt_{-1} + \beta_9 \Delta DFI_{t-1} + \beta_{10} \Delta EXPQ_{t-1} + \varepsilon_i \quad [10]$$

Where,

EXPQ = Export quantity of cocoa bean
TOP = Trade openness
CPQ = Cocoa production quantity
EXR = Exchange rate
INF = Inflation rate
AMGDP = America-GDP
ASGDP = Asia-GDP
EGDP = Europe-GDP
WP = World price of cocoa bean
AC = Agriculture credit
DFI = Direct foreign investment
ε_i = error term
t = current time
t-1 = one year lagged period
β_0 = the intercept
β_{1-n} = parameter estimates, and
Δ = first difference operator.

3. Results and Discussion

3.1. Export trend of African cocoa

The results showed that cocoa export exhibited an oscillating trend during the period 1991 to 2017 with the least ebb quantity exported been 1.06 million MT in the year 1992, representing 86.04% of the base year and the maximum peak exported been 2.407 million MT in the year 2011 representing 195.05% of the base year (Table 1a and Figure 1). Similar results were observed for the export value across the study period. Furthermore, the quantity of cocoa exported and export revenue generated during the stipulated period increased by 33,661.2 tons annually, representing 1.9% of the average quantity of African cocoa export; and increased by $1.27 billion annually, representing 4.31%of the average African cocoa export revenue during the study period (Table 1b).

Table 1a: Africa export trend of cocoa bean during 1991-2017

Year	Export quantity		$/ton		Export value ($)	
	Qty (MMT)	Index	$	Index	Billion $	Index
1991	1.234277	100	1036.062	100	1.278787	100
1992	1.062014	86.04341	1065.493	102.8407	1.131569	88.48768
1993	1.330621	107.8057	952.7717	91.96091	1.267778	99.13911
1994	1.185363	96.03703	1162.096	112.1648	1.377506	107.7197
1995	1.247838	101.0987	1372.08	132.4323	1.712134	133.8873
1996	1.820253	147.4752	1335.758	128.9265	2.431417	190.1346
1997	1.498198	121.3826	1339.14	129.2529	2.006297	156.8906
1998	1.450554	117.5226	1509.707	145.7159	2.189911	171.2491
1999	1.728752	140.0619	1246.659	120.3268	2.155165	168.532
2000	1.723118	139.6055	910.4223	87.87337	1.568765	122.676
2001	1.67428	135.6486	1051.846	101.5235	1.761084	137.7152
2002	1.651453	133.7992	1647.91	159.0552	2.721446	212.8146
2003	1.684471	136.4743	1822.613	175.9175	3.070139	240.0821
2004	2.193099	177.6829	1404.451	135.5567	3.080101	240.8611
2005	2.04234	165.4685	1470.217	141.9044	3.002683	234.8071
2006	1.997086	161.8021	1594.432	153.8936	3.184218	249.003
2007	1.758366	142.4612	1748.171	168.7323	3.073924	240.3781
2008	1.745464	141.4159	2159.31	208.4152	3.768998	294.7323
2009	1.930335	156.394	2705.988	261.1803	5.223464	408.4702
2010	1.6316	132.1907	3013.871	290.8969	4.917432	384.5388
2011	2.40742	195.047	2838.152	273.9366	6.832623	534.305
2012	2.079214	168.456	2581.072	249.1234	5.3666	419.6633
2013	1.777698	144.0275	2461.226	237.5559	4.375316	342.1458
2014	1.996982	161.7937	1681.728	162.3193	3.35838	262.6223
2015	2.024942	164.059	1517.504	146.4685	3.072858	240.2947
2016	2.047612	165.8957	1430.577	138.0783	2.929266	229.066
2017	2.070136	167.7205	1381.164	133.3091	2.859198	223.5867
Average	1.740499		1645.94		2.952484	

Source: Authors' computation, 2018

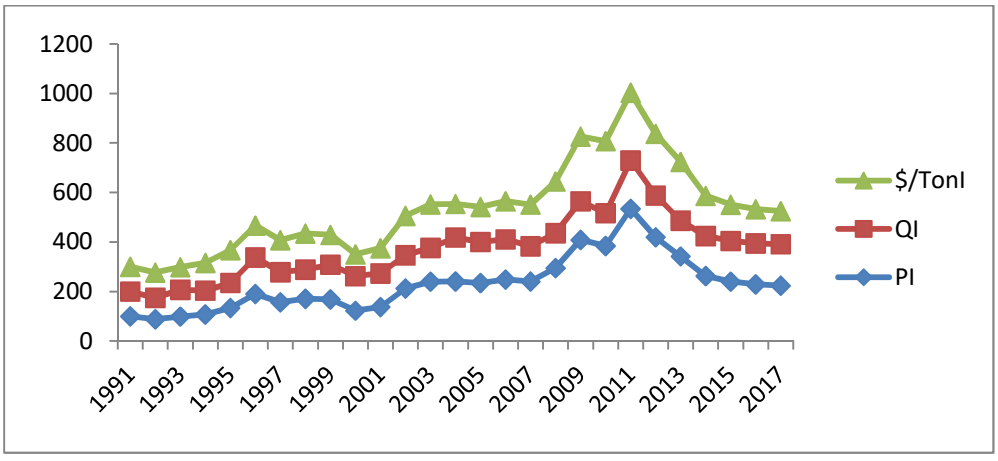

Figure 1: African export trend of cocoa beans

Note: Ton= ton; Q = Export quantity; P= Value of export; I = Index

Table 1b: Growth rate of cocoa export from 1991-2017

Variable	Export (ton)	Export ($)
Intercept	1.26924e+6	1.171963393
Slope	33661.2***	127180019.5***
Average	1740499	2952484
Annual change (%)	1.9	4.31%
R^2	0.635	0.513
F-statistic	43.5***	26.4***

Source: Authors' computation, 2018

3.2. Degree of stability of African cocoa export

The results revealed a low instability in the quantity and value of cocoa exports as evidenced by their respective instability indexes, which were less than 20% (Table 2). This indicates that African cocoa export has a competitive advantage in the global cocoa market.

Table 2: Stability index of African cocoa export

Variable	Index (%)
Export (ton)	12.25
Export ($)	18.16

Source: Authors' computation, 2018

3.3. Export concentration index

The estimated Gini coefficient index of 0.584 indicated that the level of geographical trade concentration of African cocoa export to the global world is moderate (Table 3). This was justified by the Lorenz curve, which is moderately farther from the line of equity (Figure 2). The highest importing continent of African cocoa is European continent (1.08 million MT) while Australian continent is the least importer (101 tons).

Table 3: Export concentration

Item	Index
Sample Gini coefficient	0.584
Estimate of population value	0.730

Source: Authors' computation, 2018

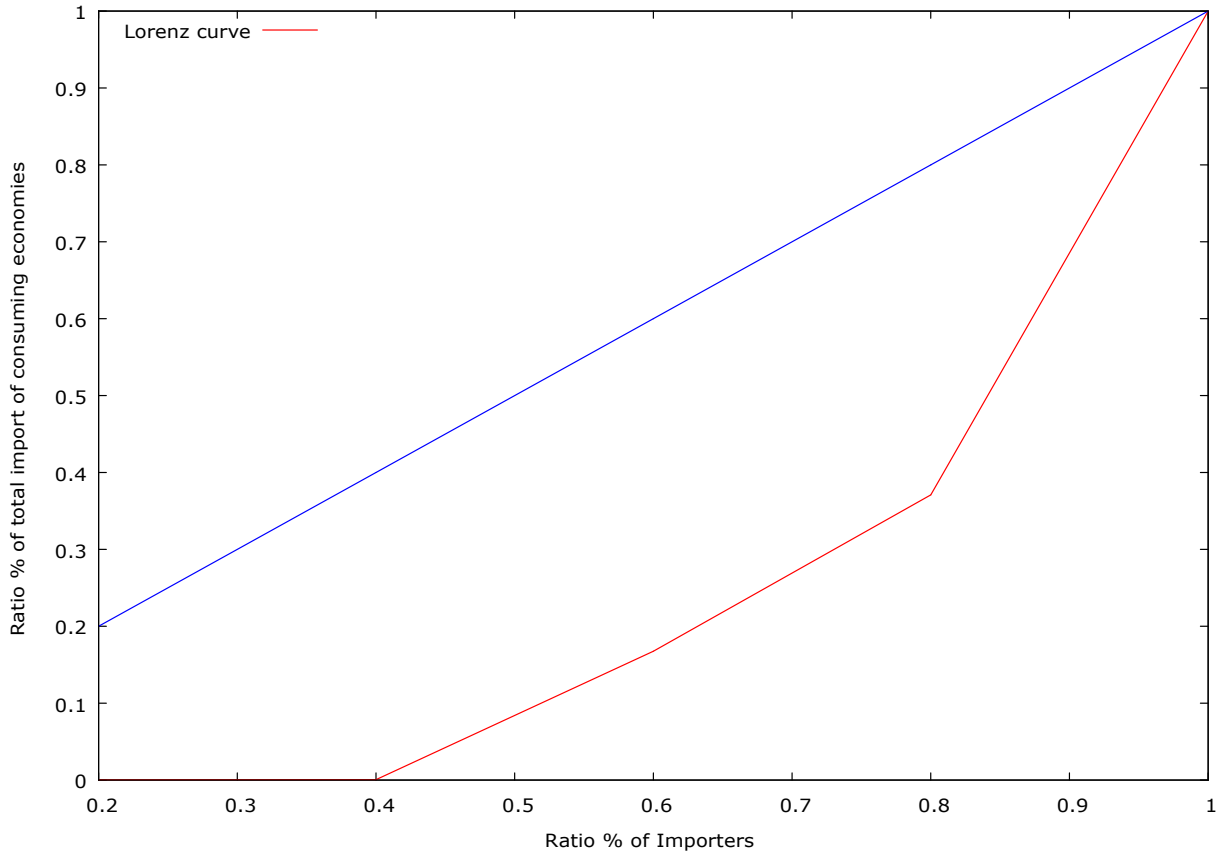

Figure 2: Lorenz curve of current export to the consuming economies

3.4. Redirecting export of African cocoa

The Linear programming algorithm was implemented for redirecting exportation of cocoa from Africa. It is assumed that if the cocoa import share of high-income continents from Africa is less than 10%, Africa can increase its export volume to those continents by 10% of the continent's import capacity. Furthermore, the export can be increased by 20% of the continent's import capacity if its import share from Africa is more than 10% and less than 20% of its total cocoa import. Contrarily, there will be no change in a continent's import if its share of Africa cocoa export is equal or more than 40%.

The average annual cocoa exports across the selected continents for the period of 1991 to 2017 was 1.55 million MT at an approximate value of $ 2.87 billion, and the LP results revealed that Africa has the capacity of exporting 2.66 million MT (41.59%) at an approximate value of $4.85 billion, which export gain is approximately $1.98 million (40.90%)(Table 4). Furthermore, the optimal solution showed that the export value of African cocoa across the selected continent would increase. The import value of European continent is the highest while Australian continent import is the least. However, the feasible solution suggested a decrease of the export quantity to Oceania continent.

The suggested geographic re-distribution of African cocoa export leads to a decrease in the Gini coefficient to 0.174 from 0.584, thus, indicating an increase in the level of geographical trade concentration.

3.5. Determinants of export performance

3.5.1. *The unit root test*

The results of the ADF and KPSS (Kwiatkwoski, Phillips, Schmidt and Shin) unit root tests indicated the presence of unit root at level for all the variable series as they were found to be non-significant at 5% probability. Thereafter, after first differencing the unit roots was absent in the residuals as indicated by the significance of the variable series at 5% probability level (Table 5). However, the weakness of the widely used traditional unit roots made the researchers to verify the robustness and efficiency of the estimated tau-statistics using the neo-classical unit root test (ERS). The ERS (Elliott, Rothenberg and Stock) unit root test indicated that the variable series were integrated of order one [I (1)], thus, upholding the robustness and efficiency of the estimated tau-statistics obtained from the conventional unit root tests. Therefore, since the variable series were integrated of order one, the application of co-integration test become justifiable.

3.5.2. *Co-integration test*

The Engel-Granger two-step procedure was applied to test the existence of long-run association among the variables (Table 6). However, for co-integration test, two criteria had to be met: the variables should be integrated of order one [I(1)], then the residual from the co-integrating relationship should be integrated of order zero [I(0)]. The results of the ADF unit root test applied to the residual of the linear combination of these variables level indicated that the residual variable is integrated of an order one less than the original order of the variable as evidenced by the tau-statistics, which is lesser than the Engel-Granger critical value at 5% degree of freedom. In other words, it means the residual of the variable has no unit root at level, thus, integrated of order zero [I (0)]. Therefore, since the residual is found to be integrated of order zero, it becomes justifiable to apply the linear price symmetric model (Error correction model).

Table 4: Redirecting African cocoa export

Continent	Total import (ton)	Current situation				Optimal solution				Redistribution	
		Quantity		Value		Quantity		Value			
		ton	%	$	%	ton	%	$	%	Qty	Value
America	517020	337859.30	21.74	586933.50	20.48	533817.60	20.06	898008.30	18.52	-195958.30	-311075
Asia	42453.72	135143.70	8.69	293466.80	10.24	397322.50	14.93	921485.70	19	-262178.80	-628019
Europe	1599574	1081150	69.56	1966227	68.61	1729839	65	2910016	60.01	-648689	-943789
Oceania	724.87	118	0.006	17880	0.62	12.98	0.00	109783.20	2.26	105.02	-91903.2
Austria & NZ	660.87	101	0.004	1527	0.05	128.27	0.01	9986.58	0.21	-27.27	-8459.58
Total	2160433.46	1554372	100	2866034.30	100	2661120	100	4849280	100	-1106748	-1983245
Change							1106748		1983245		
%							41.59		40.90		

Table 5: Stationarity test

Items	Stage	ADF	KPSS	ADF-GLS
EXPQ	Level	-2.33(0.172)^{NS}	0.927^{NS}	-1.76(0.074)^{NS}
	$1^{st}\Delta$	-5.51(1.6e-6)^{S}	0.087^{S}	-6.01(4.3e-9)^{S}
TOP	Level	-2.16(0.227)^{NS}	0.160^{NS}	-2.391^{NS}
	$1^{st}\Delta$	-4.69(0.001)^{S}	0.042^{S}	-5.136^{S}
CPQ	Level	-1.41(0.578)^{NS}	1.144^{NS}	-2.338^{NS}
	$1^{st}\Delta$	-6.65(1.9e-5)^{S}	0.130^{S}	-6.961^{S}
EXR	Level	-2.53(0.122)^{NS}	0.244^{NS}	-1.836^{NS}
	$1^{st}\Delta$	-4.39(0.003)^{S}	0.085^{S}	-5.103^{S}
INF	Level	-2.64(0.100)^{NS}	0.249^{NS}	-1.408^{NS}
	$1^{st}\Delta$	-3.04(0.047)^{S}	0.067^{S}	-3.699^{S}
AMGDP	Level	-0.84(0.787)^{NS}	1.225^{NS}	-2.438^{NS}
	$1^{st}\Delta$	-4.06(0.006)^{S}	0.083^{S}	-4.246^{S}
ASGDP	Level	-1.40(0.861)^{NS}	1.133^{NS}	-1.058^{NS}
	$1^{st}\Delta$	-3.32(0.027)^{S}	0.204^{S}	-3.517^{S}
EGDP	Level	-0.24(0.920)^{NS}	1.126^{NS}	-1.719^{NS}
	$1^{st}\Delta$	-3.80(0.003)^{S}	0.114^{S}	-3.582^{S}
WP	Level	-2.17(0.218)^{NS}	0.847^{NS}	-2.555^{NS}
	$1^{st}\Delta$	-5.70(6.1e-7)^{S}	0.043^{S}	-3.453^{S}
AC	Level	-0.09(0.939)^{NS}	0.848^{NS}	-1.990^{NS}
	$1^{st}\Delta$	-5.24(4.1e-4)^{S}	0.329^{S}	-6.008^{S}
DFI (Africa)	Level	-1.22(0.669)^{NS}	1.214^{NS}	-1.974^{NS}
	$1^{st}\Delta$	-7.08(7.3e-6)^{S}	0.132^{S}	-3.593^{S}

Note: Δ, NS and S indicates first difference, non-stationary and stationary at the level or at first difference at 5 percent significance. The critical values for the KPSS and ADF-GLS test at 5% probability are 0.462 and 3.19 respectively.

Table 6: Co-integration test

Residual (U)	τ-statistic	Engel-Granger critical value		Decision
		5%	10%	
Cocoa	-5.430*	-3.34	-3.04	Stationary at level I(0)

Note: * indicate that unit root at the level was rejected at 5% significant level

3.5.3. *The long-run dynamic cocoa export response function*

The macro indicators which have impact on the decision of the current export quantity of African cocoa were the lagged TOP, lagged EXR, lagged WP and lagged EXPQ as evidenced by their respective estimated coefficients which were different from zero at less than 1% probability level (Table 7a). The detailed decomposition showed that lagged TOP had positive impact on the current export quantity of African cocoa beans while the lagged EXR, lagged WP and the lagged EXPQ had negative impact on the current export quantity of African cocoa beans. In other words, it means that the former increase the current quantity of cocoa beans exported to the global market from African while the latter decrease the current export quantity of African cocoa beans to the global cocoa market.

The positive relationship of the lagged TOP with the current quantum of cocoa exported from African (EXPQ) indicates the integration of Africa in the trade of cocoa beans into the global economy. Even though agricultural commodities from developing countries faced trade barriers in respect of tariff escalation and quotas in the importing advanced economies, there is evidence of market liberalization in cocoa beans as there is a zero tariff regime and less stringent trade regulations for the product. Consequently, African has taken the advantage in the production and exportation of the cocoa beans to the Western consumers, notably Europe and the USA.

The inverse relation of the lagged price factors showed how the fluctuating exchange rate (EXR) and the world price (WP) of cocoa beans, which did not yield remunerative returns, affected the current export quantity of cocoa beans exported from African. Furthermore, the lagged price disincentive on the lagged EXPQ was carried forward to the subsequent period as it reduced the current EXPQ of cocoa beans from Africa.

The elasticity implication of a percent increase in the in the lagged TOP will lead to 0.80% increase in the current quantity of cocoa to be exported from Africa. The elasticity implication of a percent increase in the lagged EXR lagged WP and lagged EXPQ will results in the decrease of the current EXPQ of African cocoa beans by 0.24%, 0.56% and 1.16% respectively. The negative inelastic relationships for the first two former showed how fear of glut i.e. cob-web effect which create a downswing in the price of cocoa will force Africa exporters to reduce their current export quantity of cocoa to the international markets.

The coefficient of multiple determination index showed that 86.8% of the current cocoa EXPQ was determined by the macro-economic indicators captured by the model. In addition, the significance of the F-statistics at less than 10% degree of freedom implied that the estimated coefficient parameters in the long-run dynamic model are different from zero at 10% probability level, thus, they have significant influence on the current EXPQ of cocoa.

3.5.4. *The short-run dynamic cocoa export response function*

The short-run dynamics measured by the ECM showed negative and statistically significant attractor coefficient (ECT) (Table 7a). This implied that a price shock that induces current EXPQ deviation from the equilibrium level would induce African exporters to respond to the shock in a way that the current EXPQ would converge toward the equilibrium value. Furthermore, there is delay in the short-run EXPQ transmission as the coefficients of the lagged macroeconomic indicators were different from zero at 10% probability level. The significance of the attractor coefficient value of 1.38 ($p < 0.001$) implies that the current EXPQ corrects its previous deviation due to short-run shocks or distortion from the equilibrium at the speed of 138.0%.

In other words, it means that about 138% of the disequilibrium experienced in cocoa exports in the previous year is restored back to the long-run equilibrium position within a year after the disturbance or shock. The time required for the current EXPQ to re-establish its equilibrium from disequilibrium will be approximately 16.7 months. The adjustment rate will be very low, an indication of weak efficiency in the degree of integration of the African EXPQ with the global world market of cocoa.

The macroeconomic indicators with significant effect on the current EXPQ were the lagged TOP, lagged CPQ, lagged EXR, lagged EGDP, lagged WP, lagged AC and lagged EXPQ as indicated by their respective estimated parameters, which were different from zero at 10% risk level. The detailed decomposition results showed lagged TOP, lagged CPQ and lagged EGDP to have positive effect on the current EXPQ while the lagged EXR, lagged WP, lagged AC and lagged EXPQ had negative effect on the current cocoa EXPQ.

The elasticity implication of 1% increase in TOP will lead to an increase in the current cocoa EXPQ by 0.69%, thus, indicating the share of Africa integration into the cocoa global trade in the short-run. The elasticity implication of a percent increase in the quantity of cocoa bean produced (CPQ) will boost or spur the export performance of cocoa bean by 0.58%, *ceteris paribus*. This indicates the presence of inventory accumulation accentuated by comparative advantage of the continent in the production of this commodity. Cocoa is not only a notable cash crop and principal export commodity for West African producing economies but also it is a critical import product for consuming countries, which typically do not have favorable climatic conditions for the cultivation of the crop. Consequently, major consuming and processing economies have to import the product as posited by some trade theories.

The price elasticity implication of a percent increase in the EXR and WP will decrease the current cocoa EXPQ by 0.19% and 0.47% respectively. The negative connection (infinite elasticity) of the price

factor unfolds two scenarios: disincentive effect of oscillating downswing price fluctuation on the export performance and the fear of lagged oscillating upswing price volatility, which will dampen the future price of cocoa bean due to glut of the commodity in the global market. The previous price disincentive that affects the previous export quantity ($EXPQ_{t-1}$) reared its ugly trend on the decisions for current EXPQ. The elasticity implication of 1% increase in the lagged EXPQ will force the exporters to decrease their current cocoa EXPQ to the global cocoa market by 0.90%.

The implication of a percent increase in the income elasticity of Europeans will increase the current EXPQ by 0.45. The inelasticity of the income empirically indicated that cocoa bean commodity is a necessity in Europe. In addition, it revealed the critical importance of cocoa as an import product for the consuming European countries which typically lack the favorable climatic conditions for cultivation of the crop. The moderate-income elasticity is evidence of the gradual pace or moderate speed of adaptation of the export to the local tastes in the European importing countries.

The negative connection of credit (AC) with the current EXPQ revealed the effect of high interest rate charged on non-equity capital extended to the cocoa exporters. Consequently, the high cost of capital has posed a constraint to the exportation of cocoa bean in Africa. Therefore, the elasticity implication of 1% increase in the AC will result in the decrease of current EXPQ by 14%.

The results of the coefficient of multiple determination showed that 91.2% variation in the response variable was influenced by the stimulus variables captured by the model. Furthermore, the significance of the F-statistic at 1% probability level indicated that the estimated coefficients are not *cruzeiros* (different from zero at 10% risk level), indicating that the estimated parameters have significant influence on the cocoa export response.

3.5.5. *Diagnostic test*

The results of the diagnostic tests showed that the residual of the short-run dynamic model is devoid of serial correlation and auto-covariance as indicated by the Autocorrelation Langrage multiplier test and the Arch effect LM test, which were not different from zero at 10% degree of freedom. In addition, the residual is found to be normally distributed as shown by the Chi^2 test statistic which is not different from zero at 10% probability level (Table 7a). Structural break or change in the parameters was not present in the equation as indicated by the CUSUM Harvey-Collier test, which is not different from zero at 10% risk level. The multicollinearity test showed no presence of covariance between the predictor variables as indicated by their respective variance inflation factors (VIF) which was less than 10.00 (Table 7b).

Table 7a: Long-run and short-run predictions for current cocoa EXPQ

Long-run dynamic model (LNEXPQ)			Short-run dynamic model (ΔLNEXPQ)		
Variable	Coefficient	t-ratio	Variable	Coefficient	t-ratio
Constant	2.794(8.081)	0.346^{NS}	Constant	-0.053 (0.033)	1.615^{NS}
$LNTOP_{t-1}$	0.804(0.115)	6.967***	$\Delta LNTOP_{t-1}$	0.686 (0.163	4.219***
$LNCPQ_{t-1}$	0.499 (0.383)	1.305^{NS}	$\Delta LNCPQ_{t-1}$	0.579(0.157)	3.691***
$LNEXR_{t-1}$	-0.244(0.059)	4.158***	$\Delta LNEXR_{t-1}$	-0.193(0.085)	2.275*
$LNINF_{t-1}$	0.009(0.032)	0.274^{NS}	$\Delta LNINF_{t-1}$	-0.007(0.019)	0.351^{NS}
$LNAMGDP_{t-1}$	1.515(0.982)	1.544^{NS}	$\Delta LNAMGDP_{t-1}$	1.691(0.974)	1.736^{NS}
$LNASGDP_{t-1}$	-0.003(0.164)	0.020^{NS}	$\Delta LNASGDP_{t-1}$	0.185(0.180)	1.029^{NS}
$LNEGDP_{t-1}$	0.128(0.129)	0.988^{NS}	$\Delta LNEGDP_{t-1}$	0.453(0.161)	2.822**
$LNWP_{t-1}$	-0.560(0.103)	5.446***	$\Delta LNWP_{t-1}$	-0.470(0.095)	4.944***
$LNAC_{t-1}$	-0.074(0.078)	0.959^{NS}	$\Delta LNAC_{t-1}$	-0.142(0.046)	3.107**
$LNDFI_{t-1}$	-0.123(0.175)	0.705^{NS}	$\Delta LNDFI_{t-1}$	-0.031(0.056)	0.556^{NS}
$LNEXPQ_{t-1}$	-1.155(0.170)	6.814***	$\Delta LNEXPQ_{t-1}$	-0.896(0.185)	4.858***
R^2	0.868		ECT_{t-1}	-1.380(0.131)	10.57***
R^2Adjusted	0.723		R^2	0.912	
Durbin-Watson	1.974		R^2adjusted	0.779	
F-statistic	239***		Durbin-Watson	1.07	
			F-statistic	225**	
			Autocorrelation	$0.32(0.58)^{NS}$	
			Arch effect	$0.02(0.89)^{NS}$	
			Heteroscedasticity test	$7.51(0.82)^{NS}$	
			Normality test	$2.90(0.24)^{NS}$	
			CUSUM test	$0.24(0.81)^{NS}$	

Source: Authors' computation, 2018; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; NS = Non-significant

Table 8: Granger causality test results

Null hypothesis	F-stat	P< 0.10	Granger cause	Direction
EXPQ ↔ TOP	4.345	0.067	No	None
	0.134	0.723	No	
EXPQ ↔ CPQ	0.062	0.810	No	None
	0.457	0.516	No	
EXPQ ↔ EXR	3.345	0.101	No	None
	0.086	0.775	No	
EXPQ ↔ INF	1.159	0.310	No	Unidirectional
	8.852**	0.017	Yes	
EXPQ ↔ AMGDP	2.484	0.149	No	None
	0.105	0.753	No	
EXPQ ↔ ASGDP	0.831	0.386	No	Unidirectional
	18.21**	0.002	Yes	
EXPQ ↔ EGDP	0.397	0.544	No	None
	0.192	0.672	No	
EXPQ ↔ WP	3.308	0.102	No	Unidirectional
	6.896**	0.028	Yes	
EXPQ ↔ AC	1.229	0.296	No	Unidirectional
	6.182**	0.035	Yes	
EXPQ ↔ DFI	0.917	0.363	No	None
	2.541	0.145	No	

Note: **denotes rejection of the H_0 at 5% level of significance; NS: Non-significant; $\rightarrow \leftarrow$ *means forward and backward directions respectively*

Table 7b: Multicolinearity test

Variable	VIF
$\Delta LNTOP_{t-1}$	1.130
$\Delta LNCPQ_{t-1}$	3.883
$\Delta LNEXR_{t-1}$	2.269
$\Delta LNINF_{t-1}$	1.637
$\Delta LNAMGDP_{t-1}$	4.956
$\Delta LNASGDP_{t-1}$	1.649
$\Delta LNEGDP_{t-1}$	2.721
$\Delta LNWP_{t-1}$	4.475
$\Delta LNAC_{t-1}$	1.607
$\Delta LNDFI_{t-1}$	2.507
$\Delta LNEXPQ_{t-1}$	6.126
ECT_{t-1}	1.565

Note: VIF > 10.0 may indicate collinearity problem

3.5.6. *Causality relationship*

The granger causality results showed that the macro-economic indicators *viz*. CPI, ASGDP, WP, AC had useful information to predict the future formation of EXPQ as shown by their respective F-statistics which were different from zero at 5% degree of freedom. In the case of the EXPQ, it has no useful information to predict the future formation of the aforementioned macro-economic indicators as indicated by its F-statistics which were not different from zero at 5% degree of freedom (Table 8). However, a slight adjustment forward of the degree of freedom (> 5 but ≤ 10) showed that the EXPQ granger cause formation of TOP but the latter did not granger cause the formation of the former. Therefore, it can be inferred that the export performance of cocoa in the long-run has been determined by the purchasing and earning power of money. The causal effect of the EXPQ on the TOP justified the earlier findings on the integration of the Africa into the global cocoa trade.

4. Conclusions and Recommendation

Evidences show that the geographical trade concentration of African cocoa in the global market is very low and by adopting the optimal solution preferred by the LP the geographical trade concentration will increase. The African cocoa export has a competitive advantage in the global cocoa trade market as its export quantity is found to be very stable. Furthermore, the current export quantity of cocoa had log-run association with the macro-economic indicators and any price shock that induced current EXPQ deviation from the equilibrium level would induce African exporters to respond to the shock in a way that the current EXPQ would converge toward the equilibrium. The major macro-economic indicators affecting the export performance of African cocoa in both the long and short-runs is the price factor. Therefore, the continental bloc (African Union) should enhance the trade mechanism of cocoa by strengthening the price policy so that the dampening price effect affecting remunerative price in the international market should be nip in the bud. There is a need to improve the quality of African cocoa in order to increase the competitive prowl of the product in the global cocoa market. In addition, the regional body and the major exporting economies financial export institutions in Africa should reduce the cost of non-capital equity advanced to the exporters as high interest rate is affecting export performance of the product. The continent should increase its export to the importing economies as it has the capacity to increase its current export capacity by 41.73% with approximate export value gain of 40.82%.

Conflict of Interest

The authors declare that there is no conflict of interest.

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