AN EMPIRICAL ANALYSIS OF COCOA BEAN PRODUCTION IN GHANA

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Abstract

This article analyses cocoa production in Ghana from 1990 to 2011, using Johansen cointegration and OLS regression approaches. The results of the cointegration test show a long run equilibrium relationship between cocoa bean production, area harvested, the world price, cocoa export and RGDPK, all the variables were statistically significant. More so, the results from the OLS linear regression show a positive relationship between annual cocoa output and area harvested as well as export and RGDPK in Ghana. However, on the contrary, the results show a negative relationship between cocoa bean production and the world price. Arguably, this partly because the Ghanaian government has fixed the price of cocoa in order to protect farmers/growers from the shocks on the world market. However, this measure to some extend appears to be counterproductive, especially when the price cocoa beans increase in the world market without increase in the producer price. As a result, farmers are likely to respond to price signals in the opposite directions.

The government of Ghana should create an enabling environment and some incentives by increasing cocoa farm gate prices relative to the prices on the world market, subsidizing farm inputs, and providing affordable loans to smallholder cocoa farmers to ensure sustainable cocoa bean production in the country.

Keywords: Cocoa production, world price, cointegration, smallholder farmers

Introduction

Cocoa was first brought to Gold Coast present Ghana in 1876 by Tetteh Quarshie from Fernando Po an island in Equatorial Guinea. Between

1911 and 1976, Ghana was the largest producer of cocoa bean in the world. More so, the product contributed about 30-40% of total output. Cocoa production serves as a major employer of labour and source of income in the producing areas. The importance of cocoa output to the economy of Ghana and the total effect on the livelihoods of the cocoa farmers encouraged the colonial government of the 1930's to take over control of the industry.

In doing so, the Ghanaian government set up a marketing board (The Cocoa Marketing Board, now known as the COCOBOD) to buy and export all cocoa produced in Ghana. Although the marketing board was ineffective as it failed to ensure a better price for the farmers, the government expanded its activities by setting up additional institutions like research and development and quality control to provide additional services to the farmers to improve the cocoa industry sector. At the same time, the government provided cocoa farmers with subsidised farm inputs such as fertilizers and pesticides this in part have preserved Ghana's reputation for high quality cocoa from then till present time. Towards the end of 1970's, the price of cocoa at the international market plummeted by two thirds. During this period, Ghanaian cocoa farmers got less than 40% of the world market price from COCOBOD, resulting to a significant drop in the volume of cocoa production in the country as majority of the farmers abandoned their farms and moved to the other sectors of the economy. The situation deteriorated especially after the bushfires and droughts in the beginning of 1980s.

Since the creation of COCOBOD in 1947, there have been some mechanisms in which the price of cocoa products is determined in Ghana. The first mechanism, which was in existence till 1984, had producer prices set solely by the COCOBOD, which was subject to government consent. Since 2001, the government of Ghana set up a committee for price setting, known as a Multi-stakeholder Producer Review Committee (PPRC). The institutional price setting committee, PPRC, include the representatives of farmers, COCOBOD, Ministry of Finance and Economic Planning, recently, other stakeholders such as Hauliers (transporters) and Licenced Buying Companies (LBCs). Under this price setting mechanism, the estimation of the average cost of production (COP) and the industry cost is deducted from the net COCOBOD revenue. A proportion of the remainder, net FOB is paid to cocoa smallholder farmers.

Cocoa production continued to decline until the World Bank, and the IMF intervened by introducing Structural Adjustment programme (ASP) to rescue the economy from collapsing. Even though, the initiative had negatively impacted the lives of the smallholder farmers, through increase in cost of living and lack of farming inputs, arguably, it did include a partial policy reform of the domestic cocoa market. As a result, it leads to the liberalisation of the cocoa industry by granting private companies licenses to

buy cocoa commodities on behalf of the Ghana government, but what it did not address government monopoly to bring in competition to the international market which could, on the other hand, improve the incomes of the farmers.

Some researchers have attempted to determine the effects of some factors on cocoa production in the producing areas. For instance, Fadipe et al. (2012) found a positive relationship between cocoa output and farm size, and access to finance in Nigeria. Similarly, Vigner (2007) found the cause and effect between the areas of land cultivated and total cocoa outputs in Ghana. He asserted that an increase in farm area dedicated to cocoa is likely to increase its output. Aneani and Ofori-Frimpong (2013) found out that the spraying fungicides against black pod disease, frequency of weeding cocoa farms, and area of cocoa farm had a significant impact on cocoa yield in Ghana.

Boansi (2013) found out that the volume cocoa output in Ghana has a significant positive association with real producer price, real world price to real producer price ratio, the nominal rate of assistance, exchange rate, yield, and foreign direct investment. The results also revealed a significant positive between current cocoa exports and production. Arguably, increases in exports of cocoa beans stimulate farmers to increase production in the country.

Abdulai and Rieder (1995) investigated the determinants of the cocoa supply in Ghana using error correction model. They found out that cocoa supply was significantly related with the real producer price of cocoa, the supply of finished goods and the real exchange rate in the country. More so, their results showed that the supply of cocoa was inelastic both in the short and long runs. Abolagba et al. (2010); Ndubuto, Agwu, Nwaru and Imonikhe (2010) attempted to explore factors that seemingly to be affecting the export of cocoa from Nigeria. They found out that Nigeria has high comparative advantage in the exportation of cocoa and as such was highly competitive, more so, Nigerian cocoa production (output) was positively associated with exports.

These studies did not include all the variables we used in this study. More so, none of the studies has used the Coitegration model to verify the relationship of the variables, thus, the significance of this study. This article is an attempt to investigate some determinants (world price, farm size, export, real GDP per capita) that appear to be influencing cocoa bean production in Ghana in recent years.

This article is organized as follows: Section 1 presents an introduction and some empirical evidence related cocoa bean production, the section also briefly highlights price and the importance of cocoa to Ghana.

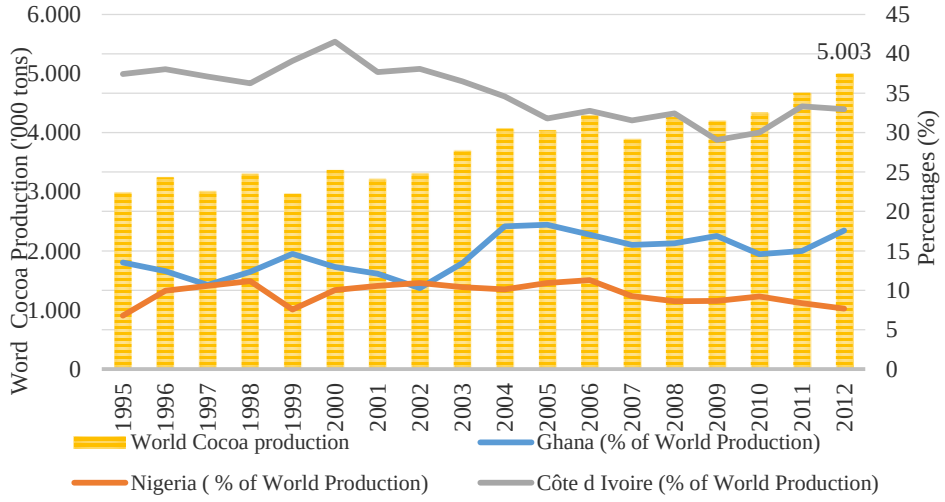
Section 2 present data and research methods, while section 3 presents empirical results and discussion. Finally, section 4 concludes the study.

Price, Cocoa Production, and its Importance to Ghana

Statistical data available from FAO (2013) as presented in figure 1 shows the trend of annual cocoa bean production in the world measured in tons and the share of world cocoa production in Ghana, Nigeria and Cote d Ivoire, spanning between 1995 and 2012. As shown in figure 1, the annual world cocoa bean output has increased by 67.6%, from 2.99 million metric tons to 5.003 million metric tons within the period between 1995 and 2012.

In 2012, Cote d Ivoire, by far the largest producer of cocoa recorded 33% share of world production, followed by Ghana (18%) and Nigeria (8%), which are third and fourth largest producers in the World. It implies that these three countries produced about 60% of cocoa beans in the world. Figure 1 also shows a fluctuating percentages in the share world cocoa bean for Nigeria and Ghana over the years.

Figure 1: World cocoa output ('000 t) and percentages in major producing countries 1995-2012



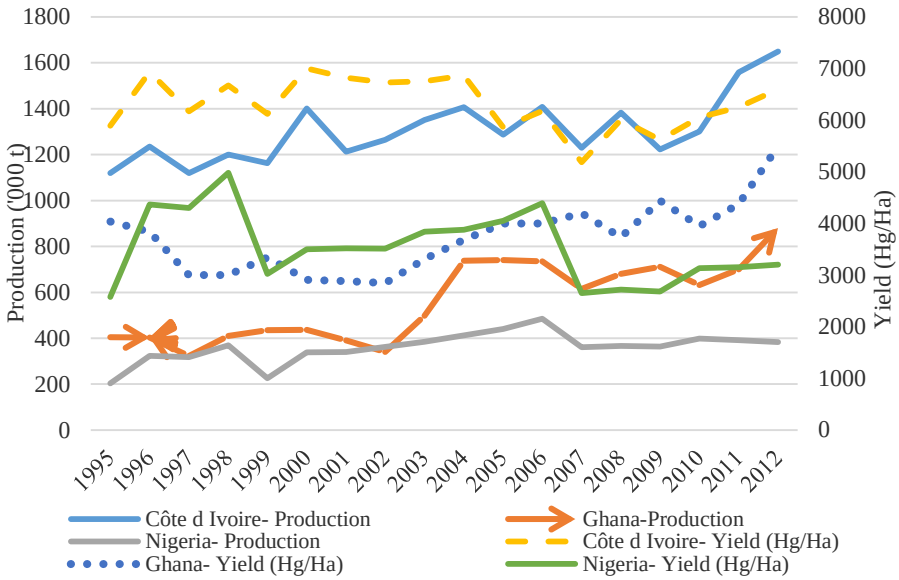
Source: Authors' analysis based on FAOSTAT, 2013

Cocoa cultivation has a delicate process, as the trees are prone to the insects, diseases, changing weather situations which lead to either drought or excessive rain that is likely to negatively impact yield per hectare. Other challenges are farmers limited access to finance, aging trees that are past their peak pod production and the decline of soil fertility. Unlike larger industrialized agribusinesses as practiced in developed countries, in the developing countries like Ghana where cocoa is grown, the vast majority of producers are smallholder farmers (80% to 90% of cocoa comes from small, family-run farms), who often rely on traditional farming practices and have

limited organizational leverage. However, steadily increasing demand from consumers across the globe in recent years has encouraged a number of global efforts and funds committed to improving cocoa farm sustainability (World Cocoa Foundation, 2014).

Cocoa bean production in Ghana has been fluctuating in the years under study. The Country has recorded negative growth rates in some years. For instance, the country recorded worst annual change in 1997 (-20%) and highest positive growth rate in 2004 (48%). More so, as shown in figure 2, the annual production of cocoa in Ghana has increased by 118%, from 404 thousand metric tons in 1995 to 879 thousand metric tons in 2012, representing an average year-over-year production increase of 8.2%.

Figure 2: Cocoa production in some major producing countries, 1995-2012



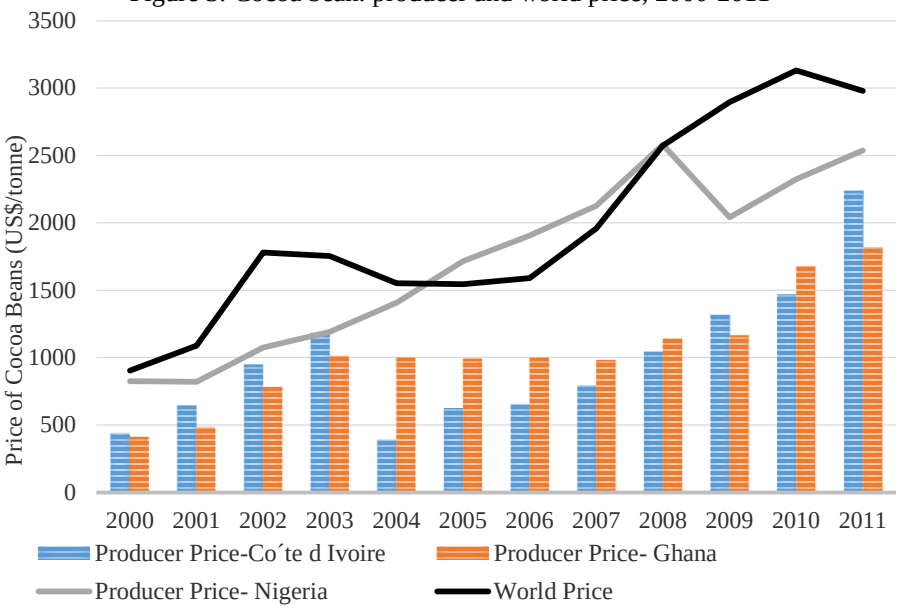
Source: Authors' analysis based on FAOSTAT, 2013

As shown in figure 2, yield per hectare varies on a yearly basis by country, producing between 300 to 650 kilograms of cocoa beans per hectare, and Cote d Ivoire has again recorded highest in yield (Hg/Ha). Just like the world price, farm gate prices during the period under review have also shown greater fluctuations in the countries under study (see figure 3).

Figure 3 shows the annual trend of world price and producer prices of cocoa beans in Ghana; Nigeria and Cote d Ivoire between 2000 and 2011. The world price within the study period was not consistent. Historically, as compared to large scale grains like white and corn, "cocoa prices have been less prone to severe price fluctuations." Arguably, this might "be due to the difference in scale of global production and consumption, as well as differing

degrees of speculative investment;" thus, it is likely to exacerbate volatility in the primary commodity prices (World Cocoa Foundation, 2014).

Figure 3: Cocoa bean: producer and world price, 2000-2011



Source: Authors' analysis based on FAOSTAT, 2013

Reflecting, inter alia, changes in global cocoa prices, partly due to the variations in the global value relative to the national currency, and a particular national market structure and conditions, competition, and quality. Although world market prices have increased over the years, real farm gate prices in several producing countries like Ghana did not reflect this upward trend. The difference between world cocoa "prices and producer prices in countries could be attributed to the aforementioned factors that affected producer price fluctuations" (International Cocoa Organization, 2012, p. 8). Apart the aforementioned factors, Ghana has some other reasons for low cocoa farm gate prices.

Data and Methods

Data Sources

We used secondary data such as books, article journals and annual statistical data from various institutions. For the purpose of the empirical analysis, annual time series data spanning from 1980 to 2011 were obtained from the Food and Agriculture Organization (FAO) of the United Nations, United Nations Conference for Trade and Development (UNCTAD) database, and International Monetary Fund (IMF). We used econometric software Gretl 1.9.14 and Stata 12.0 for the empirical analysis.

Model Specification

The model specified the annual quantity of cocoa bean output, measured in tons as a dependent variable, which is being explained by the world price of the cocoa beans, area harvested, real GDP per capita, cocoa beans export measured in tons. The multiple regression model is specified here below:

$$QCBP = f(AH, RGDPK, CEXP, WP) \quad (1)$$

Thus, the econometric model 1 is mathematically specified as follow:

$$\ln QCBP_t = \beta_0 + \beta_1 \ln AH_t + \beta_2 \ln RGDPK_t + \beta_3 \ln CEXP_t + \beta_4 \ln WP_t + \varepsilon_t \quad (2)$$

Where

$\ln QCBP_t$ is the natural log of the quantity of cocoa bean product measured in tons, $\ln AH_t$ is the natural log of area harvested measured in hectares, $\ln RGDPK_t$ is the natural log of the real gross domestic product per capita (in US$), $\ln CEXP_t$ is the natural log of cocoa export measured in tons, $\ln WP_t$ is the natural log of world price of cocoa beans (US$/ton), and ε_t is the error term.

Results and Discussion

Unit Root Test

Due to the fact that, annual time series ' data is subject to spurious regression results; we have carried out a unit root test prior to estimating the econometric model. Table 1 shows both Augmented Dickey- Fuller (ADF) and Philips-Perron (PP) tests. Both dependent and independent variables fail to reject the null hypothesis of unit root in levels *1(1),* but become stationary after first difference. Given that all the variable become stationary *1(0),* we proceed to run Johansen cointegration and ordinary least squares (OLS) regression models.

Table 1: Unit root test for model 2 (with constant term only)

Variable		ADF Stat	Critical Values		Inference	PP Stat	Critical Values		Inference
			1%	5%			1%	5%	
lnQCBP	Level	-0.661	-3.709	-2.983	1(1)	-0.446	-3.709	-2.983	1(1)
	First diff	-5.409***	-3.716	-2.986	1(0)	-5.621***	-3.716	-2.986	1(0)
lnAH	Level	-0.922	-3.709	-2.983	1(1)	-0.899	-3.709	-2.983	1(1)
	First diff	-5.526***	-3.716	-2.986	1(0)	-5.541**	-3.716	-2.986	1(0)
lnRGDPK	Level	-0.994	-3.709	-2.983	1(1)	-1.756	-3.709	-2.983	1(1)
	First diff	-4.721***	-3.716	-2.986	1(0)	-4.726***	-3.716	-2.986	1(0)
lnCEXP	Level	-1.584	-3.709	-2.983	1(1)	-1.138	-3.709	-2.983	1(1)
	First diff	-7.436***	-3.716	-2.986	1(0)	-8.076***	-3.716	-2.986	1(0)
lnWP	Level	-1.04	-3.709	-2.983	1(1)	-1.602	-3.709	-2.983	1(1)
	First diff	-3.856***	-3.716	-2.986	1(0)	-3.718***	-3.716	-2.986	1(0)

Note: The asterisks (**, ***) denote statistical significance at 0.05, and 0.01 levels respectively.

ADF = Augmented Dickey- Fuller test, and PP = Philips-Perron (PP) test

Lag-order Selection

The model selection for cointegration is usually computed using an information criterion method, known as lag-order selection criteria. Based on the evidence provided by the information criterion as shown in table 2, we have chosen lags four as the optimal lag length. Thus, we continue to test for cointegration with lags (4).

Table 2: Lag- order selection

Selection-order criteria
Sample: 1984 - 2011 Number of obs = 28

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	35.7863				7.6e-08	-2.19902	-2.1263	-1.96113
1	159.606	247.64	25	0.000	6.8e-11	-9.25758	-8.82123	-7.83022
2	187.3	55.388	25	0.000	6.8e-11	-9.45002	-8.65003	-6.83319
3	233.35	92.1	25	0.000	2.6e-11	-10.9536	-9.78997	-7.14729
4	301.063	135.43*	25	0.000	5.3e-12*	-14.0045*	-12.4773*	-9.00876*

Endogenous: logQCBP logAH logRGDPK logCEXP logWP

Note: The asterisk (*) denotes lags selection level

Johansen Test for Cointegration

Johansen cointegration test, the trace statistic, tests the null hypothesis of no cointegrating vectors ($r = 0$) against the general alternative of one or more cointegrating vectors ($r > 0$), while maximal Eigenvalue statistics tests the null hypothesis of r cointegrating vector(s) present against the specific alternative of ($r + 1$) cointegrating vector(s) present (Ahking, 2002). Table 3 shows the results of both trace and maximal Eigenvalue and tests for cointegration. Both Maximal Eigenvalue and Trace tests indicate (greater than 0.05 critical values) that we reject the null hypothesis of no cointegration vectors at 5% significance level. We have accepted the alternative hypothesis, that there is a long run equilibrium relationship between the variables as all the variables are likely to be moving together in the long run.

Table 3: Maximal eigenvalue and trace test results for cointegration (constant)

Hypothesized	Maximum Eigenvalue test		Trace Test	
No. of CE(s)	Statistic	0.05 critical value	Statistic	0.05 critical value
None	120.6125	33.46	209.7959	68.52
At most 1	65.2853	27.07	89.1834	47.21
At most 2	13.4898	20.97	23.8981*	29.68
At most 3	10.3594	14.07	10.4083	15.41
At most 4	0.0489	3.76	0.0489	3.76

Note: The asterisks (*) indicates that this estimator has selected the number of cointegrating equations corresponding to this row of the table.

When a cointegration is established, it can be viewed as an indirect test of long run causality. We, therefore, concluded that the some of the variables in the model are among the determinants of cocoa production in Ghana. We have opted to run ordinary least squares (OLS) regression analysis instead of Vector error correction model (VECM), and the result is presented in table 5.

OLS Linear Regression

Table 4 shows the results of model diagnostic tests and the estimated model diagnostics seem to satisfy a priori econometric test as all the P. values of the diagnostic tests are greater than 0.05 level. The results of the test show that the model is linear and correctly specified. The model also shows that the variability of a variable has minimum variance, and it is not heteroskedasticity, and the error term is normally distributed. The explanatory variable used in the model are not autocorrelated. Given that all the classical assumptions of the linear regression model were fulfilled, we have continued with OLS estimation method.

Table 4: Diagnostic tests for OLS model

Test		*P. Value*
Non-linearity test (squares)		0.103012
Non-linearity test (logs)		0.102013
Ramsey's RESET		0.436
Heteroskedasticity	White	0.185526
	Breusch-Pagan	0.423634
Normality		0.78246
Autocorrelation	(Ist Order)	0.247388
	Ljung-Box Q'	0.251
ARCH	Ist Order	0.828927
	2nd Order	0.983627

Note: ARCH = AutoRegressive Conditional Heteroskedasticity

As presented in table 5, it appears that the estimated models are a good fit given that the Adjusted R-squared is about 93% for the variability in the dependent variable in the models. Our results show that the dependent variable (quantity of cocoa bean production (QCBP)) is statistically significant and is positively associated with the repressors except for the world price of cocoa bean product that has a negative relationship with cocoa production.

The estimated model in table 5 provides robust evidence that the quantity of cocoa bean production (QCBP) is positively associated with the size of the cocoa area harvested (AH), statistically significant at the 1% level. This implies that the expansion cocoa farm by 1% might bring a corresponding increase in annual total output by 0.35%, holding all other factors constant. This result is consistent with the empirical works of Vigner

(2007); Fadipe et al. (2012) who found a positive relationship between area harvest or farm size and cocoa production in Nigeria.

Table 5: Regression model – OLS, using observations, 1980-2011

Dependent variable: lnQCBP					
	Coefficient	***Std. Error***	***t-ratio***	***p-value***	
Const.	-0.689298	0.976984	-0.7055	0.48652	
lnAH	0.347946	0.118893	2.9265	0.00687	***
lnRGDPK	1.41393	0.280599	5.039	0.00003	***
lnCEXP	0.276511	0.122628	2.2549	0.03246	**
lnWP	-0.220603	0.0884253	-2.4948	0.01902	**
R-squared	0.938816		Adjusted R-squared	0.929752	
F(4, 27)	103.5736		P-value(F)	5.69E-16	
Durbin-Watson	1.482024				

Note: The asterisks (**, ***) denote statistical significance at 5%, and 1% levels respectively

lnQCBP = -0.689 + 0.348 (lnAH) + 1.41 (lnRGDPK) + 0.277 (lnCEXP) - 0.221 (lnWP)
(0.977) (0.119) (0.281) (0.123) (0.0884) (standard errors in parentheses)

Similarly, real gross domestic product per capita (RGDPK) also indicates a strong positive relationship with cocoa bean production in Ghana, statistically significant at 0.01 level. This means that a 1% increase in RGDPK is likely to stimulate cocoa bean production by 1.4%. The result is in consonance with our expectation that the increase in RGDPK might indirectly lead to more consumption of cocoa products, and investment in cocoa farms by the producers, government and firms in the country

Cocoa export (CEXP) is another determinant that appears to have influence on cocoa production (QCBP) in Ghana, statistically significant at the 5 % level. It implies that, a 1 % increase in annual cocoa export is likely to increase cocoa production by 0.28%. In other words, increases in the export of cocoa beans is expected to stimulate farmers to increase production in the country (see table 5). This result is in consonance with the works of Abolagba et al. (2010); Boansi (2013) who also found a positive relationship between cocoa export and cocoa bean production in Nigeria and Ghana.

In contrast to our expectation, the results show a negative coefficient of world price (WP) of cocoa products and statistically significant at a 1 % level in influencing cocoa bean production in Ghana (see table 5). Arguably, this is partly because cocoa farmers/producers are not likely to benefit from the price increase on the world market as the government of Ghana does so on their behalf. More so, the price of the cocoa products that were given to farmers by the Ghanaian government were fixed (see figure 3). Consequently, an increase of the cocoa price on the world market might not stimulate the production of cocoa in the country. Rather, it discouraged

farmers from farm expansion, as they received a lower price relative to the prevailing prices on the international market.

Boansi (2013) argued that the government, shielding of cocoa farmers against volatility in exchange rate allowed local price to increase production even when international price fall. Arguably, this, coupled with other factors might cause production to swing in either direction.

Conclusion

The study analyzed cocoa bean production in Ghana spanning from the period 1990-2011, using Johansen cointegration and OLS regression approaches. The main aim of the study was to determine the relationship between annual cocoa output and some selected variables that are likely to stimulate cocoa production in the country.

The results from Johansen cointegration test show a long-run equilibrium relationship between cocoa bean productions, area harvested, world price, cocoa export and RGDPK, all the variables were statistically significant. More so, the results from the OLS linear regression show a positive relationship between annual cocoa bean production and area harvested as well as cocoa export and RGDPK.

However, contrary to our a priori expectation, the results revealed a negative relationship between cocoa production and world prices. Arguably, this is partly because cocoa farmers/producers did not benefit much from the price increase on the world market as the government of Ghana has fixed the prices of the products. Consequently, an increase of the cocoa price on the world market is not likely to stimulate the production. Rather, it discouraged farmers from farm expansion, as they received less from the government, relative to the prevailing prices on the international market.

The government of Ghana should ensure sustainable cocoa production by enabling environment and incentives to farmers through increasing producer prices, providing farm machinery, fertilizers and other farm inputs, providing avoidable loans to farmers, and establishing cocoa processing industries for value addition in the country.

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