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Discovery

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To Cite:
Oginni OD, Oguntade AE. Determining the nexus between world price and producer price of cocoa in Nigeria. *Discovery* 2024; 60: e23d1451
doi: https://doi.org/10.54905/disssi.v60i335.e23d1451

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Peer-Review History
Received: 02 May 2024
Reviewed & Revised: 06/May/2024 to 23/July/2024
Accepted: 27 July 2024
Published: 31 July 2024

Peer-Review Model
External peer-review was done through double-blind method.

Discovery
pISSN 2278–5469; eISSN 2278–5450

DISCOVERY SCIENTIFIC SOCIETY

ABSTRACT

This study was designed to determine the nexus between the world price of cocoa and its producer price in Nigeria. Time series of cocoa annual data worldwide and its corresponding producer price in Nigeria covering 1980 to 2020 were collected for the study and analyzed using growth function analysis and Autoregressive Distributed Lag model. ARDL analysis confirmed that a long-run relationship exists between cocoa producer price and cocoa world price. Also, the long-run estimates revealed that the world price of cocoa had a positive significant influence on the producer price; At the same time, in the short run, there was a positive insignificant influence in the previous year. The growth function showed a growth rate of 18.76% and 13.99% for World Price and Producer Price with significant acceleration in both. The previous year's shock converges to 67.37% of disequilibria, and the long-run equilibrium in the current year is given at an ECM value of -0.673680. This reflects a relatively fast responsiveness of cocoa world price to deviations from its long-run path. The Granger causality test on WP and PP showed a bi-directional causation between the two variables. Based on the findings of the study, it is suggested that the government of Nigeria should introduce price-related reforms that will improve the transmission of world prices to farmers, which would ultimately encourage production and export.

Keywords: World price; Producer price; Cocoa; Nigeria

1. INTRODUCTION

Ample research works by different researchers have over the years accentuated the importance of cocoa to the agricultural sector and the Nigerian economy especially in providing jobs and income to farmers, raw materials for the industry and foreign exchange for the country (Oyedele, 2007; Alamu, 2013; Adeniran and Sidiq, 2018; Awoyemi and Aderinoye-Abdulwahab, 2019; Adeniran and Oladun, 2020). As asserted by various researchers also, cocoa prices are believed to be significantly influenced by the global forces of demand and supply among other factors, cocoa farmers globally are generally seen as price takers with little or no influence on the price they receive for their produce (Thornton et al., 2010; Timmer, 2011; Umar and

Richard, 2011; Gayi and Tsowou, 2016). Nigerian cocoa farmers are not expected to be different from this. Nigeria is among the Commodity Dependent Developing Countries with cocoa being one of its significant agricultural export crops.

This state of commodity dependence with its growing intensity over the years further exposes. Nigerian cocoa farmers to the vagaries of fluctuations in the market price of cocoa beans and makes them more prone to vulnerabilities (Gayi and Tsowou, 2016). None of the studies on cocoa in the past has directly regarded the relationship between the world price and producer price of cocoa. The available few studies regarded price as one of the variables influencing or being influenced by cocoa production, cocoa export or any macro-economic variables (such as exchange rate, interest rate etc.). For instance, Gama et al., (2021) regarded the effect of the volume of cocoa export and area harvested on cocoa producer price change. Olaiya, (2016) assessed the trends of variables that are considered the determinants of aggregate cocoa output and exports which include world prices and producer prices of cocoa beans among other variables with data ranging from 1970 to 2010.

Olopha and Aladeniyi, (2015) compared the relationships between cocoa producer prices and exchange rates in Ghana, Ivory Coast and Nigeria over a particular period. The study provided empirical evidence to substantiate whether there is a relationship between the cocoa world price and producer price in Nigeria and the significance of the relationship (long-run and short-run) and its implications. It employed the ARDL co-integration technique in its analysis to establish the relationship between the variables and determine the long and short-run relationship between them. It also carried out diagnostic tests to ascertain the stability of the data used. The Granger causality test was used to determine the causal relationship between the variables. Finally, it suggested measures to fairly insulate the farmers against accepting prices that are not in the world price (Table 1).

Table 1 Cocoa Producer Prices and World Prices in Nigeria (1980-2020)

Years	World Price($/Kg)	Producer Price/ Tonne (Naira)	World Price/Tonne (Naira/Tonnes)
1980	2.60	1,300	1,421.6
1981	2.08	1,300	1,284.8
1982	1.74	1,300	1,171.8
1983	2.12	1,400	1,535.7
1984	2.40	1,500	1,839.7
1985	2.25	1,500	2,010.9
1986	2.07	3,500	3,631.9
1987	1.99	8,000	7,991.9
1988	1.58	11,000	7,168.4
1989	1.24	10,100	9,132.3
1990	1.27	8,500	10,208.6
1991	1.20	10,158	11,891.4
1992	1.10	12,745	19,028.3
1993	1.12	25,278	24,713.2
1994	1.40	61,180	30,7944
1995	1.43	82,674	31,310.2
1996	1.46	80,222	31,951.3
1997	1.62	89,687	35,455.4
1998	1.68	79,600	36,768.5
1999	1.14	85,766	105,266.1
2000	0.91	83,818	95,544.5
2001	1.07	91,300	119,017.5
2002	1.78	129,620	214,629.2
2003	1.75	153,749	226,139.2
2004	1.55	186,870	205,976.4

2005	1.54	225,309	202,162.4
2006	1.59	243,175	204,556.2
2007	1.95	267,435	245,325.8
2008	2.58	305,934	305,902.1
2009	2.89	410,000	430,263.2
2010	3.13	443,175	470,431.2
2011	2.98	434,260	458,510.3
2012	2.39	372,400	376,425.0
2013	2.44	383,550	383,840.6
2014	3.06	482,687	485,170.9
2015	3.14	601,300	604,262.5
2016	2.89	720,800	732,591.9
2017	2.03	618,466	620,753.9
2018	2.29	698,900	700,931.7
2019	2.34	716,520	718,195.1
2020	2.37	847,200	850,381.6

Source: World Price: World Bank Commodity Price Data (2022).
Producer Price: FAOSTAT Domain

Literature review

History of Cocoa and its Production in Nigeria

The cocoa trees initially sprang from the Amazon forest in South America and rapidly expanded in Africa starting from Ghana. In the mid-1920s, cocoa production became prominent in West and Central Africa. The plant was named "Theobroma Cacao" by Swedish scientist Carl Von Linne who lived between 1707 and 1778. Cocoa thrives in the tropical rain forest. It has three main varieties: Forastero, Criollo and Trinitario, with the first variety mainly produced. The cocoa tree matures and starts bearing fruits between the ages of five and six. It can live up to five decades if properly taken care of. It thrives in a loamy soil. The Netherlands used to take the lead among cocoa processing countries closely followed by the United States of America, but Ivory Coast has been consistently taking the lead. Ivory Coast processed 710,000 tons and 800,000 tons of cocoa beans in 2021/2022 and 2022/2023 respectively (statista.com/statistics/238242/leading-countries-of-global-cocoa-bean-processing).

Cocoa contributes significantly to the Nigerian economy until the early 1970s boom in crude oil exploration. Amongst agricultural commodity exports in Nigeria, cocoa cannot be ignored despite the challenges that led to a decline in its production in the past years. The world price of a good/commodity is simply the price of such a good/commodity in every other country except one's country. It is significantly determined by world supply and demand. Producer price on the other hand is the amount of money the producer receives from the buyer for a unit of good or service produced as output minus all deductibles. Price fluctuation is the frequent rise and fall in prices of goods and services in the market. Price fluctuations can emanate at any market be it local or international (Anjay and Ujjal, 2017; Hasssan and Zeki, 2017).

Happiness et al., (2014) regarded price fluctuations of agricultural commodities as a multi-faceted problem caused by a combination of various factors which may have grave consequences for the most vulnerable. When it comes to the detrimental effects of price fluctuations, both consumers and producers are affected. Though in the last three decades research has shown an increase in the worldwide cocoa supply and demand, the supply and demand have not always been at par (equilibrium). Fluctuations in the price of cocoa have been noted as key factors causing this imbalance. The price of cocoa affects production/supply both in the short term and the long term (Wessel and Quist-Wessel, 2015).

2. METHODOLOGY

The study was carried out in Nigeria. Nigeria is located in sub-saharan West Africa with an area of 923,769 square kilometres (356,669 sq. mi) and a population exceeding 225 million persons. Nigeria experiences a tropical hot climate and has two distinct seasons: The dry and wet seasons with an average yearly temperature ranging from 23°C to 31°C. Rains commence in southern Nigeria and progress northward, with the peak rainfall occurring typically in May, June, or July across most of the country. (Source: Wikipedia; Internet Geography). Annual data for cocoa world prices covering 1980 to 2020 were collected. Data on cocoa world price was sourced from the World Bank while data for producer prices was from the FAOSTAT domain.

Descriptive and inferential statistical techniques were both used to achieve the objectives of this study. Descriptive statistics techniques used include mean, standard deviation, kurtosis and skewness; while for inferential statistics, the growth function model, the Autoregressive Distributed Lag (ARDL) model and Granger causality tests were used. The ADF test statistics were used to ensure the time series properties of the variables to prevent spurious regression which results from the regression of non-stationary time series data. The ADF model was analyzed with the constant term and the null hypothesis ($H0$: $\beta1=0$) of the ADF test shows that the data series is not stationary, the alternative hypothesis ($H1$: $\beta1\neq 0$) shows that the data series is stationary.

Model specification

Growth Function Model

The compound growth rate was calculated by fitting an exponential function over time to the data, using the following formula:

$Y = boebt$ (1)

After linearizing in logarithm, the equation turns to:

$LogY = b0 + b1t$ (2)

Where:

Y stands for the variables we examined their trend and growth (or otherwise). This includes World Price (WP) and Producer Price (PP).

t = Time trend variable

b0, b1, = Regression parameters to be estimated

The growth rate (r) is given by

$r = (e1b - 1) \times 100$ (3)

Where e is Euler's exponential constant (e = 2.7183).

The data were subjected to the mentioned function to estimate trends in world price and producer price from 1980 to 2020. The study also examined whether there were patterns of acceleration, deceleration, or stagnation in the variables.

Checking for Stationarity

Detection of whether a time series data exhibits a unit root or not can be illustrated by considering a variable y with a unit root, expressed through a first-order autoregressive equation AR (1) as follows:

$Yt = \propto Yt\text{-}1 + \mu t$ (4)

Where;

Yt = Dependent variable of choice at time t.

$\propto$= Coefficient of one period lagged value of dependent variable of choice

Yt-1 = One period lagged value of a dependent variable of choice

μt = The white noise error term is assumed to be statistically independent and randomly distributed, with zero mean, constant variance, and no serial correlation.

From equation (4), the modelling procedure for evaluation of the existence or otherwise of unit root for the time-series data is specified generally as follows;

$\Delta Yt = \propto 0 + \propto 2Yt\text{-}1 + \sum_{i=1}^{\rho} \delta 1 \Delta Yt\text{-}1 + \varepsilon i$ (5)

Where;

Yt = Variable of choice

$\propto 0$= Intercept

Δ = First difference operator
$\propto 1$= (for i = 1 and 2) and $\delta 1$(for i = 1, 2 ------ p) are constant parameters
$\sum i$ = Stationary stochastic process
ρ = Number of lagged terms chosen by Akaike information criterion (AIC) to ensure that εi is white noise.
According to equation (5), the hypotheses implied for testing the presence of a unit root would be as follows:
Ho: $\propto 2 = 0$, i.e. there is a unit root – the time series is non-stationary
H1: $\propto 2 \neq 0$, i.e. there is no unit root – the time series is stationary.
For further differencing, the generalized model could be achieved through a modification of equation (5) to accommodate the second differences on lagged first as well as the k lags of the second differences as follows;
$\Delta 2\ \Psi t = \Psi 1\ \Delta\ \Psi t\text{-}1 + \sum_{i=1}^{p} \emptyset i\ \Delta 2\ \Psi t\text{-}1 + \varepsilon t$ (6)
For the different situations, the corresponding hypotheses for testing are as follows;
Ho = $\Psi 1 = 0$, i.e., there is a unit root, implying that the time series is non-stationary.
H1 = $\Psi 1 = 0$, i.e., there is no unit root, implying that the time series is stationary.

Estimation of Long-run Relationship between Cocoa Producer Price and World Price using Autoregressive Distributed Lag Model (ARDL)

To validate the relationship between the world price of cocoa and the producer price, a co-integration analysis was conducted using the autoregressive distributed lag (ARDL) approach. This model was chosen due to its numerous advantages over other co-integration methods, including the residual-based technique.
The hypothesis was formulated as follows:
The null hypothesis stating no co-integration (no long-run relationship) among the variables of interest is formulated as:
Ho: $\beta 1=0$
The alternative hypothesis (there is a long-run relationship or co-integration exists) among variables of interest is given as:
H1$\neq \beta 1 \neq 0$
The relationship between the Cocoa World Price (CWP) and Cocoa Producer Price (CPPt) was expressed implicitly as follows;
CPPt = f (CWPt) (7)
Where: CWPt = Cocoa World Price at a time t
And CPPt = Cocoa Producer Price at a time t
The study applied a bivariate framework as outlined in equation (4), where the variables were transformed and measured using their natural logarithms (ln) to facilitate the interpretation of coefficients in a standardized percentage form.
$InCPPt = \beta o + \beta 1InCWPt + \varepsilon t$ (8)
Where: ln – the natural logarithm of the variables; and ε**t** – the equation's white noise error term.
According to Pesaran et al., (2001), the ARDL model specification is formulated as the unrestricted error correction model (UECM) to examine the co-integration among the variables.
$\Delta InPPCt = \beta o + \sum ni{=}1\beta 1\Delta InCPPt\text{-}1 + \sum ni{=}0\ \beta 2\Delta InCWPt\text{-}i + \lambda 1InCPPt\text{-}i + \lambda 2InCWPt\text{-}i + \varepsilon t$ (9)
Where Δ is the first difference operator; εt is the error term/ white noise assumed to be normally/identically distributed.
Once co-integration was confirmed, the long-run relationship was estimated using the conditional ARDL model specified as follows:
$InCPPt = \beta o + \lambda 1InCPPt\text{-}i + \lambda 2InCWPt\text{-}i + \varepsilon t$ (10)
The short-run dynamic relationship was estimated using an error correction model specified as:
$\Delta InCPPt = \beta o + \sum ni{=}1\beta 1\Delta InCPPt\text{-}i + \sum i{=}0\ \beta 2\Delta InCWPt\text{-}i + \varphi ECTt\text{-}i + \varepsilon t$ (11)
Where; βo = Constant term, ln = Natural log, εt = White noise, $\beta 1$ and $\beta 2$ = Short run elasticities (coefficients of the first-differenced explanatory variables), = $\lambda 1$ and $\lambda 2$ are long-run elasticities (coefficients of the explanatory variables), ECTt-i = Error correction term lagged for one period, φ = Speed of adjustment, Δ = First difference operator, and n = Lag length.
All the estimated ARDL model coefficients were subjected to diagnostic tests for their reliability.

Analysis of the Causal Relationship between World and Producer Prices of Cocoa Using Granger Causality Test

The Standard Granger causality test revealed the causality between cocoa world price and cocoa producer price. The Granger test is based on the following general regressions:

$Yt = \beta o + \sum_{i=1}^{n} \beta oYt\text{-}i + \sum_{i=1}^{n} \beta iXt\text{-}i + \mu t$ (12)

$Xt = \alpha o + \sum_{i=1}^{n} \alpha oXt\text{-}i + \sum_{i=1}^{n} \alpha iYt\text{-}i + \varepsilon t$ (13)

Where;

Yt and Xt represent the time series under examination. μt and εt represent idiosyncratic terms which encompasses all variations in Yt and Xt not accounted for by the specified lagged values.

3. RESULTS AND DISCUSSION

Descriptive statistics of the variables used in the study are shown in (Table 2). The results show an average world price and producer price of 226,896 naira and 58,506.10 respectively. Skewness measures the degree of asymmetry or deviation of the variables from a normal distribution with an expected value of zero. The result of skewness showed that the world price skewness (0.92) is close to 0 and can be said to be normally distributed, for the producer price however, the value (4.57) which is far from 0, it is not normally distributed. WP is regarded as platykurtic in its distribution (light tails and fewer extreme values) while PP has a kleptokurtic distribution (having heavy tails and more outliers).

Table 2 Summary Statistics for Cocoa World Price and Cocoa Producer Price

Estimate	WP	PP
Mean	226896.0	58506.10
Median	119017.5	8500.000
Maximum	850381.6	750000.0
Minimum	1171.800	736.8000
Std. Dev.	252938.3	122413.9
Skewness	0.922284	4.575014
Kurtosis	2.643657	26.17982
Jarque-Bera	6.029414**	1060.921***
Probability	0.049060	0.000000
Sum	9302737.	2398750.
Sum Sq. Dev.	2.56E+12	5.99E+11
Observations	41	41

Source: Author's Computation, 2024

NOTE: Jarque-Bera Test for Normality. Null Hypotheses: Variables are normally distributed ***, ** and * indicates statistical significance level at 1%, 5% and 10% level respectively.

Trend Analysis of Cocoa World Prices and Producer Prices in Nigeria

The trend in cocoa producer prices in Nigeria (1980-2020)

As evidenced in Table 1 and Figure 1, the producer price of cocoa per tonne from 1980 to 1982 was 1300 naira. There was a slight increase of 100 naira per year from 1983 to 1985. Then a surge in price from 1986 when the producer price of a tonne of cocoa rose to 3,500 naira and rose to 11,000 naira in 1988. There was a steady fluctuation between 1989 and 1992. Then another surge in price in 1993 when the producer price rose to 25,278 naira with the price soaring higher in subsequent years until 1998. It continued rising from the year 2001 to 2010, dropped slightly in 2011, a further drop in 2012 and continued to rise from 2013 when the price was 383,550 naira until 2020 when the price was 698,900 naira.

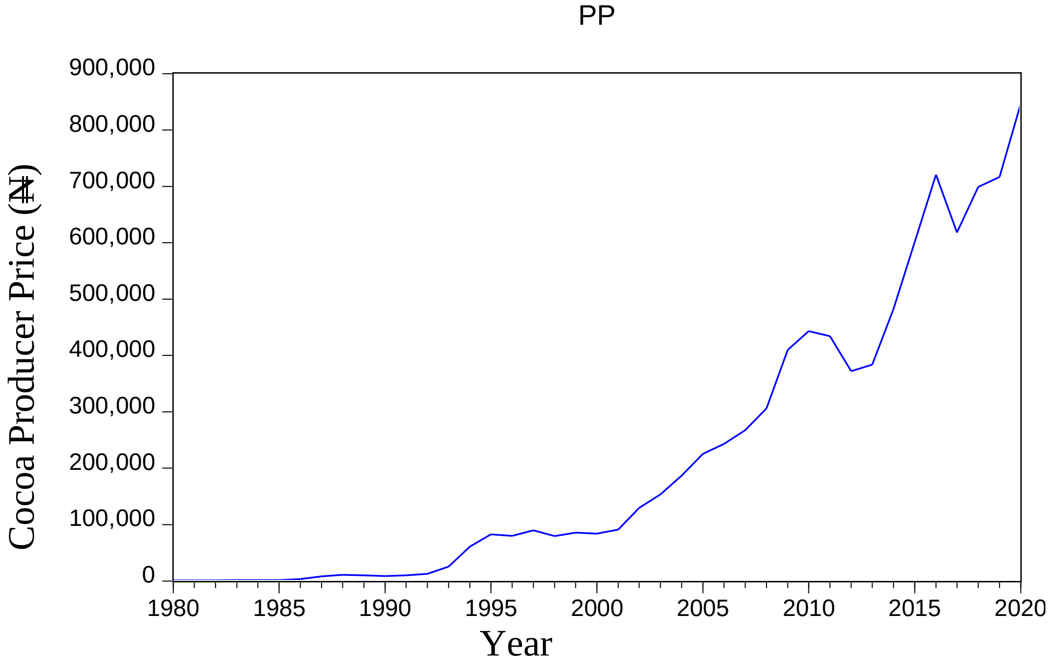


Figure 1 Graph showing the trend in cocoa producer prices in Nigeria (1980-2020)

Trend in Cocoa World Price (1980-2020)

The relative stability of the US dollar over the years has made the fluctuation in cocoa world price (in dollars) not as pronounced as when compared to the fluctuations in naira. In the four decades regarded in this study, cocoa world price has a mean of 2,000 dollars/tonne with a minimum and maximum of 910 and 3,140 dollars per tonne respectively. This is in contrast to the cocoa world price in naira terms where we have a mean of 226,896 naira /tonne, a minimum of 1,172 naira/ tonne and a maximum of 850,382 naira/tonne as reflected in Table 1, and Figure 2, with the naira exchange rate being the significant factor responsible for the staggering fluctuation in the cocoa world price.

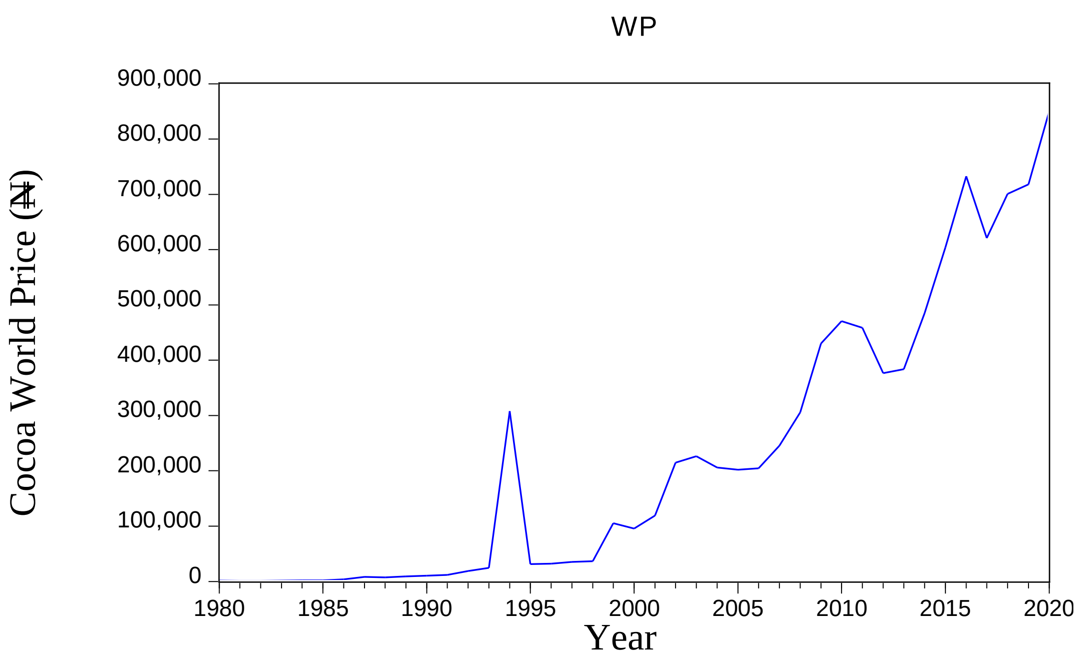


Figure 2 Graph showing trend in cocoa world price (1980-2020)

The Growth Rate of Cocoa World Prices and Producer Prices

The estimated trend equations and the computed values of the instantaneous (annual) and compound growth rate of cocoa world prices and producer prices in Nigeria for the period under study are shown in (Table 3). Instantaneous Growth Rate (IGR) is the rate of growth of a variable at a point in time, while Compound Growth Rate (CGR) is the rate of growth over some time. The IGR of 17.2% and 13.1% for WP and PP respectively implies that over the period (1980-2020), the 2 variables increased by the different percentages per annum. The R2 values of 0.913 and 0.527 for WP and PP mean that approximately 91.3% and 52.7% of the variations in the respective variables were explained by variation in time. The significant F-statistic for the two cocoa prices regarded implies that as a group, all the explanatory variables are jointly significant in explaining the growth rate in the cocoa prices.

Table 3 Estimated Growth Rate Function for Cocoa World Prices and Producer Prices in Nigeria

Variables/ Regressor	Constant (bo)	Coeff(b1) / Slope	R-square	F-value	R (Growth rate %)
WP	-333.395	0.172	0.913	408.18***	18.76792
PP	-252.381	0.131	0.527	43.52***	13.99688

Source: Author's Computation, 2024

Table 4 shows the estimated quadratic equations in time variables from 1980-2020. From the result in the Table, the coefficients of t2 for both variables are positive and statistically significant at 1% meaning there is an acceleration in the growth of the variables.

Table 4 Estimated Quadratic Equations for Variables under Review

Variables/Regressor	B0	B1	B2	T-value	T2
WP	-161.09	80.95	4.30 E-5	18.77***	20.06***
PP	-121.67	-65.52	3.27 E-5	-6.14***	6.61***

Source: Author's Computation, 2024

The Relationship between World and Producer Prices of Cocoa from 1980-2020

Unit Root Test

This study utilized the Augmented Dickey-Fuller (ADF) technique to assess the stationarity characteristics of the variables examined. While the ARDL approach to co-integration is applicable regardless of whether the variables are integrated of order 0 (I(0)) or 1 (I(1)), it remains crucial to conduct unit root tests to ensure that no variable is integrated of order 2 (I(2)). This precaution is necessary because the presence of an I(2) variable would invalidate the computed F-statistics used for testing co-integration. The tests were conducted with only constant terms included, and the Akaike Information Criterion (AIC) was employed to determine the optimal lag order in the ADF test equation.

The null hypothesis that each series "has a unit root" is tested against the alternative hypothesis that the series "does not have a unit root" for all variables. According to the unit root test results presented in Table 5, both WP and PP are stationary at the first difference, denoted as I(1). Given that the ARDL technique is capable of handling series that are purely I(0), purely I(1), or a combination of both and suitable for series with small sample size, it was selected as the appropriate co-integration method in this study to analyze the relationship between these two variables.

Table 5 Augmented Dickey-Fuller Unit Root Test (With Constant Terms Only)

Variable	Level I(0)	First Difference I(1)	Remarks
InWP	0.351(0)	-7.807(0)***	I(1)
InPP	3.316(4)	-2.824(1)*	I(1)

Source: Author's Computation, 2024

ARDL Bounds Testing Results

The F-statistic was calculated using the Wald test of coefficients in the ARDL-OLS regressions. As depicted in Table 6, the computed statistic is 4.51, surpassing both the lower bound critical value of 3.62 and the upper bound critical value of 4.16 at a 5 per cent significance level. Consequently, the null hypothesis of no co-integration was rejected, indicating the presence of a long-run co-integration relationship between the producer price and the world price of cocoa in Nigeria.

Table 6 Results of Co-integration Test Based on ARDL Bounds Test Approach

Critical Value	Lower Bound I(0)	Upper Bound I(0)
1%	4.94	5.58
5%	3.62	4.16
10%	3.02	3.51

The computed F-statistics: FLPP (LPP /LWP) = 4.51

Source: Author's Computation, 2024

Analysis of Long-run Estimates

The long-run coefficients of ARDL (3, 0) as presented in Table 7 revealed that the coefficient of cocoa world price is significant at 5% and that the world price had a positive and significant influence on the producer price. This is corroborated by the findings of (Gama et al., 2021). By implication, a 1% increase in cocoa world price would lead to a 0.41% increase in producer price. This means that an increase in cocoa world price would translate to an increase also in the producer price.

Table 7 Estimated Long-Run Coefficients using the ARDL Approach

Regressor/Variable	Coefficient	Standard Error	T-Stat	Prob.
WP	0.413806	0.247438	1.672358	0.01039
C	-25834.22	39341.35	-0.656669	0.5159

EC =PP - (0.4138*WP -25834.2243)

NOTE: ***denotes significant at 1%; ARDL (2, 1) selected based on Akaike Information Criterion; LPP = Log of Producer Price.

Source: Author's Computation, 2024

Analysis of Short Run Estimates- Vector Error Correction Model (VECM)

The Error Correction Model (ECM) based on the ARDL bounds test approach was utilized to analyze the short-run dynamic coefficients associated with the long-run co-integration relationships. The results of the short-run coefficients from the ARDL (3, 0) model are presented in (Table 8). D (PP (-1)) represents the short-run effect of the previous year's producer price of cocoa on the current year's price. The positive sign of this coefficient indicates that the previous year's producer price positively affects the current year's price, although it is not statistically significant.

The statistically significant negative coefficient of ECM (-) confirms the presence of a long-run relationship between the variables regarded. ECM measures how quickly the endogenous variable adjusts to changes in the independent variables before reaching the equilibrium level. In the context of this study, ECM measures the speed at which the cocoa producer price adjusts to the long-run equilibrium after a shock. In this study, the ECM is statistically significant at the 1% level with a value of -0.673685. This implies that approximately 67.37% of disequilibria resulting from shocks in the previous year converge to the long-run equilibrium in the current year.

Table 8 Results of the ARDL Short-Run Relationship

Variable	Coefficient	Standard Error	T-Stat	Prob.
D (PP (-1))	0.627425	0.542737	1.156038	0.2560
D (PP (-2))	-1.388563	0.545722	-2.544451	0.0158
CointEq (-1)*	-0.673685	0.194461	-3.464368	0.0015

Source: Author's Computation, 2024

Results of ARDL Diagnostic Tests

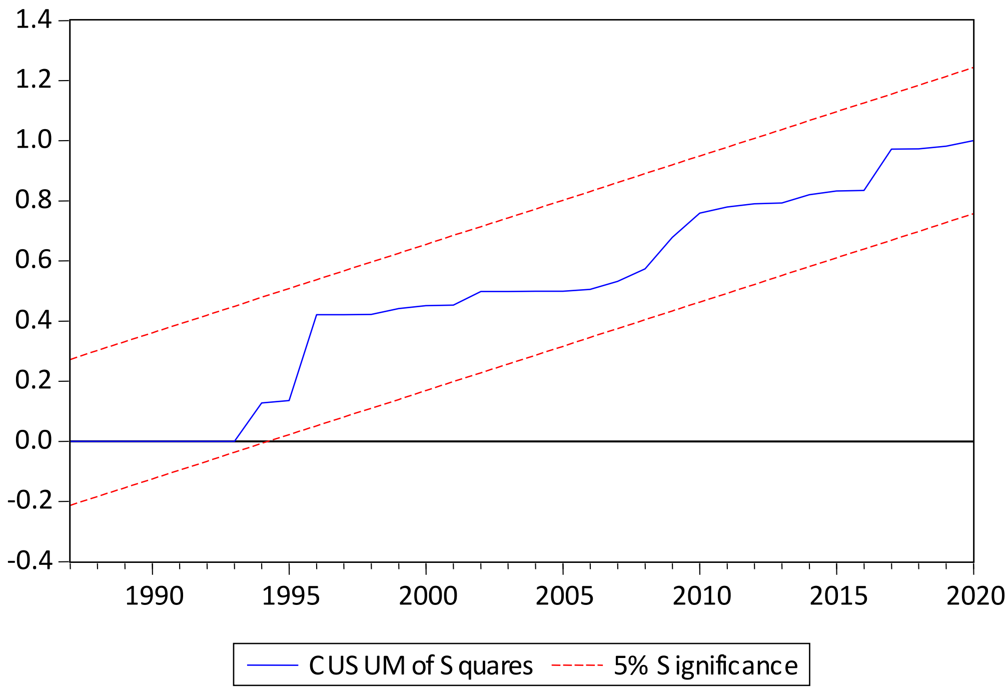
The adequacy of the dynamic model specifications was assessed through several diagnostic tests, including the Jarque–Bera normality test, Breusch–Godfrey autocorrelation diagnostics, Breusch–Pagan–Godfrey tests for heteroscedasticity, and Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMQ) plots for testing parameter and variance stability. Detailed results of these diagnostic tests are provided in (Table 9 and Figures 3 (a&b)). The results of the Breusch-Godfrey Serial Correlation LM test and the Breusch-Pagan-Godfrey heteroskedasticity test, shown in Table 9, indicate that the probability values exceed the 0.05 significance level.

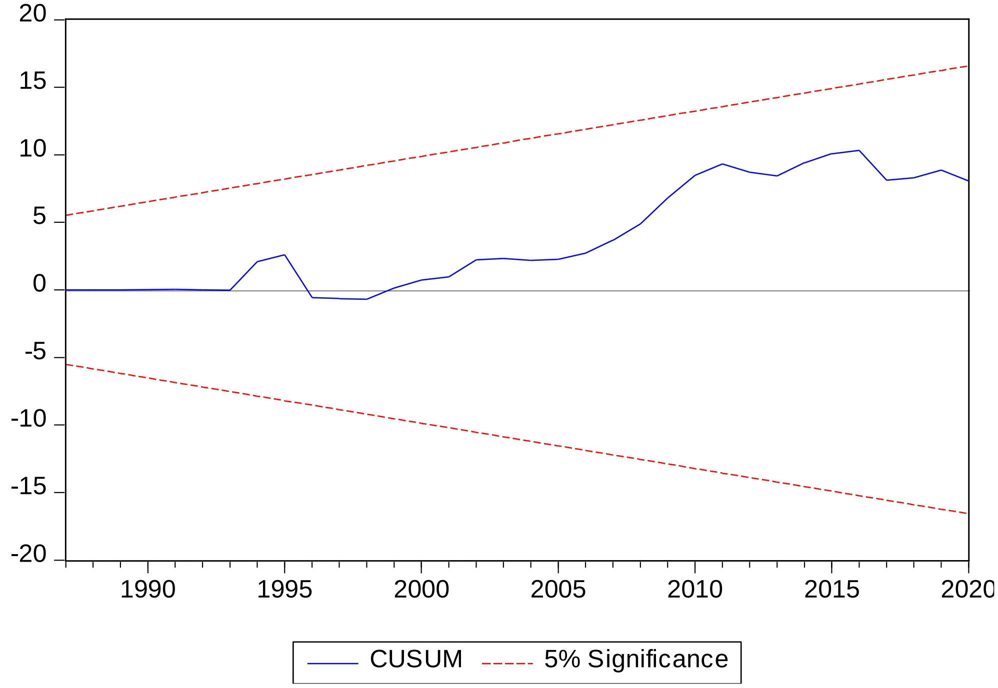
This suggests that the null hypotheses of no serial correlation and homoscedasticity cannot be rejected, meaning that the model is free from serial correlation issues and exhibits equal variance (homoscedasticity). This result is desirable for the validity of estimates and reliability of standard error and T-statistics. From the result of the Jarque-Bera normality test, the probability value is less than 0.05 which is evidence of non-normality, meaning the series are not normally distributed. The CUSUM (blue) line lies within the 5 % significance level boundary (i.e. in between the two critical boundary lines). This is evidence of parameter and variance stability.

Table 9 Results of Diagnostic Tests

Test	$\chi 2$ statistic	Probability
Serial Correlation Test	1.100231	0.3451
Heteroskedasticity	0.452351	0.7700
Normality	41.6015	0.0000

Source: Author's Computation, 2024





Figures 3 (a & b) The plot of the Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Recursive Residuals of Square (CUSUMq) Tests for the ARDL Model
Source: Author's Computation, 2024

4. CONCLUSIONS

The objective of the research was to determine the relationship between the world price of cocoa and its corresponding producer prices in Nigeria. The study made use of annual time series data on the aforementioned variables in Nigeria covering 1980 to 2020. The analytical tools used were descriptive statistics (mean, standard deviation, frequency distribution and percentage), growth function model & graphs, Granger causality model and auto-regressive distributed lag (ARDL) model (bounds testing approach to co-integration). The results of the growth function analysis showed a growth rate of 18.76% and 13.99% for World Price and Producer Price respectively with significant acceleration in both. The ARDL findings affirmed a sustained relationship between cocoa producer price and cocoa world price (with an F-value of 4.51, $p < 0.05$). Long-run estimations indicated that cocoa world price exerted a positive and significant influence on producer price.

In the short run, cocoa world prices were observed to positively impact cocoa production in the preceding year, albeit insignificantly. The enduring relationship between these variables was further corroborated by ECM (-1), where 67.37% of discrepancies from the prior year's disturbance reverted to equilibrium in the current year, represented by an ECM value of -0.673680. This underscores the cocoa world price's prompt adjustment to deviations from its long-term trajectory. The Granger causality test on WP and PP showed a bi-directional causation between the two variables meaning WP affect (causes) PP and vice-versa. Based on the findings of the study, it is suggested that the government of Nigeria should introduce price-related reforms that will improve the transmission of world prices to farmers, which would ultimately encourage production and export.

Informed consent
Not applicable.

Ethical approval
Not applicable.

Conflicts of interests
The authors declare that there are no conflicts of interests.

Funding
The study has not received any external funding.

Data and materials availability
All data associated with this study are present in the paper.

REFERENCES

1. Adeniran AO, Oladun EA. Implication of Transport Development Models on Agricultural Development in Nigeria: An Empirical Review. Open J Econ Commerce 2020; 3 (2):28-41.
2. Adeniran AO, Sidiq OB. Economic Recession and the Way-Out: Nigeria as Case Study. Glob J Humanit Soc Sci: E Econ 2018; 18(1):1-6.
3. Alamu SA. Analysis of Seedling Subsidy Policy and Cocoa Production in South-West Nigeria. J Educ Soc Res 2013; 3(4):5 9-68.
4. Anjay KM, Ujjal R. Effects of Price Fluctuations on the Financial Capacity of "Class A" Contractors. IJCRT 2017; 5(4): 1920-1938.
5. Awoyemi AO, Aderinoye-Abdulwahab SA. Assessment of the Use of Cocoa Production Management Practices among Cocoa Farmers in Ekiti State, Nigeria. J Trop Agric Food Environ Ext 2019; 18(2):37-41.
6. Gama EN, Abdusalam RY, Katanga YN. Estimation of Short-run and Long-run Effects of Cocoa Price Fluctuation on Export and Area Harvested in Nigeria. Dutse J Pure Appl Sci (DUJOPAS) 2021; 7(1):326-328.
7. Gayi SK, Tsowou K. Cocoa Industry: Integrating Small Farmers into the Global Value Chain. Special Unit on Commodities, UNCTAD, 2016.
8. Happiness H, Cecilia R, Alban M. Price Fluctuation of Agricultural Products and its Impact on Small Scale Farmers Development. Case Analysis from Kilimanjaro Tanzania. Eur J Bus Manag 2014; 6(36).
9. Hasssan A, Zeki B. Determination of the Effect of Price Fluctuations on Producer's Income- The Case of Potatoes. Turkish J Agric Food Sci Technol 2017; 5(11):1342-1349. doi: 10.24925/turjaf.v5i11.1342-1349.1356
10. Olaiya TA. Examining the Political-Economy of Cocoa Exports in Nigeria. Int J Appl Econ Finance 2016; 10(1-3):1-13. doi: 10. 3923/ijaef.2016.1.13
11. Olopha P, Aladeniyi O. Co-integration Analysis of Cocoa Producer Prices for Ghana, Ivory Coast and Nigeria. J Nat Sci Res 2015; 5(8).
12. Oyedele JO. Enhancing the Sustainability of Cocoa Growing in Nigeria. In A Bamidele, AS Bamire, K Ayodeji & F Oluwole (Eds.), ICCO Roundtable Congress on Sustainable World Cocoa Economy at Accra, Ghana, 2007.
13. Pesaran MH, Shin Y, Smith RJ. Bounds testing approaches to the analysis of level relationships. J Appl Econ 2001; 16(3): 289 -326.
14. Thornton PK, Jone PG, Alagarswamy G, Andresen J, Herrero M. Adapting to climate change: Agricultural system and household impacts in East Africa. Agric Syst 2010; 103(2):73-8 2.
15. Timmer P. Managing price volatility: Approaches at the global, national, and household levels. Center on Food Security and Environment at Stanford University 2011; 1-42.
16. Umar MM, Richard JC. Causes, Magnitude and Consequences of Price Variability in Agricultural Commodity Market: An African Perspective. School of Agricultural and Wine Sciences, Charles Sturt University, Australia, 2011; 1-26.
17. Wessel M, Quist-Wessel PMF. Cocoa Production in West Africa, a Review and Analysis of Recent Developments. NJAS-Wagen J Life Sci 2015; 74-75(1):1-7. doi: 10.1016/j.njas.20 15.09.001