

## Assessment of Efficiency of Price Information Transmission Between the Central Market and Source Market for Cocoa in South-Western Nigeria a Cointegration Analysis

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**Abstract:** This study employs the econometric co-integration technique as analytical tool in an attempt to empirically determine the efficiency of price information transmission between the central market (Ex-Lagos Price) and the source market (Ondo/Ekiti) for cocoa marketing in Nigeria between 1986 and 2003. Secondary data on prices of graded cocoa were collected from the Produce Departments of Ondo and Ekiti States' Ministry of Agriculture and Rural Development as well as from the Central Bank of Nigeria (CBN), Federal office of Statistics (FOS) and International Cocoa Conference Organization (ICCO). The empirical results revealed that based on the parameters of market co-integration, price information on cocoa was found to be fairly adequately transmitted thus indicating that deregulation of the cocoa market has not reduced pricing efficiency in the cocoa markets in the study area.

**Key words:** Co-integration; price, deregulation, efficiency, Nigeria

### INTRODUCTION

Cocoa (*Theobroma Cocoa*) is the principal source of income for million of farmers' families and workers in the cocoa producing State of Nigeria. It is a major source of employment generation described by Ajayi and Oyejide<sup>[1]</sup>, a significant contributor to social infrastructural development by Kotey<sup>[2]</sup>, a source of raw materials for Agro-Industries, a foreign exchange earner by ICCO<sup>[3]</sup> and source of revenue to cocoa producing states in particular and Nigeria in general denoted by Imoudu<sup>[4]</sup>. Currently, Nigeria accounts for about 6% of the world cocoa production and it is the fifth largest cocoa producer. Over 95 percent of the total cocoa output in Nigeria comes from the south western part of the country and Ondo and Ekiti States account for over 50-55% of the total cocoa produced in Nigeria<sup>[5]</sup>.

Prior to 1988 the Cocoa Marketing Board had the statutory responsibility to procure cocoa beans locally and export. It created and maintained a structure of Licensed Buying Agents (LBAs) for the purpose of aggregating cocoa from the farmers across the cocoa producing areas. The Board fixes the price of cocoa ahead of the buying season and all farmers and LBAs are made aware of the ruling price. The same price hence rules

throughout the country and throughout a season. The Cocoa Marketing Board was however abolished in 1986 for a number reasons, the most important of which is that, it was taxing the cocoa farmers excessively by fixing lower prices per tonne for cocoa.

Post the abolition of the cocoa Marketing Board, the structure of cocoa marketing in Nigeria changed dramatically. There are now more Buying Agents, Licensed Buying Agents and several exporters. Prices also vary from location to location and continuously over the buying season. There are however two centroids for prices; Lagos (ports) and farm gate (States). The Ex Lagos prices reflect the prices international buyers of cocoa are willing to pay to ex Lagos. The farm gate prices represent the prices the Buying Agents are willing to pay the farmers, given the ex Lagos prices, transportation and other handling charges as well as a reasonable margin. Given this pricing structure, it is expected that the farm gate prices should strongly reflect (correlate with) Ex Lagos prices if the transmission market of information and hence prices is efficient. This is a desirable property of a system of markets that are lucked together by trade and markets with this property are said to be integrated. For the Nigerian cocoa market post abolition of cocoa Marketing Board, the relevant question therefore is "are

prices being efficiently transmitted between Lagos (ports) and the farm gate"? This is the question this study attempts to answer. The study used the test of market integration between Lagos (ports) cocoa market and (Ondo and Ekiti) States cocoa market as the main tool to address the issue.

**Market integration and Co-integration tests:** An efficient market is one in which prices fully reflect the information available such that abnormal profit cannot be earned by exploiting this information set by Aron and Ayogu,<sup>[6]</sup>. This implies that for efficiency to exist in a market information must be transmitted fairly efficiently to all players in the market. In the reality of the composite of cocoa market in Nigeria, it means that prices information must be efficiently transmitted. Difference in prices between Lagos (which can be referred to as the central market) and (Ondo and Ekiti) States, prices (locations which can be referred to as the peripheral market) can only be accounted for by transaction costs. This thus implies that prices in these central and peripheral cocoa markets should be co-integrated.

Recent developments in econometrics have led to more advanced tests of market integration based on price series information and the concept of co-integration has gained widespread acceptance in economic analysis in testing market efficiency and market integration by Abayomi<sup>[7]</sup>. The co-integration is a property of two or more variables which have already shown to be integrated and which though trending (non stationary) cannot drift too far apart since they are tied together in some sense hence a long run equilibrium will exist in a model based on such variables.

There are two main contemporary economic approaches to testing the existence of a co-integrating relationship between time series. The first is the Engle and Granger<sup>[8]</sup> two-step procedure using the Dickey Fuller (DF) or the Augmented Dickey Fuller (ADF) test by Dickey and Fuller<sup>[9]</sup>. In the first step, the residual from the co-integration is obtained. In the second step, they are tested for stationary using the Dickey-Fuller test.

The second approach is the maximum likelihood procedure of Johansen<sup>[10]</sup>, which relies on the relationship between the rank of a matrix and the characteristic roots.

This study used these study to determine empirically the existence of co-integration between the prices of cocoa ex-Lagos and in (Ondo and Ekiti) States in an attempt to determine the efficiency of price information transmission in the Nigerian Cocoa sub sector.

## MATERIALS AND METHODS

**The data:** The data used for the study are time series of cocoa prices, ex-Lagos (the central market) and in (Ondo and Ekiti) States (the peripheral market). The ex-Lagos prices were collected from the Central Bank of Nigeria (CBN), Federal Office of Statistics (FOS) and the International Cocoa Conference Organization (ICCO), while the states' prices were collected from the Produce Department of Ondo and Ekiti States' Ministry of Agriculture and Rural Development. The time series were collected for the period between 1986 and 2003.

Econometrics analysis of economic co-integration technique was used to estimate the existence of co-integrating relationship between price series of cocoa ex-Lagos Nigeria (the central market) and Ondo/Ekiti States (the peripheral market). Economic co-integration referred to the occurrence of a long run relationship among different series. Within the context of this analysis if the long run (PF) Farm gate producer price in Ondo/Ekiti and (PD) Domestic Producer Price in Nigeria exhibit a linear constant relationship then the series are co-integrated and hence the markets are integrated. On the other hand if co-integration is not detected between the two series, then it means that the series have exhibited period of moderate divergence between each other.

In carrying out the co-integration test through the ADF test for stationarity for the variable PF, for example, the model is represented as:

$$\Delta \ln PF_t = \mu_0 + \beta \ln PF_{t-1} + \sum_{k=1}^{k=K} \mu_{k+1} \Delta \ln PF_{t-k} + \varepsilon_t$$

Where:

$\Delta$  refers to the difference operator

i.e.  $\Delta P_t = P_t - P_{t-1} \dots$

$\mu_0$  is the constant

$\varepsilon_t$  is the disturbance term

$P_t$  = price per ton of graded cocoa

$K$  = Number of years in the series

## RESULTS AND DISCUSSION

**Cocoa price movements and trends:** Post abolition of the Cocoa Board, there is no more fixed and guaranteed cocoa price per cocoa season. Rather farm gate cocoa prices vary from location to location and within locations over time. The time dimension could be as short as one or two weeks while the location dimension could be as short as 40 to 600 kilometres, depending on the conditions of the roads. It is believed that these farm gate prices are

Table 1: Average annual Cocoa prices (logos and farmgate) and variance (%)

Year	PD	PF	Variance (%)
1986	8.000	7.000	12.50
1987	21.000	20.000	4.76
1988	8.500	7.500	11.76
1889	9.500	8.000	15.79
1990	9.000	8.500	5.56
1991	16.000	9.500	40.63
1992	50.000	49.000	2.00
1993	110.000	105.000	4.55
1994	100.000	88.000	12.00
1995	100.000	95.000	5.00
1996	90.000	85.000	5.56
1997	100.000	98.000	2.00
1998	90.000	85.000	5.56
1999	87.000	80.000	8.05
2000	180.000	165.000	8.33
2001	315.000	295.000	6.35
2002	200.000	180.000	10.00

Table 2: Stationarity test on (PF) and (PD) and johansen co-integration for PF/PD between 1986 and 2002

Test	Test statistic	Critical value @ 5%
ADF for (PF)	-5.673621	-3.0199
ADF for (PD)	-4.657390	-3.8067
Johansen PF/PD	11.79929	15.41

responding to Lagos prices, which in turn are responding to the international cocoa market prices. The international cocoa prices are affected by a number of factors that include demand and supply of cocoa beans internationally as well as political crises in producing countries that the market believes can curtail supply.

During the cocoa season, the produce departments in the states monitor and collect statistics on farm gate cocoa prices, among other variables that affect cocoa production. From the monthly data, the Departments compile the annual cocoa price data. Similarly the ex-Lagos prices for cocoa are monitored at the national level and are documented by the Federal Office of Statistics and the Central Bank of Nigeria. The average monthly ex-Lagos prices are averaged into annual price data from year to year. These annual farm gate and ex-Lagos prices for the period 1985 to 2002 are presented in Table 1. The table also contains the variances between the annual ex-Lagos and the Farm gate prices. The variances range from 4.5% to as much as 40.6 % with an average value of 9.4%.

Table 2 shows the outcome of co-integration tests using Augmented Dickey Fuller (ADF) test for stationarity and Johansen co-integration tests for the variables of domestic producer price of cocoa in Nigeria (PD) and farm gate producer price of cocoa in Ondo/Ekiti State (PF). The result of stationarity test between each of the price variables of Domestic producer price in Nigeria PF and farm gate producer price in Ondo/Ekiti states (PD) shows that the absolute values of ADF statistics i.e. (-5.67321) for PF and (-4.657390) for PD at first difference

Is greater than the absolute critical values of (-3.0199) for PD and (-3.8067) for PF at 5% level of significance, respectively.

Also the result of Johansen co-integration test between the (PD) and (PF) shows that the value of Likelihood Ratio (LR) i.e. 11.79929 is less than the Critical value (CR) i.e. 15.41 at 5% level of significance. Result of stationarity and Johansen co-integration tests revealed that there is the existence of long-term relationship between the prices of cocoa in Ondo/Ekiti (source market) and ex-Lagos price (central market) between 1986 and 2002.

## CONCLUSION

The performance of stationarity and co-integration tests on the domestic producer price of cocoa in Nigeria (PD) as dictated by ex Lagos price and the farm gate producer price of Cocoa in (Ondo and Ekiti) states in Nigeria yielded ADF statistics of -5.67321 for PD and -4.65739 for PF at the first difference; values which are greater than the critical value of -3.0199 for PD and -3.8067 for PF at 5% level significance. Thus fulfilling the necessary condition for establishing non-stationarity on the price series. The Johansen co-integration test between PD and PF yielded a Likelihood ratio of 11.79929, which is less than the critical value of 15.41 at 5% level of significance, thus establishing co-integration between the two price series.

The implication of the findings from this study is that price information was being transmitted fairly efficiently between ex-Lagos (central market) and Ondo/Ekiti (Peripheral market) in Nigeria. Thus indicating that the two markets are integrated. This implies that the deregulation of the cocoa sector has not put the farmers at a disadvantage in terms of the price earned at their farm gates rather adequate information flow has enabled them to benefit fairly well from upward movement in prices

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