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Estimation of Short and Long-Run Effect of Cocoa Price Fluctuation on Export and Area Harvested in Nigeria

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Abstract
Cocoa is an important cash crop that contributes to employment generation and the Goss Domestic Product (GDP) of Nigeria and the second contributor to the country's GDP after crude oil. To estimate the effect of the volume of cocoa export and area under cocoa on cocoa producer price change, the data for these variables from 1970 to 2018 were adapted and used for the study. The unit root test, co-integration test and vector error correction models were used for analysis of the data. The results of unit root test showed that all the variables were integrated of the first order. The Johansen co-integration test was used to identify the cointegrating equations and the long run effect of producer price on the variables. Results of the Vector Error Correction Model revealed that cocoa producer price adjusted slowly to changes in the volume of cocoa export and area under cocoa production. The short run analysis however, showed that while export responded positively, area harvested was significant, but negatively related to producer price variation, on average in the short run. Measure recommended to influence the cocoa enterprise was the formation of marketing cooperative that could store cocoa during periods of high output when the cocoa prices are low. Other management policies, especially policies that will ease access to cocoa farm inputs and increased cocoa quality in the short and long run were recommended.

Keywords: Cocoa production, export, cointegration, producer price

INTRODUCTION
Agriculture remains the bedrock for economic growth, development and poverty eradication in low- and middle-income countries. Studies have shown that agriculture is the largest non-oil export earner for Nigeria, a major contributor to wealth creation, poverty reduction and a major employer of labour (Central Bank of Nigeria (CBN), 2005; Oadejo, 2019). An important component of the agricultural sector in Nigeria is the cocoa production enterprise. After independence from the 1960s, Nigeria was one of the world's major exporter of agricultural commodities amongst which was cocoa. Olabode and Ogunrinola (2020) observed that the Nigerian agricultural sector is responsible for 17.8% of the Gross Domestic Product (GDP) and has about 42.7% of total labour force. The cocoa sector accounts for about 2% of the national export earnings and over 200,000 rural households depend on it as a source of income and a major determinant of the rural economy (National Cocoa Development Committee (NCDC),

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2008; Popoola *et al*., 2015).Apart from direct production, cocoa marketing and supply chain provides a source of livelihood to millions of investors and farmers in different areas as trade, transport, processing, and export of cocoa products (Hamzat *et al*., 2003). It had been forecasted that cocoa output would have risen in demand by 30% before the end of the year 2020 (Olabodeand Ogunrinola, 2018). Despite the importance of cocoa production to the Nigerian economy, it has been experiencing various challenges that may be linked to a poor marketing process, low productivity as a result of low input supply and an unstable agricultural policy from policy makers.

After the attainment of independence, the Nigerian government's policy on agricultural development especially in cocoa production was one of minimum intervention (Idowu *et al*., 2007). Emphasis was in the area of research, extension services, crop marketing and pricing activities. This policy of government was justified by the prevailing economic policy inherited from the colonial masters (Manyong *et al*., 2005). By realizing the relative importance of cocoa to the economy, the government intervened in the area of input supply and produce marketing. The government put in place the marketing boards which were mandated to stabilize prices paid to the farmers, ensure public access and control over foreign exchange, strengthen the marketing mechanisms, create an ideological antipathy to private cocoa marketers and impose constraints on multinational enterprises dealing on cocoa products (Delloitte *et al.,* 1990). For example, the cocoa marketing activity was carried out by the marketing boards that was functioning more like a monopoly. The board served as a disincentive to cocoa farmers both in their production and marketing activities (Idowu, 1986). The commodity boards were used mainly as a taxation agent and this resulted to low prices paid to the farmers (Idachaba, 1990). Other processes that affected cocoa production and marketing were the oil boom syndrome that caused over-valuation of the Nigerian currency (Naira) as compared to other currencies (Adekunle and Ndukwe, 2018). The oil boom caused a rapid capital inflow into the country and this caused the naira to appreciate. Over valuation of the Nigerian Naira led to the *Dutch disease* where it was cheaper to import with a stronger Naira than produce. The effect was a consistent decline in aggregate cocoa output given increasing import of agricultural finished products.

With the continuous decline in cocoa output, the World Bank and the International Monetary Fund introduced the Structural Adjustment Programme (SAP) to rescue the various economies of cocoa producing countries from collapsing (Darkwah and Verter, 2014). This affected the farmers given the increased living costs and inadequate supply of farming inputs. To reduce the effect of the low price and boast the economy, the cocoa sector was liberalized and private industries were licensed to buy and sell cocoa and other agricultural products. The government policy recommendations also favoured an upward review of producer prices and input subsidization to maintain an increased aggregate cocoa output supply. The implementation of the liberalization process led to an increase in the number of licensed marketers in the cocoa sector. In fact, in 2011 about 123 export companies were registered with the Nigeria Export Promotion Council, three of which, had a combined market share of 60%(Hütz-Adams, 2018).As a result, the share received by farmers from the world market price rose significantly. Despite the implied increase in cocoa price, aggregate output of cocoa continued to decline (Idowu *et al*., 2007). Other intervening variables could be the reason for the continuous decline in cocoa production and cocoa output.

In a developing economy with a fragile economic base like that of Nigeria, almost any economic activity could result to export price fluctuation. Price fluctuation may be as a result of currency devaluation which in some circumstances may be an incentive for export growth. Ettah and Akpan (2011) opined that the 1986 devaluation of the naira increased the demand for agricultural products and raised prices of agricultural commodities over the years. Conversely, with the discovery and exploitation of crude oil in early 1970's, crude oil prices increased and the petroleum subsector gained pre-eminence over agriculture. This resulted to a decline in the value of agricultural exports to total imports, resulting to the appreciation of the Naira. Okunmadewa (1999) observed that price fluctuations and instability of exchange rate movements as a result of floating exchange rate have raised concerns about the impact of the movements on agricultural trade flow in Nigeria. The concern is therefore raised on challenges that are introduced as a result of price and exchange rate movements in relation to agricultural exports. Kargbo (2006) in a study observed that prices, real exchange rates, domestic production capacity, and real incomes impacts significantly on agricultural export. DeGrauwe (1988) in a study on exchange rate volatility showed that exchange rate variability causes fluctuation in export revenue. Various policies had been implemented by the government in an attempt to maintain a stable price and exchange rate. The exchange rate and cocoa export price in Nigeria from 1970-1977 were stable and it was attributed to the Nigeria Commodity Board (NCB) policy that controlled the marketing and producer price for cocoa.

One of the policies thrust components of the present government in Nigeria is to prioritize the private sector as an engine to drive growth of the agricultural sector especially on the output of agricultural crops (FMARD, 2020). Nigeria experienced an economic recession in 2017 (CBN, 2018) and is experiencing the second recession in five years as a result of falling crude oil prices, the weakening of the Naira and a fall in revenue accruing from a low or declining value of exports. In an effort to rescue the economy and improve on the volume of export, the Nigerian government has turned to the agricultural sector and other viable revenue sectors as astrategy to contain the falling oil prices. It would therefore be necessary to look into factors affecting the agricultural sector especially the cocoa output in Nigeria, by studying the sector's impact on economic growth.

The impact of agricultural policies especially on crop price fluctuation on some input variables in Nigeria has received limited attention in empirical literature. This is so, in spite of the fact that agricultural output was one of the main reasons for most of the agricultural programmes initiated by the Nigerian government (Ukoha, 2007). Studies had been carried out on the effect of macroeconomic factors such as inflation, price variation, output supply on agriculture. These studies use cross-sectional data for analysis to determine seasonal effects of identified variables on agricultural production. As such, there exists a shortage of empirical studies on the influence of time series data on identified crops, particularly cocoa. Most of the studies on cocoa in Nigeria centers on productivity, efficiency and profitability (Popoola, 2015; Wasiu and Burhan, 2018; Amos, 2017). Few studies investigated the influence of annual data such as inflation, exchange rate, price volatility, or the impact of agricultural policy on individual crops (Olatunji, 2012; Obike *et al*., 2017). This study aims at investigating the effect of cocoa producer price fluctuation on cocoa export and area under cocoa production. Results obtained from this study will be useful to farmers, cocoa marketers and policy makers given that recommendations made will provide information that can influence decision on production requirement and cocoa output.

RESEARCH METHODOLOGY

Study area and data source

This study was conducted in Nigeria. The country is situated in the Gulf of Guinea in West Africa. Nigeria lies between 40^0 and 140^0 north of the equator and between longitude 30^0 and 150^0 east of the Greenwich. Nigeria has a total land area of 923,768.622 km^2 and a population of 209,588,670 (Worldometer, 2021). To estimate the long and short-run effects of cocoa price variation on cocoa export and area under cocoa, yearly data from 1970 to 2018 was used. These data were sourced from the website of Food and Agricultural Organization of the United Nations (FAOSTATS, 2019), the political economy of cocoa exports in Nigeria (Taiwo, 2016) and various issues of the publications of the Central Bank of Nigeria (CBN, 2020). The study made use of descriptive and inferential statistics to achieve the set objectives of the study. While the descriptive statistics summarize the features of the variables under study, inferential statistics like the Augmented Dickey Fuller (ADF) test, Johansen cointegration test and vector error correction model were used to estimate the relationship between the variables.

Model Specification

The unit root tests

Analysis of the time series data begins by considering the characteristics of data used. This is achieved by considering the order of integration of each series. The need for a check to stationarity is to avoid estimating spurious regression. Spurious regression results with statistically significant relationships between the variables, when it is concurrent correlation. There are various types of unit root test. This study used the Augmented Dickey–Fuller (ADF) test to examine the variables for the presence of unit root. The test employed the existence of the unit root as the null hypothesis while non-existence of the unit root in the data series is the alternative hypothesis. If the test statistic is greater than the critical values, the null hypothesis of an implied non-stationary series is rejected. If the null hypothesis is rejected, then the time series data is stationary, hence no unit root. The ADF test was specified following Awunyo-Vitor and Sackey (2018) in (i) as;

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Where$\Delta$is the difference operator, $Y_t$is equals time series data on variable to be tested, β_0 is the intercept term, $\beta_1$is the coefficient of interest in the unit root test, β_2, $\beta_3 \ldots \beta_p$ are the parameters of the augmented lagged difference of Y_t to represent the pth-order auto-regressive process. $\varepsilon_t$is the error term. Once a unit root has been confirmed for a data series, the next task is to determine whether there exists a long-run equilibrium relationship among variables or not. This result to the need for a cointegration test.

Lag length estimation

The VAR model was analyzed to estimate the optimal lag length based on the minimum Akaike Information Criterion (AIC)and the Schwartz Bayesian Criterion (SBC)(Darkwahand Verter, 2014). An appropriate lag length is important given that many lags reduces the power of the test due to estimation of increased parameters and loss of degrees of freedom. Few lags may not capture the dynamics of the actual error correction process giving faulty estimates of coefficients and standard errors.

Cointegration analysis - Johansen test

The cointegration theory was developed to solve the problem of random walk associated with non-stationary data. In time series data, integrated processes are considered together and they form equilibrium relationships. The concept of cointegration is that multivariate time series are integrated while certain linear transformations of the time series are not stationary. Two or more time series may be non-stationary while their linear combination is stationary. Such a series is considered to be cointegrated given that they move together over time(Babur, 2010). These series are therefore bound in the long run. The Johansen cointegration test procedure canbe used to establish the existence of a long-run relationship among variables. Cointegration provides more powerful tools than other econometric models when the data sets are of limited length, as most economic time-series are. The equation for the Johansen Cointegration test is specified following the work of Faloye and Bakare (2015). Assume that there is a long-run relationship between two variables $[Y_t, X_t]$.For a long-run equilibrium relationship to exist, there need to be a linear combination of$Y_t and\ X_t$, which can be gotten directly from estimating the following regression.

$Y_t = \beta_1 + \beta_2 X_t + \mu_t$……………………………………………………………(ii)

Taking the residuals will give;

$$\hat{\mu}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_2$$

If $\hat{\mu}_t \sim I(0)$ then the variables $Y_t and\ X_t$, are considered to be cointegrated.

Vector Error Correction Model (VECM)

When the variables in the series are cointegrated, there is need to specify and estimate a vector error correction model (VECM) with the error correction term to identify the dynamic behaviour of the model (Athanasios and Antonios, 2011). The VECM is constructed to determine not only the short-term disturbances, but adjustment mechanism to estimate the speed of adjustment. Since the variables are supposed to be cointegrated, then in the short run, deviations from this long-run equilibrium will feed back on the changes in the dependent variables in order to force their movements towards the long-run equilibrium state. Hence, the cointegrated vectors from which the error correction terms are derived are each indicating an independent direction where a stable meaningful long-run equilibrium state exists. The final form of the Error-Correction Model (ECM) was selected according to the approach suggested by Hendry (Maddala, 1992). The general form of the vector error correction model (VECM) is explained in (iii) as:

$\Delta LnPRI_t = \beta_0 + \sum_i^{n-1} \beta_1 \Delta LnPRI_{t-1} + \sum_i^{n-1} \beta_2 \Delta LnEXP_{t-1} + \sum_i^{n-1} \beta_3 \Delta LnARE_{t-1} + \lambda EC_{t-1} +$
ε_t……………………………………………………………………………………. (iii)

Where:

Δ is the first difference operator,

EC_{t-1} is the error correction term of lag one period,

λ is the short-run coefficient of the error correction term ($-1<\lambda< 0$),

ε_t is the white noise term.

The specification of the model allows the deletion of the insignificant variables, while the error correction term is retained.

EMPIRICAL RESULTS AND DISCUSSION

Descriptive statistics
Table 1 shows the descriptive statistics and correlation analysis carried out on the data. The results of the analysisshowed that the average price of cocoa was₦140909.5 with a standard deviation of 188754.4.

Table 1. Descriptive statistics

	Price	Export	Area Harvested
Mean	140909.5	185446.8	883943.6
Median	61180.0	189985.0	739000.0
Maximum	663453.5	294661.0	1359550.0
Minimum	288.0	92891.0	700000.0
Std. Dev.	188754.4	48667.6	231430.4
Skewness	1.254106	0.230128	0.810773
Kurtosis	3.326749	2.469128	2.078058
Jarque-Bera	13.06236	1.007891	7.103749
Probability	0.0014	0.6041	0.0286
Sum	6904565	9086892	43313238
Sum Sq. Dev.	1.71E +12	1.14E +11	2.57E +12
Observations	49	49	49

Source: Author's computation, 2021

The average for formal Export is 185446.8 metric tonnes with a standard deviation of 48667.6 and the averages for area harvested is883943.6 Ha with standard deviations of 231430.4.A Jarque–Bera test shows thatthe residuals for export are normally distributed while price and area harvested are not normally distributed. Thus, the need to use the Logarithm form of the variables.

Correlation Analysis
Table 2 shows the results of the correlation analysis of macroeconomic variables that affect cocoa production. Results of the correlation matrix for the study shows that cocoa export and area of cocoa harvest, cocoa export and producer price, area of cocoa harvest and producer price have a positive relationship. The results show that the variables are correlated and therefore influences each other. This could be observed when there is an increase in the price of cocoa; the farmers will increase and improve their cocoa farms. As a result, there will be an increased volume of cocoa marketing activities and therefore, increase in cocoa export.

Table 2. Correlation analysis

Correlation	Price	Area	Export
Price	1		
Area	0.852557	1	
Export	0.536137	0.508097	1

Source: Author's computation, 2021

Unit Root Test
Table 3 shows the result of the Augmented Dickey-Fuller (ADF) unit root test. The results show that the three variables were all negative at level and non-stationary. This shows that they require differencing. The log of the variables became stationary after first differencing, implying

that they are integrated of order one. Other authors had similar results. For example, Adekunle and Ndukwe (2018) while studying the impact of exchange rate dynamics on agricultural output performance in Nigeria observed that some variables were stationary at level while others were stationary after first difference.

Table 3: Augmented Dickey Fuller Test (with constant term only)

Variable		ADF Statistics	Critical Values 1%	5%	Inference	Decision
LnPRI	First dif	-5.845***	-3.578	-2.925	1(1)	Stationary
	Level	-0.932	-3.574	-2.924	1(0)	Non-stationary
LnARE	First dif	-9.366***	-3.577	-2.925	1(1)	Stationary
	Level	-0.405	-3.578	-2.925	1(0)	Non-stationary
lnEXPO	First dif	-5.216***	-3.589	-2.930	1(1)	Stationary
	Level	-0.551	-3.588	-2.929	1(0)	Non-stationary

Note: The asterisks (**, ***) denote statistical significance at 0.05, and 0.01 levels respectively. ADF = Augmented Dickey- Fuller test,
Source: Author analysis, 2021

Optimal Lag Selection Criteria

The optimum lag selection criteria outcome is shownin Table 4. The result shows that all the test criteria select the optimum lag length 1. As such, the estimated lag 1 will be employed to estimate the co-integration test and the VECM model.

Table 4: VAR Lag order selection criteria;
Endogenous variables: LnPRI, LnEXP, LnARE

Lag	Log L	LR	FPE	AIC	SC	HQ
0	47.1231	NA	2.82e-5	-1.9610	-1.8405	-1.9161
1	161.7688	208.9098*	2.58e-07*	-6.6563*	-6.1746*	-6.4767*
2	169.3074	12.7319	2.78e07	-6.5914	-5.7483	-6.2771
3	173.9986	7.2973	3.41e-07	-6.3999	-5.1954	-59509
4	184.2221	14.5401	3.32e-07	-6.4543	-4.8885	-5.8706

* indicates lag order selected by the criterion (2)
LR: sequential modified LR test statistic (each test at 5% level) SC: Schwarz information criterion
FPE: Final prediction error AIC: Akaike information criterion;
FPE: Final prediction HQ: Hannan-Quinn information criterion error;
Source: Author's computation, 2021

Cointegration Test

The trace statistics and maximum eigenvalue statistics tests of Johansen cointegration test was employed using the unrestricted cointegration rank test to establish the existence of a long-run relationship between the variables. The null hypothesis that states that there are no cointegration equationswas rejected. In Table 4, the Trace test and Maximum-Eigenvalue tests both indicated the presence of 2 cointegration equation at 5%. The results show the presence of long-run relationship among the variables. Ahoba and Gaspart (2019) had similar results in their study. The VECM approach becomes appropriate given that the conditions of stationarity ant first difference were met.

Table 5: Maximal eigenvalue and trace test results for cointegration (constant)

Hypothesized No. of CE(s)	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value	Decision
None *	31.1622	29.7971	22.2616	21.1316	**Reject**
At most 1	8.9005	15.4947	6.9343	14.2646	**Accept**
At most 2	1.9662	3.8415	1.9662	3.8415	**Accept**

* denotes rejection of the hypothesis at the 0.05 level
Source: Author's computation, 2021

Johansen normalization interpretation

Table 6 shows the Johansen normalization output in the short run. The results show that in the long run, log of export (LnEXP) had a negative impact while log of area harvested (LnARE) had a positive impact on log of producer price (LnPRI) on average *ceteris paribus*. The variables are statistically significant at 1% level. Thus, the null hypothesis of no cointegration is rejected against the alternative of a cointegrating relationship in the model. Having established a cointegrated relationship among LnPRI, LnEXP and LnARE, the next issue is to determine how the variables adjust in response to a random shock. This phenomenon represents the short-run disequilibrium dynamics. The short run dynamics of the model can be estimated by analyzing how the variables in a cointegrated system responds or corrects itself to the residual or error from the cointegrating vector. This justifies the use of the error correction mechanism. Athanasios and Antonios (2011) in their study used the VECM for the analysis.

Table 6: Johansen normalization results

	Cointegrating Equation(s):		Log likelihood 173.7102
	Normalized cointegrating coefficients (standard error in parentheses)		
	LnPRI	LnEXP	LnARE
Coefficient	1.000000	4.901148	-11.45856
Standard Error		(0.92923)	(0.84530)
t-value		5.2744	13.5556

Source: Author's computation, 2021

Error Correction Model (VECM) Estimation

The result of the estimated VECM is reported in Table 7 and include estimated parameters of the speed of adjustment parameters of the long run and short-run coefficients. The significance of the coefficient of the error correction term (adjustment coefficients) indicates the long run causal effect. The adjustment coefficient for LnPRIwas -0.1059, and statistically significant in the model. This means that the previous year's deviation from long run equilibrium is corrected in the current period at an adjustment speed of 10.59%.As a result, an adjustment speed of 10.59% indicates a slower but significant adjustment process. For LnEXP, the adjustment coefficient was 5.51% and not statistically significant. This imply that shocks to the variable adjust slowly even with appropriate policies put in place by the government. The adjustment speed for LnARE was 3.75% and statistically significant. This could imply relative stability in rate of increase in area under cocoa crop over the period. Though farm size is important under agricultural establishment, policy makers recommend increase in efficiency level to increase cocoa output than farm size due to environmental concerns.

For the results of the analysis of variables in the short run, LnPRI was utilized as the dependent factor while LnEXP and LnARE were used as independent variables. The estimated results revealed that the coefficient for LnEXP was positive and significantly different from Zero. Thus, a percentage change in LnEXP is associated with a 0.47% increase in LnPRI on average, *ceteris paribus* in the short run. The coefficient of LnAREwas negative and not statistically significantly. This shows that a 1% increase in LnARE is associated with a 0.43% decrease in LnPRI on average, *ceteris paribus*, in the short run. The non-significance of LnARE shows that area under cocoa production does not necessarily influence output in the short run.

Table 7:Error Correction Result

Cointegrating Eq:	CointEq1		
LnPRI(-1)	1.000000		
LnEXP(-1)	4.901148		
	(0.92923)		
	[5.27443]		
LnARE(-1)	-11.45856		
	(0.84530)		
	[-13.5556]		
C	37.79036		
Error Correction:	**D(LnPRI)**	**D(LnEXP)**	**D(LnARE)**
CointEq1	-0.105964	-0.055118	0.037574
	(0.04211)	(0.03874)	(0.01194)
	[-2.51657]	[-1.42260]	[3.14613]
D(LnPRI(-1))	0.167069	0.013091	-0.030352
	(0.14093)	(0.12968)	(0.03997)
	[1.18543]	[0.10095]	[-0.75930]
D(LnEXP(-1))	0.476487	-0.383971	-0.055401
	(0.18018)	(0.16579)	(0.05111)
	[2.64448]	[-2.31595]	[-1.08404]
D(LnARE(-1))	-0.438754	0.088319	-0.127706
	(0.49643)	(0.45679)	(0.14080)
	[-0.88382]	[0.19335]	[-0.90697]
C	0.059255	0.002279	0.009565
	(0.02004)	(0.01844)	(0.00568)
	[2.95722]	[0.12359]	[1.68298]

Source: Author's computation, 2021

Statistical diagnostic tests results

To check if the model fit the data used for this study, the VECM was adapted and subjected to different diagnostic tests. These tests were for serial correlation, normality and heteroscedasticity to ascertain if it is statistical adequate. A level of significance at 5 % level used for all the tests.

Testing for Serial Correlation

The results of VEC Residual Serial Correlation LM Tests of no serial correlation at lag order 1 to 2was not rejected at 5% significance level. This shows that the analysis is free of serial autocorrelation. As a result, VECM is suitable to be used for this study.

Table 8: VEC residual serial correlation LM test

Lags	L-M statistics	Probability
1	8.386588	0.4957
2	14.38704	0.1092

Source: Author's computation, 2021

The VEC residual normality test

The test for normality was captured using theJarque-Beraapproach. The results show that the residues arenormal distributed. The Jarque-Bera approach was adopted for the study because it factors in the skewness and kurtosis. As Evidenced by the results of the residue, there is no presence of serial correlation.

Table 9: The VEC residual normality test

Component	Jarque-Bera	Df	Probability
1	1.260873	2	0.5324
2	0.735333	2	0.6923
3	0.993970	2	0.6084
Joint	2.990176	6	0.8101

Source: Author's computation, 2021

VEC residual heteroskedasticity Test

The test for heteroskedasticity showed that the probability was 11.6%, higher than 5%. Therefore, the null hypothesis of the presence of heteroscedasticity was rejected and the alternative was accepted. The model also shows that the variability of variables in the model has minimum variance, and it is not heteroskedastic and the error term is normally distributed.

Table 10: VEC residual heteroskedasticity Test

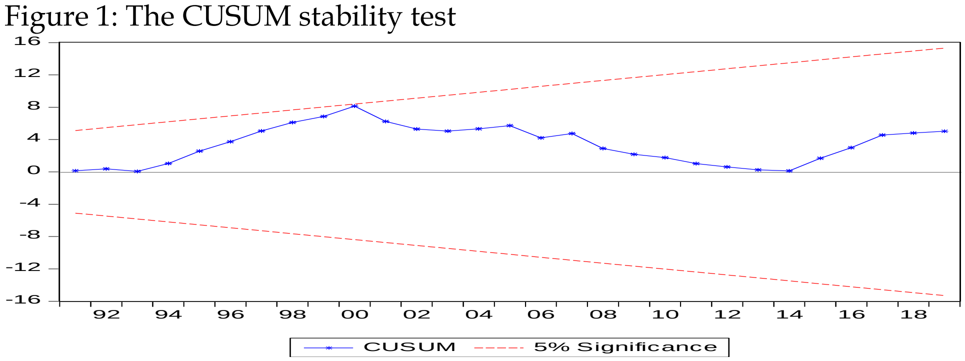
Chi-square	Df	Prob.
59.87216	48	0.1168

Source: Author's computation, 2021

Stability test results

CUSUM statistics are used to determining the parametric stability of the model under study.

Figure 1: The CUSUM stability test



Source: Author's computation, 2021

The decision about parameter stability is based on the position of the plots relative to the 5 % critical bounds. If the plots of the CUSUM statistics stay within the area in the two critical lines, then the parameters of the model are stable over the period of the study. Figures 1 indicate that the position of both CUSUM plots stay within the area in the two critical lines, which means there are no structural changes in the model.

CONCLUSION AND RECOMMENDATIONS

The study analyzed cocoa production in Nigeria from 1970 to 2018with the help of Augmented Dickey–Fuller (ADF) test, the Johansen cointegration and VECM analysis. The main objective of the study was to determine the effect of annual cocoa price variation on cocoa export and area under cocoa crops. The ADF tests showed that the annual data integrates and thus, stationary at first level ($I(1)$). Johansen cointegration test showed a long-run equilibrium relationship between cocoa producer price, cocoa export and area harvested. The VECM results for the adjustment coefficient for LnPRIwas statistically significant in the model. However, the results revealed a negative relationship between annual cocoa price and export. This may be cause by the fact that cocoa farmers are not directly concerned with cocoa export and do nothave timely information on price increases. The short run results showed a positive significant relationship between cocoa export and price. The area under cocoa did not significantly influence cocoa prices in the short run. It was recommended that the Nigerian government should ensure that marketing information on prices should be released to the farmers so that cocoa price increases should not end with the licensed buyers. Due to slow adjustment to prices in the long run, farmers could form cooperatives where their produce could be stored during periods of reduced prices. Other management policies, especially policies that will ease access to cocoa farm inputs and increased cocoa qualityin the short and long run were recommended.

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