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TREND ANALYSIS OF COCOA INDUSTRY PRODUCTIVITY TO SELECTED MACROECONOMIC VARIABLES IN NIGERIA

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ABSTRACT
This study examined the trend analysis of cocoa output and export to certain macroeconomic and climatic variables between 1980 and 2016. The exponential trend model, quadratic trend function Ordinary Least Square (OLS) were used in analyzing the data. The trend results show that the estimated coefficient of the time variable was positive and statistically significant at 1% with respect to quantity of cocoa production and exportation in the period under review. The growth trend of cocoa production and exports in Nigeria over the period under study (compound rates of growth) were 27.38%. Growth rate of cocoa production (0.324) and export (-1.331) in Nigeria is relatively low (0.32) and (-1.331) probably due to decreasing domestic export. There was a significant difference in the mean quantity of cocoa production and exports within the period under review. In the long-run, rainfall (-0.425), temperature (0.328), area harvested of cocoa, influenced long-run cocoa production in Nigeria within the study period (-2.735). It was recommended that fiscal and monetary policies must be rigorously explored in order to promote production and export in order to add value to cocoa for higher export prices in the international market. Policies should imperatively focus on yield inducing growth through improved seeds and high yielding varieties that will be tolerant to climate variation effects.
Keywords: Trend Analysis, productivity, Cocoa Industry, Macro Economic Variable

INTRODUCTION

Nigeria is a nation that is blessed with good climatic condition that favours agricultural production (Oladosu and Yekinni, 2008) Agricultural production therefore is concern with the improvement of the agricultural base of either a state or a nation (Akpan, Udoh and Patrick; 2015). The importance of this sector is more pronounced in developing countries including Nigeria, where it is the main thrust of national survival, employment, local and foreign exchange earnings (Adebayo and Okuneye, 2005). The leading cash crops in the country are cocoa, cotton, groundnut, oil palm, sesame seed and rubber.

Coco (*THEOBROMA CACAO*) has remained a valuable crop and major foreign exchange earner among other agricultural commodity export of the Nigerian Economy (Nwachukwu, Agwu, Nwaru and Imonikhe; 2010). The Nigerian cocoa contribution to the nation's economic development is vast and Cocoa has been the main agricultural stake in Nigerian's economy until the 1970's (Folayan, Oguntade and Ogundari, 2006).

Macroeconomic according to Akers (2007) is defined as a branch economics dealing with the performance, structure, behavior, and decision making of an economy as a whole, rather than individual markets. This includes national, regional and global economics. Macroeconomics studies aggregate indicators such as gross domestic product (GDP), unemployment rates, and sometimes indices to understand how the whole economy functions. Some macroeconomic variable is interest rate; inflation rate, currency exchange rate fluctuation, money supply, gross domestic product, expenditure ratio etc. The main objectives of the macroeconomic policy in Nigeria are economic growth and development, price stability, self-reliance and social equity (Ike and Onoriode 2015).

Over the years, there has been a growing recognition of the macroeconomic policy as the key element of agricultural development. In the Nigerian economy, as indeed in most other economics, the agricultural sector is an integral part of the domestic economy, which is itself an integral part of the global economy. The farm industry like any other industry in the market is affected by various macroeconomic variables such as inflation, unemployment, money supply, exchange rate fluctuations, interest rate and gross domestic product among others, Ike and Onoriode 2015).

Taiwo (2016) examined the Political-economy of Cocoa Exports in Nigeria. His study empirically assessed the trends in cocoa output and export using the methods of functional-analytic framework. The study revealed a continued marginal decline in the aggregate output of cocoa attributable to how capacity building and utilization for controlling the economic and ecological variables affecting cocoa productions. Aggregate output of cocoa in Nigeria showed a strong positive relationship with management of the exchange rates and the utilization of modern weather control mechanism for annual rainfall and pest control. Idowu, Osuntogun and Oluwasola (2007) researched on the factors that contributed to the misfortune of cocoa production and export to include low yield, inconsistent production pattern, incidences of diseases and pest and the employment of the use of cutlass and hoe agriculture, ageing cocoa farms. They asserted that the production and marketing of cocoa are labor intensive; hence, it can help to solve the problem of rural employment. Olukunle (2013) on his study found out that export quantity of cocoa also decline.

Prominent among the reasons was the argument of the indirect tax imposition on cocoa farmers through the Cocoa Marketing Board, which used to fix cocoa prices at a level well below the world prices. In their view, this acted as a price disincentive to farmers and hence farmers started abandoning their farms. This coupled with the petro-dollar dominated economy of the late seventies and early eighties, this event created many opportunities in urban centers and cities and facilitated the rural-urban migration which in turn led to the continuous decline of aggregate cocoa output and export. Oluyole and Sanusi, (2009) and Villalobos (1989) identified some of these factors as: Low yield, inconsistent production pattern, disease incidence, pest attack and use of simple farm tools. In addition, Oduwole (2004) identified aging cocoa farms as one of the factors responsible for the decline in cocoa production in south western Nigeria. The dilemma facing the non-oil (cocoa) export sector is not only that it is being over shadowed by the oil export trade, but the declining non-oil export loss of market share in the cocoa trade globally is a clear evidence of how the cocoa industry competitiveness of the Nigerian economy has been consistently eroded over the last three decades.

According to Mogues, Moriss, Freinkman, Adubi and Ehui (2008), the major constraints to agricultural production include limited use of modern agricultural inputs, declining

agricultural terms of trade and international debt, seasonal production bottlenecks, the risks of depending on market, lack of government financial support, government indifference and high levels of taxation, low food prices, poverty and lack of capital, land tenure systems, problems of competition with cheap food imports and food aid as well as the general world recession. Agricultural output, inflation, subsidy, exchange rate, food import and export influence the GDP of the agricultural sector at various degrees.

METHODOLOGY

The study was carried out in Nigeria. The study used secondary data (time series). The data were obtained from the central Bank of Nigeria (CBN) statistical bulletins, National Bureau of statistics (NBS), Annual reports and statements of accounts , Economic and financial review, world Bank publications, food and Agricultural organizations (FOS) Publications etc. The secondary data that was used for the research covered a period of 1970-2017. The data collected for this study were the estimated cocoa output (production level), from 1980-2016, as well as macroeconomic variables (producers price of cocoa , average rainfall, recurrent and capital expenditure, inflation rate, interest rate, exchange rate and Gross Domestic product (GDP)) inferential Statistics such as exponential trend model and quadratic trend function, and Ordinary Least Square were employed in analyzing the data.

Model Specification

The exponential trend model for will be used to examine the productivity and export trend of cocoa. The model is specified as:

$$Q_{it} = \text{Exp}^{(\beta 0+\beta 1t+ei)} \quad (1)$$

When liberalized become:

$$\text{Log } Q_{it} = \beta_0+\beta_1 t+ei \quad (2)$$

Where,

Log = natural logarithm.

Q_{it} = Productivity and export

T = time trend variable measure in years.

B_0 and β_1 = Parameters to be estimated.

e_i =error term.

Cocoa productivity model

To estimate the response of cocoa productivity to selected macroeconomic variables, a regression equation specified in its explicit long-run and short-run form as:

$$\text{Log}Q_t = \beta_0+ \beta_1 \log \text{Rain}_t +\beta_2 \log \text{Temp}_t + \beta_3 \log \text{PPR}_t + \beta_4 \log \text{INF}_t + \beta_5 \log \text{GSR}_t + \beta 6 \log \text{AHR}t + \beta_7 \log \text{INTR} + \beta_8 \log \text{DUR}_t + \beta_9 Q_{t-1} + \beta_{10}(\text{ECM})_{t-1} + \varepsilon_t \quad (3)$$

Where,

Log = Natural logarithm of the variables.

Q_t = Cocoa productivity in period t (in tons)

AHR_t = Area cultivated of cocoa (hectare) in period t.

Rain_t = Average annual rainfall in millimeters in period t.

Temp_t = Average annual temperature in centigrade in period t.

PPR_t = Producers price of cocoa (₦) in period t.

RER_t = Real exchange rate (₦) in period t.

INF_t = Inflation rate (%) in period t.
DUR_t = Domestic utilization of cocoa (₦) in period t.
$INTR_t$ = Interest rate (%) in period t
Q_{t-1} = Lagged production quantity of cocoa (tones) in period t-1.
ECM – the error correction factor
ε_t = Stochastic disturbance term.
$\beta_0 - \beta_{10}$ = Parameters to be estimated.

Cocoa export model

The response of cocoa export to changes in macroeconomic variables, the long-run and short-run is specified and in its explicit form as:

$$LogC_t = \beta_0 + \beta_1 \log Rain_t + \beta_2 \log Temp_t + \beta_3 \log RPD_t + \beta_4 \log EXR_t + \beta_5 \log REP_t + \beta_6 \log INF_t + \beta_7 \log INTR + \beta_8 \log DUR_t + \beta_9 RE_{t-1} + \beta_{10}(ECM)_{t-1} + \varepsilon_t \quad (4)$$

Where,
Log = Natural logarithm of the variables.
C_t = Quantity of cocoa export (tons) in period t.
Q_t = Quantity of cocoa production (tons) in period t.
$Rain_t$ = Average annual rainfall in millimeters in period t.
$Temp_t$ = Average annual temperature in centigrade in period t.
EXR_t = Nominal Exchange rate (₦/$) in period t.
REP_t = The ratio of the export price to the producer price. REP_t measures the behavior of exporters and it is expressed as a ratio of the export price to what is paid to farmers (producer price). The price paid to producers represents a cost to exporters.
INF_t = Inflation rate (%) in period t.
DUR_t = Domestic utilization of cocoa (₦) in period t.
$INTR_t$ = Interest rate (%) in period t
RE_{t-1} = Lagged export quantity of cocoa (tones) in period t-1.
ECM – the error correction factor
ε_t = Stochastic disturbance term.
$\beta_0 - \beta_{10}$ = Parameters to be estimated.

Acceleration, deceleration or stagnation in cocoa productivity and export was computed by fitting quadratic function in time to the data following Onyeenweaku and Eze (1987) and Onyenweaku and Okoye (2005). It is stated thus:

$$LnY = a + bt + bt^2 \quad (5)$$

Where,
Y= productivity and export for cocoa respectively
a= intercept
b= coefficient to be estimated
t= time trend

RESULTS AND DISCUSSION

Trend in Growth Rate of Cocoa Production and Exportation in Nigeria (1980 -2016)

The estimated exponential growth equation for cocoa production and exportation in Nigeria (1980 -2016) are presented in Table 1.

Table 1: Estimated exponential trend equations for cocoa production and exportation in Nigeria (1980 -2016)

Dependent Variable (m. tone)	B0	B1	r2	Adj. R2	F-ratio
Quantity of cocoa Produced	161651.062 (9.663) ***	.242 (9.890) ***	.742	.734	97.814***
Quantity of cocoa Exported	105235.378 (7. 689) ***	.206 (7.426) ***	.619	.607	55.138***

Source: Central Bank of Nigeria statistical bulletin various issue (1980-2016). Note: *** = significant at 1%. Figures in brackets are t-values.

The trend results show that the estimated coefficient of the time variable was positive and statistically significant at 1% with respect to quantity of cocoa production and exportation in the period under review. This implies that time trend variable was a major factor in determining quantity of cocoa produced and exported within this time frame and thus, quantity of cocoa produced and exported increased with time. The coefficient of simple determination (0.742 and 0.619) for cocoa production and export respectively was high and significant at $p<0.01$.

Computed instantaneous and Compound rate of growth of cocoa

The computed instantaneous and compound rate of growth in quantity produced and exported of cocoa in Nigeria within the study period is obtained from the following:

Table 2: Compound growth rate for quantity of cocoa produced and exported in Nigeria (1980 – 2016)

Variables	**Parameter (β_1)**	**Exponential compound growth rate (%)**
Quantity of cocoa produced	0.242^{***}	24.2
Quantity of cocoa exported	0.206^{***}	20.6

*** = significant at 1%

The Exponential compound growth rates of 24.2 and 20.6 for cocoa production and exportation respectively implies that over the period of 1980 – 2016, the production and exportation of cocoa in Nigeria increased at instantaneous (at a point in time) at rates of over 20%. The closeness in the growth rate in production and export implies that very little of what is produced of the crop is domestically utilized in Nigeria. The implication is that there is low industrial usage of cocoa in Nigeria. This may be due to the absence of beverage and cosmetics manufacturing companies in Nigeria. The positive view to this is that more foreign earning will be made from cocoa exports than would have if there is increased demand for cocoa domestically.

The compound growth rate (r) was estimated for cocoa production and exportation in Nigeria within the reference period. The result is estimated below:

Compound growth rates $(r) = (e^{b1} – 1) \times 100$

Cocoa production: $r = (e^{0.191} - 1) \times 100$

$r = (2.71828^{0.242} – 1) \times 100 = 27.38\%$

Cocoa exportation: $r = (e^{0.182} - 1) \times 100$

$r = (2.71828^{0.206} - 1) \times 100 = 22.88\%$

The growth trend of cocoa production and exports in Nigeria over the study period under study (compound rates of growth) were 27.38% and 22.88% respectively. This implies that the growth rate of cocoa production export in Nigeria is relatively low, probably due to decreasing domestic utilization of cocoa considering the poor number of industries utilizing it as a raw material in the Nigeria while the relatively low growth in production is due to low yield, inconsistent production pattern, low adoptive tendencies to improved technology, high rate of dissertation caused by rural-urban migration, disease and pest incidence, and the prevalence of redundant workers in the cocoa farm sector. This finding is in line with Oladosu and Yekinni (2008), who averred that export of cash crops like Palm oil, groundnut, rubber and cocoa has suffered a reduction in recent years due to numerous identifiable factors. FAO (2009) identified some of these factors as inconsistent production pattern, increase in domestic utilization of these crops, low yield due to the use of unimproved seedlings and poor pricing system for the commodities in world market due to the low quantity of these products comparable to that of other major exporting countries like China, Indonesia, and Argentina. The low instantaneous and compound growth rates of cocoa export imply that there would be continuous poor foreign earning from it and this is detrimental to the Nigerian economy.

Doubling time for the compound growth rate

The calculated period of time required for the exponential growth rates in quantity exported and produced of cocoa to double in size or value as the case may be was estimated following Ike and Onoriode (2015) and is specified as:

$$Dt = 69.8/r$$

Where Dt = Doubling time of the compound growth rate (years); r = compound growth rate. The result is presented in Table 3

Table 3: Doubling time for the compound growth rate in years of quantity of cocoa production and exportation (1980-2016)

Variables	Exponential compound Growth rate (%)	Doubling time (years) of compound growth rat
Quantity of cocoa produced	24.2	2.88
Quantity of cocoa exported	20.6	3.39

Source: Calculated from the computed compound growth rate (r)

The result shows that it will take at least two (2) years, eight (8) months and eight (8) weeks to double the compound rate of growth in the quantity produced of cocoa based on the current trend as well as least three (3) years, three (3) months and nine (9) weeks to double the compound rate of growth in the quantity exported of cocoa. This implies that cocoa production and exports is among the cash crops that ought to be considered and enhance it production technology so as to earn enough foreign income for country and thus help to diversify the economy away from a monotonous one. This suggests that research must be intensified in order to improve cocoa production and hence exportation by improving on cocoa production technologies significantly in a way that the rate of growth will achieve the needed self-sufficiency and enhanced economy.

Nature of growth

An investigation of the nature of growth (whether there is acceleration, deceleration or stagnation in quantity produced and exported of cocoa) between 1980 and 2016 was estimated using the trend quadratic equation and the result is presented in Table 4.

Table 4: Estimated quadratic equations in time variables for quantity produced and exported of cocoa in Nigeria. (1980 -2016)

Cocoa production	Coefficient	Std. Error	t-statistic	Prob.	r^2	F-ratio
Constant (B_0)	161651.06	16729.057	9.663***	.000	.742	97.814***
Time (B_1)	0.242	788.469	9.890***	.000		
Squared Time (B_2)	-0.598	25.994	7.025***	.000		
Cocoa exportation						
Constant (B_0)	105235.378	13685.738	7.689***	.000	0.733	93.311***
Time (B_1)	4789.706	645.032	7.426***	.000		
Squared Time (B_2)	-0.677	14.149	9.660***	.000		

*** and **= significant at 1% and 5% levels respectively.

The statistically significant negative values of the coefficient of squared time variables (B_2) for quantity of cocoa production and exported revealed deceleration in the growth rates of this variable, thus, indicating that quantity of produced and exported of cocoa in Nigeria exhibited decline in growth within the period under review, This tends to confirm the earlier finding of this study that cocoa production and exportation need to be stepped up through the implementation of output scheme policies that will help boast the growth of domestic rubber production to enhance the quantity of cocoa available for export. Technological research on early maturing, easy soil acclimatization and disease resistant cocoa seedling will have a multiplier effect on domestic rubber production and thereby enhance rubber exportation in Nigeria.

Macroeconomic variables affecting cocoa export in the short-run and long-run in Nigeria (1980 – 2016)

The regression result of the short and long-run effects of macroeconomic and climatic variables on cocoa export is presented Table 4.8. To examine the time series properties of the variables in order to guarantee that none of the variable is integrated of order 2 or above, ADF is applied to test the stationary hypothesis for all series under consideration. The results shown in Table 3.1 suggest that none of the variables is integrated of order 2 or above. Consequently, the existence of the long-run relationship can be examined using the ARDL bounds testing procedure. The result of the ARDL bound test is presented in Table 5

Table 5: ARDL Bounds test for Co-integration

Variables	F-statistics	Co-integration
Rubber export model	6.124***	Co-integrated
Critical Value Bounds	I0 Bound	I1 Bound
10%	1.98	1.99
5%	2.45	2.31
1%	3.65	2.97

Notes: *** Statistical significance at 1% level; the lag length k=9 was selected based on the Schwarz criterion (SC). Critical values are obtained from Narayan (2005) case III for 46 observations.

Since the calculated F-statistic (6.124) is higher than the upper critical values at P< 0.05, there is strong evidence of a long-run relationship among the underlying variables. Therefore, the empirical findings lead to the conclusion that a long run relationship between ratio of producer's price to domestic price, average annual rainfall, average annual temperature, nominal real exchange rate, inflation rate, lagged export quantity of cocoa, domestic utilization of cocoa and interest rate exists. The ARDL regression result of the short and long-run effects of macroeconomic and climatic variables on cocoa export in Nigeria (1980 -2016) is presented in Table 6.

Table 6: Autoregressive Distributed Lag (ARDL) regression result of the long-run effect of macroeconomic and climatic variables on cocoa export in Nigeria (1980 -2016)

Variables	Coefficient	Standard error	t-ratio
Long-Run Coefficients			
Constant	-0.125	0.034	-3.676***
$LnRainfall_t$	-0.425	0.401	-1.060
$LnTemperature_t$	0.328	0.121	2.711**
$LnCocoaoutput_t$	0.324	0.078	4.154***
LnDomestic utilization of $cocoa_t$	-0.524	0.251	-2.088**
$LnNominalExchange\ rate_t$	-0.102	0.049	-2.082**
Interest rate	0.423	0.112	3.777***
LnRatio of producer's price to domestic $price_t$	-0.621	0.212	-2.929***
Short-run coefficients			
Constant	1.179	.113	10.434***
D(LnQuantity of cocoa $export_{t-1}$	-1.331	.575	-2.315**
D($LnRainfall_{t-1}$)	-.349	.065	-5.369***
D($LnTemperature_{t-1}$)	2.215	.859	2.579**
D(LnRatio of producer's price to domestic $price_{t\ t-1}$)	-.854	.436	-1.959*
D(LnDomestic utilization of $cocoa_{t-1}$)	-3.489	.971	-3.593***
D($LnNominal\ Exchange\ rate_{t-1}$)	.810	.667	1.214
D(LnRatio of export price to producer's $price_t$)	.786	.805	0.980
D($LnInflation\ rate_{t-1}$)	-2.735	.804	-3.402**
ECM_{t-1}	-0.509	0.214	-2.379**
R^2	0.910		
Adjusted R^2	0.782		
F-statistics	22.14***		
Durbin-watson	1.812		

Source: Researcher's compilation from E-views 9.5 WIN processed. Note: ***, **, and * indicates that 1%, 5% and 10% levels of significance.

The ARDL regression result of the short and long-run effects of macroeconomic and climatic variables on cocoa export in Nigeria (1980 -2016) shows that the overall goodness of fit of the equation as indicated by the coefficients of multiple determinations (R^2 = 0.910) showed that the independent variables included in the model explained about ninety-one (91) percent of the variations in cocoa exports (dependent variable) in the period under review. The F-statistics was significant and confirms the significance of the entire model. The Durbin Watson

test for the existence of serial autocorrelation shows that there was no positive first-order serial autocorrelation at 1% that is, DW (1.812) > Du (1.650).

The result shows that in the long-run, temperature, cocoa output, domestic utilization of cocoa, nominal exchange rate, ratio of producer's price to domestic price and interest rate were the significant variables that influenced the cocoa exports in Nigeria within the study period. The regression coefficients of temperature, cocoa output and interest rate were positively signed, indicating a direct relationship with the export quantity of cocoa. This implies that increase in temperature, cocoa output and interest rate induces cocoa exports to increase proportionately and vice versa.

Contrastingly, the regression coefficients of domestic utilization of cocoa, nominal exchange rate, ratio of producer's price to domestic price and interest rate were negatively signed indicating an indirect relationship with the exports quantity of cocoa. This implies that increase in these variables will induce a decrease in cocoa exports.

In the short-run, the result showed that previous values of cocoa export, rainfall, temperature, ratio of producer's price to domestic price, domestic utilization of cocoa and inflation were the significant variables that influenced cocoa exports in Nigeria within the study period.

The regression coefficient of the previous values of temperature was the significant variables that positively influenced cocoa exports within the period of study. Increasing this variable will lead to an increase in cocoa exports. The previous values of ratio of producer's price to domestic price, domestic utilization of cocoa and inflation rate were the significant variables that negatively influenced cocoa exports within the period of study. This suggests that increase in these variables will lead to a decrease in cocoa export.

The coefficient of the error correction term was negative and statistically significant at 1% level. Theoretically, the estimated coefficient of the error correction term should be negative and lie within an interval of zero and one. Thus, the larger the magnitude of this coefficient is, the faster the speed of adjustment toward the long-run equilibrium. The magnitude of the error correction term was -0.509 and significant at $P < 0.05$. In the cocoa exports model, any deviation from the static equilibrium was corrected at the rate of about 51percent within the study period.

CONCLUSION

Time trend variable was a major factor in determining quantity of cocoa produced and exported from 1980-2016 and thus, quantity of cocoa produced and exported increased with time. Growth rate of cocoa production and export in Nigeria is relatively low probably due to decreasing domestic utilization of cocoa. The study revealed deceleration in the growth rates of cocoa output and export. There was a significant difference in the mean quantity of cocoa production and exports within the period under review. In the long-run, rainfall, temperature, area harvested of cocoa, inflation rate, interest rate and producers' price of cocoa were the significant factors that influenced long-run cocoa production in within the study period.

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