

# Impact Assessment of the Cocoa Rehabilitation Project on Cocoa Exports in Ghana

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## Abstract

Cocoa export is the biggest source of Ghana's core revenue from agriculture. This study employs the cointegration approach to measure the impact of the factors that influenced cocoa export performance in Ghana after the cocoa rehabilitation project was introduced into the cocoa sector from 1988 to 1993 by analyzing relevant time series data from 1988 to 2018. The results of the analyses show that all the variables used in the study do not substantially influence cocoa exports in the long run. The study concludes that even though the cocoa rehabilitation project may have had a lasting impact on the performance of the cocoa sector in recent years; resulting in increments in foreign exchange revenue, production and exports, the project to a larger extent has failed to adequately cater for all of the needs of the most important stakeholder of the cash crop—the farmer. The study recommends that Government should restructure and empower the Ghana Cocoa Board through the Ministry of Food and Agriculture to ensure proper supervision and accountability in the management of cocoa sector reforms.

## Keywords

Cocoa, Cocoa Exports, COCOBOD, CRP, Johansen Cointegration, Error Correction Model

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## 1. Introduction

The Cocoa Rehabilitation Project (CRP) was a Government of Ghana initiative and part of the Economic Recovery Program (ERP) package under the supervision of the World Bank (WB) and the International Monetary Fund (IMF). It was funded by a number of institutions and it was the first Agricultural Development Bank (ADB)/Agricultural Development Fund (ADF) financed cocoa

project in Ghana. The project value was 100 UA million from start to completion.

### **Project Formulation**

According to ADB/ADF (OPEV) [1], the project came about as a result of factors relating to the sharp fall in production from 400,000 tons to about 180,000 tons in the 1970s. This sharp decline was attributed to factors such as the fall in producer prices which acted as a disincentive to cocoa farmers, persistent weakness in the internal market, unfavorable government control measures over cocoa purchasing and exports, high marketing and administrative costs and export duties and low outputs due to pests, diseases and aging cocoa trees.

The main objective of this study is to measure the impact of the CRP on the performance of the cocoa sector in Ghana and also identify the possible linkages between the CRP and the current state of the cocoa sector of Ghana. The study also provides an assessment of the CRPs in general by measuring the impact their objectives may have had on cocoa exports and its possible relationship with cocoa production, gross domestic product (GDP) growth rate, world cocoa prices, and real exchange rate.

## **2. Literature Review**

A good number of cocoa sector reforms have led to a more liberal cocoa sector [2] [3] [4] which has impacted positively on production and export performance in Ghana [5] [6] [7] [8], Nigeria [9] [10] [11] and Cote d'Ivoire [12] leading to an increase in exports and thus impacting GDP and GDP growth rate positively [13] [14] [15]. Others such as [16] by applying the comparative cost theory by [17] concluded that a positive relationship between production and exports led to fewer taxes on producers and reduction in costs. References [18] [19] [20] identified real exchange rate as an important driver of cocoa exports in Nigeria during the period of the structural adjustment programs (SAPs) in the 1980s through to the early 2000s. Reference [19] also found a positive relationship between cocoa export and world cocoa prices in Nigeria. However, high trade deficits and international debts as a result of the performance of the Cedi against major trade partners result in a fall in cocoa production and exports.

The share of producer prices comparative to world cocoa prices in the 2000s varied from one country to another [21] where higher producer prices were paid to farmers in Ecuador, as a result of an efficient marketing regime [22] in Cameroun as a result of reduced taxes on cocoa [23] and in Indonesia as a result of limited but supportive government policy reforms [24]. Meanwhile, Ghanaian farmers faced lower producer prices [25] as a result of high inflation levels and exchange rate distortions while farmers in Cote d'Ivoire were paid much lower producer prices because of high taxation, estimated between 25% and 30% from 2002-2009 [26]. Moreover, the effect of the world cocoa prices on farmers' investment decisions is quite significant [27] [28] [29] [30] [31] even as they continue to respond positively to fluctuations in farm gate prices with sustained or

increase in production [32] [33]. Additionally, the impact on both skilled and unskilled labor employment on production is substantial [34] [35] [36] as there exists a positive linkage between technology and production [37] [38] [39] [40] [41].

The Ghana Cocoa Board (COCOBOD), through the Cocoa Research Institute of Ghana (CRIG) has over the years improved on technology in production, leading to quality hybrid cocoa varieties and improved cocoa flavor quality. The significance of this study is to generally assess the feasibility, sustainability and profitability of the CRP as well open up the possibility of conducting studies on other policy reforms introduced into the cocoa sector.

### 3. Methodology and Materials

#### Data Sources and Model Specification

Annual time series data from 1988 to 2018 obtained from Ghana Chamber of Mines and the Minerals Commission of Ghana were used for the analyses in this study. Also, the official CRP document and other relevant journals were sourced for secondary information.

The Cointegration Approach was chosen for the modelling and analysis in this study because of its relevance, practicality and usefulness in policy analysis. The cointegration approach also helps to define the relationship between the variables expressed in the models.

The multiple regression model used identifies Ghana cocoa exports as the response variable whereas Ghana cocoa production, world cocoa exports, world cocoa production, world cocoa prices (US\$/t), gross domestic product growth rate and real exchange rate are the explanatory variables. The model is given as:

$$GCEx = f(GCP, WCEx, WCP, WCPx, GDPgr, RER) \quad (1)$$

The general form of the model estimated in this study is expressed in the following form:

$$GCEx_t = \beta_0 + \beta_1 GCP_t + \beta_2 WCEx_t + \beta_3 WCP_t + \beta_4 WCPx_t + \beta_5 GDPgr_t + \beta_6 RER_t \quad (2)$$

GCEx is Ghana cocoa exports, while GCP is Ghana cocoa production, WCEx (World cocoa exports), WCP (World cocoa production), WCPx (World cocoa prices), GDPgr (gross domestic product growth rate of the Ghanaian economy), and RER (annual average real exchange rate; Ghanaian Cedi relative to the US Dollar).

To reduce the inconsistency in the variables, a natural log was employed into the model. To determine the relationship between the response and explanatory variables, we regressed the following equation. The primary objective here is to establish whether the explanatory variables have any impact on the response variable.

$$\ln GCEx_t = \beta_1 + \beta_2 \ln GCP_t + \beta_3 \ln WCEx_t + \beta_4 \ln WCP_t + \beta_5 \ln WCPx_t + \beta_6 \ln GDPgr_t + \beta_7 \ln RER_t + \varepsilon \quad (3)$$

where,  $\ln$  is the natural log,  $\beta_1\beta_2\beta_3\beta_4\beta_5\beta_6\beta_7$  are coefficients of the explanatory variables and  $\varepsilon$  is the error term.

According to [42], the non-stationarity condition of time series data analysis is often likely to result in misleading results as well as drawing spurious conclusions. So to avoid this, we employed the Augmented Dickey-Fuller (ADF) unit root tests [43] to examine the time series properties of each variable by testing for their stationarity at both levels and first difference. By employing Engel and Granger's two-step methodology, we investigated the short-run equilibrium relationship between the variables by using the error correction model (ECM). First, we established a long-run model after a cointegration relationship between the variables had been established; after which we used the information on the error term in the long-run model as an added variable in the short-run model.

## 4. Results and Discussion

### 4.1. Analysis of the Descriptive Statistics

**Table 1** summarizes the descriptive statistics used in this study. The mean values of Ghana cocoa exports and production for the period under study show that about 75.16% of all cocoa produced in Ghana were exported.

### 4.2. Results of Correlation Analysis

**Table 2** presents the correlation matrix of the model. As expected, the response variable exhibits a fairly strong relationship with the explanatory variables. Noticeably, extremely high values are reported for Ghana cocoa production, as well as world cocoa exports and production.

### 4.3. Results of Analysis of the Time-Series Properties of the Variables

Having employed the ADF unit root tests, we measured the univariate time series properties of the variables to define the characteristics of the roots of the variables in the data. The critical values were tested at 1%, 5%, and 10% significance levels. The ADF tests results show Ghana cocoa exports, world cocoa exports and production to be significant at all levels. However, Ghana cocoa production, world prices, GDP growth rate as well as real exchange rate were found to be insignificant at all levels.

Having confirmed that some of the variables are not stationary at levels, we went ahead to conduct a unit root test for the first difference of the data. All the variables were significant at first difference. **Table 3** presents the results of the ADF unit root test. First difference results of the variables are also summarized in **Table 3**. The ADF test results show that all the variables fall beyond their respective p-values, indicating a rejection of the null hypothesis of a unit root in favor of the alternative hypothesis of no unit root. The implication of these results is that all the variables entering into the Error Correction Model (ECM) are integrated of order 0.

**Table 1.** Descriptive statistics.

Variable	Mean	Median	Standard Deviation	Maximum	Minimum	Kurtosis
GCEX	416,909.7	360,250	169,559.1	748,161	202,964	1.706126
GCP	554,679.3	497,000	233,509.7	903,000	241,796	1.461074
WCEX	2,577,559	2,515,252	559,156.8	3,590,806	1,667,178	1.821824
WCP	3,699,874	3,705,196	858,197.6	5,201,108	2,521,947	1.644827
WCPx	1843.067	1547.110	733.8644	3136.980	925.780	1.886331
GDPgr	5.416129	4.800000	2.348914	14.00000	2.200000	7.002301
RER	1.191677	0.867000	1.378875	4.694000	0.020000	3.742325
Observation	31	31	31	31	31	31

Source: Authors' computation.

**Table 2.** Correlation analysis.

Correlation	GCEX	GCP	WCEX	WCP	WCPx	GDPgr	RER
GCEX	1.000000						
GCP	0.908906	1.000000					
WCEX	0.935102	0.924462	1.000000				
WCP	0.902682	0.973929	0.944761	1.000000			
WCPx	0.647743	0.734525	0.716321	0.805625	1.000000		
GDPgr	0.284905	0.296491	0.274727	0.348939	0.279676	1.000000	
RER	0.848787	0.923137	0.935266	0.957184	0.760921	0.211399	1.000000

Source: Authors' computation.

**Table 3.** Summary of ADF unit root tests on variables.

Variable	ADF Statistics	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%	P-Value	TCV*
lnGCEX	-5.015397	-4.296729	-3.568379	-3.218382	0.0018	I (0)
lnGCP	-3.987739	-4.309824	-3.574244	-3.221728	0.0207	I (0)
lnWCEX	-5.517291	-4.296729	-3.568379	-3.218382	0.0005	I (0)
lnWCP	-4.191994	-4.296729	-3.568379	-3.218382	0.0127	I (0)
lnWCPx	-2.808181	-4.309824	-3.574244	-3.221728	0.2057	I (1)
lnGDPgr	-3.516691	-4.296729	-3.568379	-3.218382	0.0556	I (1)
lnRER	-1.364939	-4.296729	-3.568379	-3.218382	0.8507	I (1)
D( lnGCEX )	-8.381240	-4.309824	-3.574244	-3.221728	0.0000	I (0)
D(lnGCP)	-5.608922	-4.296729	-3.568379	-3.218382	0.0005	I (0)
D( lnWCEX )	-7.651971	-4.296729	-3.568379	-3.218382	0.0000	I (0)
D(lnWCP)	-8.619896	-4.309824	-3.574244	-3.221728	0.0000	I (0)
D(lnWCPx)	-4.115838	-4.296729	-3.568379	-3.218382	0.0042	I (0)
D(lnGDPgr)	-6.347617	-4.309824	-3.574244	-3.221728	0.0001	I (0)
D(lnRER)	-4.148849	-4.309824	-3.574244	-3.221728	0.0416	I (0)

Source: Authors' computation, TCV\*—Test Conclusion on Variables.

#### 4.4. Results on Cointegration Analysis

Johansen Cointegration test was performed to examine whether there exist a long run relationship among the variables and also to determine the cointegrating rank of the model and the number of common stochastic trends that exist among the variables. The results of the Johansen Cointegration test are presented in **Table 4**.

At most, there are at least two cointegrating vectors that can be established at a 5% significance level among the seven variables indicated by both the Trace and Maximum Eigen value statistics. In order to have a full understanding of the extent of the relationship among the explanatory variables and the response variable, the long run model was assessed with the understanding of how the variables were assumed to have an effect on cocoa exports from Ghana based on the Engel-Granger methodology. The estimated long-run model is given in Equation (4) below:

$$\begin{aligned} (\ln \text{GCEx}) = & 0.26 * D(\ln \text{GCP}) + 1.56 * D(\ln \text{WCEx}) + 0.75 * D(\ln \text{WCP}) \\ & - 0.09 * D(\ln \text{WCPx}) - 0.04 * D(\ln \text{GDPgr}) \\ & - 0.13 * D(\ln \text{RER}) - 10.52 \end{aligned} \quad (4)$$

**Table 5** presents the results of the estimated long-run equation.

**Table 4.** Johansen cointegration test. (a) Unrestricted cointegration rank test (Trace); (b) Unrestricted cointegration rank test (Maximum Eigenvalue).

(a)

Hypothesized	Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.865973	173.1979	125.6154	0.0000
At most 1 *	0.825821	114.9161	95.75366	0.0013
At most 2	0.629984	64.23363	69.81889	0.1287
At most 3	0.478730	35.40158	47.85613	0.4270
At most 4	0.318800	16.50843	29.79707	0.6760
At most 5	0.117551	5.375336	15.49471	0.7677
At most 6	0.058520	1.748775	3.841466	0.1860

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level; \* denotes rejection of the hypothesis at the 0.05 level; \*\*MacKinnon-Haug-Michelis (1999) p-values.

(b)

Hypothesized	Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.865973	58.28175	46.23142	0.0017
At most 1 *	0.825821	50.68248	40.07757	0.0023
At most 2	0.629984	28.83206	33.87687	0.1777
At most 3	0.478730	18.89315	27.58434	0.4228
At most 4	0.318800	11.13310	21.13162	0.6340
At most 5	0.117551	3.626561	14.26460	0.8965
At most 6	0.058520	1.748775	3.841466	0.1860

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level; \* denotes rejection of the hypothesis at the 0.05 level; \*\*MacKinnon-Haug-Michelis (1999) p-values.

Source: Authors' computation.

**Table 5.** Long-run static equation.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.52075	4.340509	-2.423852	0.0233
lnGCP	0.260473	0.286626	0.908755	0.3725
lnWCEX	1.568095	0.374915	4.182538	0.0003
lnWCP	0.745365	0.915346	0.814299	0.4235
lnWCPx	-0.097632	0.121791	-0.801636	0.4306
lnGDPgr	-0.046289	0.085406	-0.541989	0.5928
lnRER	-0.134609	0.064934	-2.073015	0.0491
R-squared	0.910056	Mean dependent var		5.584534
Adjusted R-squared	0.887570	S.D. dependent var		0.179490
S.E. of regression	0.060184	Akaike info criterion		-2.587140
Sum squared resid	0.086931	Schwarz criterion		-2.263336
Log likelihood	47.10067	Hannan-Quinn criter.		-2.481588
F-statistic	40.47209	Durbin-Watson stat		1.688552
Prob(F-statistic)	0.000000			

Source: Authors' computation.

The p-values indicate that in the long run, only world cocoa exports was significant at 5% critical level and thus had a slight impact on cocoa exports from Ghana. However, both domestic and world production, world price, GDP growth rate as well as real exchange rate were found to have no direct positive effect on Ghana cocoa exports. The long-run static equation shows that 91% of the explanatory variables can be explained by the response variable.

#### 4.5. Results of the Vector Error Correction Model (VECM) Analysis

Having established the existence of a cointegration relationship among the variables, we proceed to estimate the short-run error correction model to assess equilibrium adjustments by using the disequilibrium estimates from the long-run model. The error correction term (ECT) is given as:

$$ECT_{t-1} = [Y_{t-1} - \beta_0 - \beta_1 X_{t-1} - \beta_2 X_{t-1} - \dots - \beta_n X_{t-1}] \quad (5)$$

where the response variable is  $Y_{t-1}$ ,  $\beta_0$  is constant and  $\beta_1 X_{t-1} - \beta_2 X_{t-1} - \dots - \beta_n X_{t-1}$  are explanatory variables. The ECT cointegrating equation signifying a long-run relationship among the variables is therefore specified as:

$$ECT_{t-1} = [1.000 \ln GCEX_{t-1} + 0.461 \ln GCP_{t-1} - 1.960 \ln WCEX_{t-1} - 2.557 \ln WCP_{t-1} - 0.328 \ln WCPx_{t-1} + 0.525 \ln GDPgr_{t-1} + 0.054 \ln WCP_{t-1} + 21.485] \quad (6)$$

Having specified the ECT, we estimated the short-run VECM equation as follows:

$$VECM: \Delta y_t = \beta_0 + \sum_{i=1}^n \beta_1 \Delta y_{t-i} + \sum_{i=0}^n \beta_2 \Delta x_{t-1} + \dots + \sum_{i=n}^n \beta_i \Delta n_{t-1} + \varphi z_{t-1} + \mu_t \quad (7)$$

The results of the VECM are stated in Equation (8) as:

$$\begin{aligned}
D(\ln \text{GCEx}_t) = & -0.325 \text{ect}_{t-1} - 0.157 * D(\ln \text{GCEx}_{t-1}) + 0.470 * D(\ln \text{GCP}_{t-1}) \\
& - 1.072 * D(\ln \text{WCEx}_{t-1}) - 0.343 * D(\ln \text{WCP}_{t-1}) \\
& - 0.203 * D(\ln \text{WCPx}_{t-1}) + 0.227 * D(\ln \text{GDPgr}_{t-1}) \\
& - 0.183 * D(\ln \text{RER}_{t-1}) + 0.038
\end{aligned} \tag{8}$$

**Table 6** presents the results of the error correction model. The first differences and the error term from the model based on the variables as shown in the table above are represented by  $D$  and  $\text{ect}_{t-1}$  respectively.

To interpret the results of the adjustment coefficients in Equation (8), it can be seen that the deviation of previous years from long-run equilibrium is corrected in the short-run at an adjustment speed of 32.6%. The result of the short-run estimate is consistent with [44] and [45] which concluded that the level and performance of the real exchange rate significantly affect a country's export volumes and value when they assessed the impact of real exchange rate on export performance in Tanzania and Ethiopia and Bangladesh respectively. More so, all the explanatory variables used in the study do not significantly influence cocoa exports from Ghana in the short run. **Table 7** presents a summary of findings based on the objectives of this study and reports on their impact on cocoa exports from Ghana for the period under study based on the original aims and objectives of the CRP.

## 5. Conclusion and Recommendations

### 5.1. Conclusion

The results of the analysis show that over the study period, Ghana cocoa production and exports accounted for 14.99% and 16.17% of all world production

**Table 6.** Parsimonious short-run static equation.

	Coefficient	Std. Error	t-Statistic	Prob.
ECT Eqn	-0.325535	0.284323	-1.144946	0.2657
D(lnGCEx(-1))	-0.156885	0.380345	-0.412482	0.6844
D(lnGCP(-1))	0.470258	0.514050	0.914811	0.3712
D(lnWCEx(-1))	-1.072070	0.795461	-1.347733	0.1928
D(lnWCP(-1))	-0.342941	1.380056	-0.248498	0.8063
D(lnWCPx(-1))	-0.203057	0.292418	-0.694406	0.4954
D(lnGDPgr(-1))	0.226595	0.177619	1.275738	0.2167
D(lnRER(-1))	-0.182625	0.404336	-0.451667	0.6564
C	0.037900	0.038348	0.988320	0.3348
R-squared	0.477861	Mean dependent var		0.014701
Adjusted R-squared	0.269006	S.D. dependent var		0.129815
S.E. of regression	0.110990	Akaike info criterion		-1.309635
Sum squared resid	0.246374	Schwarz criterion		-0.885302
Log likelihood	27.98971	Hannan-Quinn criter.		-1.176739
F-statistic	2.288000	Durbin-Watson sta		2.208472
Prob(F-statistic)	0.063776			

Source: Authors' computation.



**Table 7.** Impact of the factors affecting Ghana cocoa exports (1988-2018) positively (+) or negatively (–) based on the aims of CRP and objectives of the study.

Component Indicators	Objectives of the Study	Assessment Grade			Remarks	
		Substantial	Partial	Negligible		
Aims of the CRP	GCP			+	Generally, domestic production did not have much significant impact on exports	
	1) Increase Production and Exports	GCEx			+	All exports from Ghana represented 16.17% of world total exports
		WCP		+		Ghana's total production represented 14.99% of world total production
	2) Increase Foreign Exchange Revenue	WCPx	--			Unsteady cocoa prices considerably affected foreign exchange revenue from exports
		GDPgr			+	Overall, the sector contributed about 8.7% to total GDP and 25% of total export revenue
	3) Poverty Alleviation/ Standard of Living Improvement.	RER		--		The performance of the Ghanaian Cedi against the US Dollar had a negative effect on exports
		COCOBOD Performance		+		COCOBOD has intensified both internal and external marketing
		Economic Growth			+	Cocoa sector contribution to Economic growth of Ghana was insignificant
	Overall Assessment Grade	Conclusion		+		Cocoa exports made a partial contribution to the growth of the cocoa sector of Ghana

and exports. The study concludes that besides GDP growth rate which is marginally significant and therefore has a positive impact on cocoa export performance in Ghana, all the other variables exhibit a negative relationship with Ghana cocoa exports in the long run. The study findings are consistent with [3] [12] [46] and other related research such as [47] which found cocoa production to have a positive impact on exports in the short run in Nigeria and Cote d'Ivoire respectively; even though we report the impact in Ghana to be insignificant. The study also agrees with [48] to report a negative relationship between world cocoa prices and export performance in Ghana. References [19] and [49] however report a positive relationship between world prices and cocoa exports in Nigeria and Cote d'Ivoire respectively. This study also disagrees with findings by [50] and [51] which reported a linkage between cocoa export performance and GDP growth rate as a measure of improved standard of living and poverty

reduction. We report that a positive GDP growth rate cannot be used as a measure of improved standard of living of cocoa farmers because the income streams of typical cash crop Ghanaian farmers are complex as many farmers practice mixed cropping and sequence cropping, due to the obvious risks involved with mono or sole cropping.

## 5.2. Recommendations

The study recommends that COCOBOD schemes and programs that seek to train farmers to produce cocoa that conform to global demands and standards, to increase production and income must be strictly enforced as well as broadened to cater for practical field or on-site training and periodic supervision to help farmers gain the requisite knowledge and experience in proper farm management in accordance with the provisions made for by the CRP policy document.

Secondly, the study recommends that Government should take a second look at Ghana's inputs supply structure and restructure it to meet the pressing demands and needs of the farmers. For instance, the fact that inputs are not readily available in local stores, even when the farmers can afford them typifies a failure of the inputs supply structure.

Lastly, it is recommended that Government recognizes the significant role women play in the various stages of cocoa production and introduces such policies that will attract more women into the sector and also provide financial assistance to make cocoa farming attractive to the youth as a measure to tackle high rural unemployment, increase annual yields and foreign exchange revenues, reduce rural-urban migration as well as help alleviate rural poverty.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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