

ANALYSIS OF MARKET INTEGRATION AND PRICE VARIATION IN RICE AND MAIZE MARKETING IN OSUN STATE, NIGERIA.

ABSTRACT

The study examined market integration and price variation in local rice and white maize marketing in Osun State, Nigeria. Specific issues addressed in ~~this the~~ study include determination of existence of co-integration between the rural and urban markets and the leading market between the rural and urban markets for the food grains. Secondary data were used for the study ~~and, which it~~ covered time series data on retail grain prices ~~spanning~~ from 2000 – 2010, ~~sourced from Osun State Agricultural Development Programme (OSSADEP).~~ Coefficient of variation and price correlation coefficient were used to examine the behavior of local rice and white maize market price in urban and rural areas. The Augmented Dickey-Fuller (ADF) test was used to investigate stationarity in the pairs of prices while the Johansen co-integration technique, ~~with its associated Vector Error Correction Model (VECM),~~ was used to determine the existence of co-integration between the markets. Augmented Dicker Fuller procedure (ADF) indicated that **all the variables were not stationary at their level but stationary in first difference.** Both the trace and maximum eigen value statistics indicated the existence of co-integration relation at 5% significant level for the pair of product prices, implying that rice and maize markets during the study period were linked together and therefore the long-run equilibrium was stable. The results also indicated that urban rice and maize markets did not granger-cause rural rice and maize market ($p > 0.05$), while rural rice and maize markets granger caused urban rice and maize market ($p < 0.05$). The error correction model showed significant causality link between the rural and urban markets, suggesting a clear trend in price leadership. It follows that there could be efficiency in transmission of price information among operators if relative stability is attained in the rural markets of local rice and white maize in Nigeria. The study

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recommends that farmers should be placed at the centre of the marketing policy to enable them determine the direction of price **movements**.

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INTRODUCTION

Agriculture is one of the most important sectors of the Nigerian economy. This is because it contributes more than 30% of the total annual GDP, employs about 70% of the labour force,

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accounts for over 70% of the non-oil exports and, ~~perhaps most importantly~~, provides over 80% of the food needs of the country (Adegboye, 2004). The major food grains in Nigeria are rice,

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maize, sorghum, wheat, pearl, millet, and cowpea with rice ranking as the sixth major crop in terms of the land area while sorghum accounted for 50% of the total grain production and occupies about 45% of the total land area devoted to cereal production in Nigeria (National

Extension Agricultural Research and Liaison Station, 1996). The rate of growth of Nigeria's food production is 2.5% per annum in recent years, while food demand has been growing at the

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rate of more than 3.5% per annum due to high rate of population growth of 2.83% (Kolawole and Ojo, 2007). Food grain marketing warrants special attention because food grains play an

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important role in Nigeria as staples in many homes. Secondly, the structure and the conduct of the food grain market can affect the economy of the people in the communities and the nation's

economy in significant ways (Onu and Iliyasu, 2008). The government of Nigeria, realizing the importance of the grain subsector has continued to intervene in stabilizing the grain subsector through agricultural policy reformation.

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Adetunji and Adesiyun (2008) stated that agricultural production problems can be overcome through introducing new technology and efficient marketing systems, It is however obvious that increased production without corresponding well-developed and efficient marketing system may

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amount to wastage of resources. Olukosi *et al.* (2007) stated that a good and efficient marketing

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system promotes the pace of economic development by encouraging specialization, which leads to more output. This study therefore sought to know the trend in price of some selected grain crops (rice and maize) in rural and urban markets as well as the level of integration between markets for these selected grain crops in Osun State. The research questions include (a) How do prices relate between markets? (b) Are there linkages between markets in urban and rural areas? (c) What is the degree of market integration among these rural and urban markets?

Objectives of the Study

The overall objective of the study was to examine the extent and degree of market integration and price variations in the Osun State maize and rice markets. The specific objectives were to:

1. examine the price behaviour between rural and urban markets for rice and maize
2. determine if co-integration (long run equilibrium) relationship exist between local rice and white maize prices in rural and urban markets
3. determine the leading markets between urban and rural markets
4. determine the degree of market integration.

Hypothesis of the Study

H₀: Prices of rice and maize in rural markets do not determine prices of rice and maize in urban markets.

RESEARCH METHODOLOGY

Study Area

This study was carried out in Osun State, Nigeria. Osun State has an estimated population of 3,423,535 (National Population Commission, 2006). The State which is made up of 30 Local Government Councils and lies between longitudes 40° and 60° East of the Greenwich Meridian and latitudes 50° and 80° North of the Equator. This means that the State lies entirely in the

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Tropics. The State is bounded in the West by Oyo State, in the North by Kwara State, in the East by Ondo State and in the South by Ogun State. Agriculture is the traditional occupation of the people of Osun State. The tropical nature of the climate favours the growth of a variety of food and cash crops. The main cash crops include cocoa, palm produce, kola, while food crops include yam, maize, cassava, millet, rice and plantain. The vegetation consists of high forest and derived savannah towards the North. The climate is tropical with two distinct seasons. Usually the wet season last between March and October, while the dry season comes between November and February. Mean annual rainfall is between 2,000 and 22,000mm. Maximum temperature is 32.5°C while the relative humidity is 79.90%.

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The choice of Osun State for ~~this-the~~ study was deemed to be appropriate because of its antecedent in agriculture and food marketing. According to Ogunbodede and Olakojo (2001),

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Osun and Oyo States produce 50% of the total quantity of maize produced in Southwestern Nigeria and due to the influx of food produced from neighboring States of Oyo, Kwara, Ekiti, and Ondo.

In ~~this-the~~ study, effort was made to analyze price trends of local rice and white maize in the rural supply market and urban demand market in Osun State, Nigeria with the view to determining if linkages existed between them and ascertaining the nature of their interrelatedness.

Sources of Data

The secondary data used in ~~this-the~~ study were sourced from Osun State Development Programme. The average monthly retail price (N/Kg) of local rice and white maize covering January, 2000 to December, 2010 (11years) for Osogbo (urban market), Telemu (rural market) and Erin Ijesa (rural market) were used.

Data Analysis Techniques

Data were analyzed using E Views software, and statistical processes were employed in order to achieve an appropriate analysis. To deal with national currency fluctuations, which may cause price to look as though they are integrated; all prices were quoted in Naira per kilogram (₦/kg) and series of prices were all deflated by using Consumer Price Index (CPI). The real prices obtained were then used for the analyses.

$$\text{Real price} = \frac{\text{Nominal Price}}{\text{CPI}} \times 100$$

Data collected were analyzed using the following:

Coefficient of Variation and Pearson Price correlation Coefficient were used to examine the price behavior of rural and urban markets of local rice and white maize in study area. This was computed as shown below:

Price Correlation Coefficient (r)

$$r = \frac{\sum_{t=1}^T (P_{it} - \bar{P}_{it})(P_{jt} - \bar{P}_{jt})}{\sqrt{\sum_{t=1}^T (P_{it} - \bar{P}_{it})^2 \sum_{t=1}^T (P_{jt} - \bar{P}_{jt})^2}} \dots\dots\dots(1)$$

Where,

P_{it} and P_{jt} = Price variables at time T

$\bar{P}_{it}$ and $\bar{P}_{jt}$ = mean of the variables

Price correlation coefficients were used to examine the strength of price linkages across markets. Given price series from two markets at time t, P_{it} and P_{jt} , the degree of linear association between the markets can be measured by the sign and magnitude of the correlation coefficient, r. The t - statistic was used to ascertain if the coefficient between prices in the markets was statistically different from zero.

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Co efficient of Variation (CV)

$$CV = \frac{\text{Standard deviation}}{\text{Mean}} \times 100\% \dots\dots\dots (2)$$

Johansen Multivariate Co-integration Procedure

Johansen developed a multivariate co-integration method in 1988, which is still the most suitable approach to test prices of food markets that are usually endogenous and simultaneously

determined (Mohammad, 2005). The four important points to be considered before performing co-integration tests, according to Enders (2004), are:-

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First, co-integration refers to one or more linear combinations of non-stationary variables. Second, all variables must be integrated of the same order. However, this condition is not necessarily required in all cases. It is possible that variables are integrated of different orders. Third, there may be as many as $n-1$ linearly independent co-integrating vectors if a linear combination of non-stationary variables has n variables. The number of co-integrating vectors is called the co-integrating rank (r). If more than two time series are considered, it is possible to have more than one co-integrating rank. Finally, consider the case in which each variable contains a single unit root. Before conducting the co-integration tests, the lag lengths are determined by using the minimum value of the Akaike information criterion.

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Johansen Co-integration Procedure was used to determine the existence of co-integration (long run equilibrium) relationship between local rice and white maize prices in the rural and urban markets of the study area as follows:

Testing for Stationarity:

Stationary time series data happen if the average, variance and covariance at any lag are still constant at any time (Widarjono, 2007). The individual price series are tested for the order of integration to determine whether or not they are stationary. A number of tests for stationarity are available in the literature; these include the Dickey-Fuller (DF) test (Dickey and Fuller, 1979), the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) and the Philips-Perron (PP) test. A standard test for non-stationarity is the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1981).

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For each price series X_t the test statistic was measured by the following regression.

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{k=1}^p \beta \Delta X_{t-k} + \varepsilon_t \quad \dots\dots\dots (3)$$

Where

- X_t = Price at time t
- Δ = first difference operator.
- t = time indicator.
- ε_t = the error term.
- δ, α and β = Parameters to be estimated.
- K = Number of lag of the price variables to be included.

The first stage is to test whether each series is stationary i.e. I (0). If the null hypothesis of non stationarity cannot be rejected, that is, the absolute value of the ADF statistic is smaller than the critical Augmented Dickey Fuller (ADF) value, then the next stage is to test whether the first differences are stationary. If the null hypothesis of non-stationarity cannot be rejected, then the series is still not stationary. Therefore, differencing continues until the series becomes stationary and order noted. The process is considered stationary if $\delta / \sigma < 1$, thus testing for stationarity is equivalent with testing for unit roots ($\partial < 1$) under the following hypotheses:

$H_0: \hat{\rho} = 0$ the price series is non-stationary or existence of unit root.

$H_1: \hat{\rho} \neq 0$ the price series is stationary or there is white noise in the series.

The hypothesis of non-stationarity will be accepted at 0.01 or 0.05 levels if ADF is greater than the critical value.

Selection of lag length:

For the determination of the lag length to be included in VAR (Vector Auto Regression) model.

Akaike's (1974), information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and Hannan-Quinn criterion (HQIC) are used for VAR models. When using AIC, SBC or HQIC based on the estimated standard errors in respective equations, the model with the lowest value from the AIC, SBC or HQIC will be chosen.

$$SBIC = \ln(\sigma^2) + k/T \ln T$$

$$HQIC = \ln(\sigma^2) + 2k/T \ln T$$

$$AIC = \ln(\sigma^2) + 2k/T$$

In this paper, the AIC was used because it has the lowest estimated standard error when compared with others. AIC can be described by the following equation:

$$AIC = \ln(\sigma^2) + 2k/T \dots\dots\dots (4)$$

Where;

σ^2 = the variance of the estimated residuals.

T = the number of parameters

k = the sample size.

The maximum lag length begins with 3 lags and proceeds down to the appropriate lag by examining the AIC, HQIC and SIC information criteria.

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The number of lagged difference terms to be included can be chosen based on t-test, F-test or the Akaike's Information Criterion (AIC) (Greene, 1993).

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Testing the number of co-integrating relationships:

Johansen also, proposed two likelihood ratio tests namely, Eigen value and trace statistic for the determination of r . It is a maximum likelihood ratio test involving a reduced rank regression between two variables, say $I(1)$ and $I(0)$. λ trace has a null hypothesis of number of co-integrating vectors being less than or equal to r , while alternative hypothesis is that there are more than r co-integrating vectors. Additionally, λ max has a null of r co-integrating vectors against $r+1$ co-integrating vectors. For both tests, if the test statistics is more than the critical value, we reject the null hypothesis. Testing is conducted as a sequence and under the null, $r = 0, 1, \dots, n-1$. When $r = 0$, failing to reject H_0 will complete the test. But if this is not the case meaning when $H_0: r = 0$ is not rejected, the test continues until the null is no longer rejected.

- (a) The trace statistic is computed as:

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$$\lambda_{trace} = T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \quad (6)$$

Where;

λ_i = estimated Eigen value (characteristic roots) obtained from Π matrix

T = the sample size.

r = number of co-integrating vectors

n = number of variables under considerations.

- (b) The maximum Eigen value statistic computed as:

$$\text{MAX}(r/r+1) = -T \ln(1 - \lambda_{r+1}) \dots \dots \dots (7)$$

T = the sample size

(λ_{r+1}) = estimated Eigen values (characteristic roots) obtained from the Π matrix

H_0 : there is no co-integrating vector between them

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H_A : there is co-integrating vector between them.

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If the value of λ trace and λ max exceed the critical value, reject the null hypothesis and accept the alternative hypothesis of more co-integration vectors at 0.05 or 0.01 level.

Absence of a co-integrating relationship spots nonexistence of long-run relationship.

Vector Error Correction Model (VECM):

If prices are integrated of the same order and prices of each model are co-integrated, a vector error correction model (VECM) is appropriate to determine the multivariate relationships among prices. Johansen defined two matrices α and β , such that $\Pi = \alpha\beta'$, where both α and β are $(n \times r)$ matrices. The procedure is based on maximum likelihood estimation of the error correction model and each two-variable system is modeled as a vector auto regression (VAR) as in the following equation:

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$$X_t = \mu + \sum_{i=1}^p \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \varepsilon_t + \beta_t \dots \dots \dots (8)$$

Where;

X = the vector of endogenous variables

Γ_i = the matrix of short run coefficients

Π = the matrix of long-run coefficients

ε_t = the vector of independently and normally distributed errors.

K = number of lags, and should be adequately large enough both to capture the short-run dynamics of the underlying VAR and to produce normally distributed white noise residuals.

If the coefficient matrix Π has reduced rank $r < n$, then there exist $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta'X_t$ is stationary. r is the number of co-integrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a co-integrating vector. It can be shown that for a given r , the maximum likelihood estimator of β defines the combination of X_{t-1} that yields the r largest canonical correlations of ΔX_t with X_{t-1} after correcting for lagged differences and deterministic variables when present. Johansen proposed two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix. The procedure for testing co-integration is based on the error correction model (ECM) representation of X_t given by

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$$\Delta X_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \varepsilon_t + \beta_t \quad \dots\dots\dots (9)$$

Where;

- Δ = the difference operator
- X_t = (nx1) Vector of I (1) (i.e integrated of order one) Prices
- Γ_i = $-(I - \Pi_1 - \dots\dots\dots, K-1)$
- i = 1,2,....., K - 1
- Π = $-(I - \Pi_1 - \Pi_k)$ each of Π_i is an $(n \times n)$ matrix of parameters
- K = number of lags
- ε_t = an identically and independently distributed n -dimensional vector of residuals with zero mean and variance matrix
- β = Co-integrating vector (containing the long-run)
- μ = constant term
- t = Time trend.

Since $X_{t-k} \sim I(1)$, but ΔX_t and ΔX_{t-1} variables are $I(0)$ (i.e., integrated of order zero), Equation (9) will be balanced if ΔX_{t-k} is $I(0)$. So, it is the Π matrix that conveys information about the long-run relationship among the variables in X_t . The rank of Π , r , determines the number of co-integrating vectors, as it determines how many linear combinations of X_t are stationary. If $r = n$, the variables are stationary in levels. If $r = 0$, no linear combination of X_t is stationary.

If $0 < \text{rank}(\Pi) = r < n$, and there are $n \times r$ matrices α and β such that $\Pi = \alpha\beta'$ then it can be said that there are r co-integrating relations among the elements of X_t . The co-integrating vector β has the property that $\beta'X_t$ is stationary even though X_t itself is non-stationary. The matrix α measures the strength of the co-integrating vectors in the ECM, as it represents the speed of adjustment parameter

Empirical model:

For this study it was hypothesized that rural and urban market prices for local rice and white maize are jointly determined or endogenous, given an implicit representation of the model with two endogenous variables without exogenous variables as;

$$X_t = (\ln_RP_t, \ln_UP_t) \dots\dots\dots (10)$$

Where;

$$X_t$$

$$\ln_RP_t = \text{Natural log of rural market price}$$

$$\ln_UP_t = \text{Natural log of urban market price}$$

From equation (10) above, the long-run co-integrating equation can be specified explicitly for rural market price as;

$$\ln_RP_t = \omega_0 + \omega_1 \ln UP_t + Y_t \dots\dots\dots (11)$$

Where;

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ω_0 = the log of a proportionality coefficient, a constant term capturing the transportation and other forms of cost

ω_1 = Long run coefficient deprecating the relationship between rural and urban market prices

Y_t = Random error term

If $\omega_1=0$ then there is no relationship

If $0 < \omega_1 < 1$ there is a relationship but the relative price is not constant, meaning that the goods will be imperfect substitutes.

If $\omega_1=1$ there is relationship with constant relative price, meaning that the law of one Price holds and goods are perfect substitutes.

Equation (11), describes a case where prices adjust immediately. If however, a dynamic adjustment pattern is expected in prices, it will be accounted for by introduction of lags of the two prices, but even at that, the long-run relationship between prices will take the same form depicted in equation (11) above.

VECM model in this study was estimated as:

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$$\Delta RP_t = \psi_{10} + \sum_{i=1}^p \psi_{11i} \Delta RP_{t-i} + \sum_{i=1}^p \psi_{12i} \Delta UP_{t-i} - \rho (RP_{t-1} - UP_{t-1}) + Y_{1t} \quad (12)$$

$$\Delta UP_t = \psi_{20} + \sum_{i=1}^p \psi_{21i} \Delta RP_{t-i} + \sum_{i=1}^p \psi_{22i} \Delta UP_{t-i} - \rho (RP_{t-1} - UP_{t-1}) + Y_{2t} \quad (13)$$

Where;

Δ = the difference operator

RP and UP = rural and urban markets prices

Ψ_{11} and ψ_{12}	=	Short run coefficients
ρ	=	error correction instrument measuring the speed of adjustment from the short-run state of disequilibrium to the long-run steady-state equilibrium
Y_t	=	an error term assumed to be distributed as white noise
ψ_{10} and ψ_{20}	=	Constants.

Granger causality test:

The Granger causality test was used to determine the leading markets between urban and rural markets. Granger causality provides additional evidence as to whether, and in which direction, price integration and transmission is occurring between two price series or market levels. This is because one granger causal relationship must exist in a group of co-integrated series (Chirwa, 2000). When Granger causality run one way (uni-directional), the market which Granger-causes the other is tagged the exogenous market. Exogeneity can be weak or strong. Weak exogeneity occurs when the marginal distribution of $X_{i(t-1)}$ and $X_{j(t-1)}$ was-are significant, while strong exogeneity occurs when there is no significant Granger-causality from the other variable. It could also be bi-directional which indicates that both series influence each other (e.g. X causes Y and Y also causes X).

The Granger model used in this study was-is represented by:

$$RP_t = \alpha_0 + \sum_{i=1}^{m_1} \alpha_i UP_{t-i} + \sum_{j=1}^{m_2} \beta_j RP_{t-j} + \varepsilon_t \quad 14$$

Where;

- n = number of observation
- M = number of lag

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RP_t = Rural market price

UP_t = Urban market price

α and β = Parameters to be estimated.

H_0 : Price of local rice and white maize in one market does not determine (granger cause) the price in the other market

H_A : Price of local rice and white maize in one market does determine the price in the other market (not granger cause)

Wald test for market integration:

The type and degree of market integration was determined by the statistical significance of the estimated parameters based on the results of the set of hypothesis using the F-statistic of the Wald tests restrictions. The restrictions were tested on the OLS (Ordinary Least Square) estimation of the following equation:

$$X_t = \eta + \sum_{k=1}^k A_k X_{t-k} + \varepsilon_t$$

Where;

t = 1, 2,... refers to the months from January 2000 to December, 2010

X_t = $n \times 1$ vector of the logarithmic prices at time t ($X_t = X_{1t}, X_{2t}, \dots, X_{nt}$)

A_i = $n \times n$ matrices of parameters;

η = $n \times 1$ vector of intercept terms

ε_t = $n \times 1$ vector of error terms,

k = the lag length

ε_t = the vector of error term

(a) Long-Run Market Integration:

H_0 : Local rice or white maize market prices are integrated in the long-run.

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H_A : Local rice or white maize market prices are not integrated in the long-run.

(b) Short –Run Market Integration:

H_0 : A price change in a market is immediately transmitted to the other market.

H_A : A price change in a market is not immediately transmitted to the other market.

RESULTS AND DISCUSSION

Price Behaviourbehavior of Rice-rice and Maize-maize in the Study-study Areaarea

Average annual retail prices of local rice and white maize: The behavior of the average monthly retail price of local rice and white maize from 2000 to 2010 are presented in Tables 1 and 2. It could be seen that in Osogbo market, prices ranged from an average of about ₦ 40.2/kg in 2000 to a peak of ₦ 99 /kg in 2010. In Erin Ijesa market, prices ranged from ₦ 36.6/kg in 2000 to ₦ 94/kg in 2010 while retail prices of white maize in Telemu market ranged from ₦ 37/kg in 2000 to ₦ 95/kg in 2010. It was observed, that Erin Ijesa market had the lowest period average price ₦36.6 /kg) while Osogbo market had the highest ₦ 99/kg.

Table 1: Average Annual-annual Retail-retail Price-price of Local-local Rice-rice (2000 - 2010)

Year	Osogbo (Urban)	Erin Ijesa (Rural)	Telemu (Rural)
2000	48.4	47.2	49.5
2001	58.5	53.4	60.5
2002	62.6	58.9	63.5
2003	72.5	67.2	73.5
2004	85.8	82.5	88.0
2005	95.6	90.0	98.5
2006	115	110.9	117.3

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2007	125.4	120	126.5
2008	137.0	132.8	136.2
2009	145.4	139	143.2
2010	160	146.5	162.0
Average	100.5	95.3	101.7
Overall average	99.1		

Source: Computed, employing Price data series from OSSADEP [\(date\)](#)

Table 2: Average ~~Annual-annual~~ ~~Retail-retail~~ Price-price of ~~White-white~~ Maize-maize (2000 - 2010)

Year	Osogbo	Erin Ijesa	Telemu
2000	40.2	36.6	37.0
2001	45.2	42.8	42.5
2002	53.5	49.8	48.5
2003	56.4	54.3	55.2
2004	64.1	62.1	62.9
2005	72.7	69.2	68.3
2006	79.5	73.4	74.0
2007	86.2	82.0	81.5
2008	92.3	88.0	85.2
2009	95.6	90.0	90.5
2010	99.0	94.0	95.0
Average	71.3	67.4	67.3
Overall Average	68.7		

Source: Computed employing Price data series from OSSADEP [\(date\)](#)

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The average annual retail price of white maize in urban area was higher than the price in rural area, while in the case of local rice, the price is higher at Telemu market, a consumers' market in the rural area than Erin Ijesa a producers' market in the rural area. The difference in mean is expected and in this case statistically significant ($p < 0.01$). Among other things, they could represent the extra cost, including transportation and transactions, incurred by the marketing agents, as well as marketing margins. It has been argued that given the high cost of transactions and the risk to invested capital, the margins of the marketing agents could be considered reasonable. These findings collaborate with the findings of Ojiako *et al.* (2012), in their analysis of the spatial integration of cassava product market price in Nigeria, where it was reported that the mean price value of *Lafun* in the urban market was higher than prices in the rural markets.

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Variability in Average-average Retail-retail Prices-prices of Local-local Rice-rice and White white Maizemaize

The rural markets had a higher coefficient of variation than the urban market. This indicates that the retail price for white maize in the urban market was more stable than what obtained in the rural markets (producer areas). This is because most marketers preferred to sell their produce in the urban area and this could eventually lead to scarcity in the rural area and high price of produce in the rural area.

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Table 3: Variability in Average-average Annual-annual Retail-retail Prices-prices of Local-local Rice-rice (2000 - 2010)

Markets	Average Price (₦ /kg)	Coefficient of Variation (%)
Osogbo	100.5	38.2
Erin	95.3	36.0
Telemu	101.7	40.3

Source: Rice price series from January, 2000 to December, 2010 collected from OSSADEP (date)

Variability in average monthly retail price of white maize is shown in Table 4. Monthly prices were also observed to be low during the period covered by the study. Prices varied between from 27.9 % for in Osogbo (a consuming urban area), 28.1 % for in Erin Ijesa (producing rural area) to 28 %, for in Telemu (a producing rural area). There wasn't much variability in average monthly retail price of white maize for the period covered by the study. Prices varied between from 27.9 % for in Osogbo (a consuming urban area), 28.1 % for in Erin Ijesa (producing rural area) to 28.0 % for in Telemu (a producing rural area).

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Table 4: Variability in Average-average Annual-annual Retail-retail Prices-prices of White white Maize-maize (2000 - 2010)

Markets	Average Price (₦ /kg)	Coefficient of Variation (%)
Osogbo	71.3	27.9
Erin	67.4	28.1
Telemu	67.3	28.0

Source: Maize price series from January, 2000 to December, 2010 collected from OSSADEP

Price Correlation-correlation Coco-efficient for Rice-rice and Maize-maize in Osun State:

Pearson price correlation analysis was used to determine the behaviour of market price between local rice and white maize in rural and urban markets of the study area as presented in Table 5. The results (Table 5) were calculated as 0.90 between Erin and Osogbo, 0.85 between Osogbo and Telemu, while it was and 0.35 between Erin and Telemu. Results were significant at 1% level of significance except for 0.35 which was significant only at 5% level. The results of the analysis of the correlation between market prices of local rice in urban and rural area, is shown in

Table 5. The results showed a correlation coefficient of 0.86 between Erin Ijesa and Osogbo market prices, 0.90 between Osogbo and Telemu, and 0.087 between Erin and Telemu. The coefficients were significant at 1% level.

Table 5: Pearson Correlation between Retail Prices of Local Rice in the Selected Markets

	Osogbo	Erin Ijesa	Telemu
Osogbo	1.00	0.86	0.90
Erin Ijesa	0.86	1.00	0.87
Telemu	0.90	0.87	1.00

Source: Rice price series from January, 2000 to December, 2010 collected from OSSADEP

Table 6: Pearson Correlation Between Retail Prices of White maize in Selected Markets

	Osogbo	Erin Ijesa	Telemu
Osogbo	1	0.92	0.85
Erin	0.92	1	0.35
Telemu	0.85	0.35	1

Source: Maize price series from January, 2000 to December, 2010 collected from OSSADEP (date)

The high and significant correlation of the price series calculated as 0.90 and 0.86 is an indication of co-movement in the prices. The positive correlation showed that the an increase in the retail price in one market would follow the price increase in other markets. This could be possible due to the transmission of market information by marketers via the use of mobile phones coupled with the short distance between markets. This corroborates the findings of Oladapo and Momoh (2007), which noted high correlation coefficients of pineapple prices in Edo, Oyo and Lagos States' rural and urban markets.

JOHANSEN MULTIVARIATE CO-INTEGRATION TEST RESULT

Comment [DJA25]: Only the use of mobile phones and short distances could cause this in a market environment?

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Testing for Stationarity

Stationarity test for rice and maize in Osun state: As presented in Table 7, the ADF test statistics calculated at price levels for the local rice price series were -1.8208, -1.8845 and -1.8134 for Osogbo, Erin Ijesa and Telemu respectively. The results indicates that all the variables were not stationary at their level. The null hypothesis of non-stationarity could not be accepted at the probability of 5 % level of significance. Therefore, the null hypothesis of non-stationary was accepted for all the variables at their levels. The values in first differences were -7.6644, -6.2239 and -8.390 in Osogbo, Erin Ijesa and Telemu respectively. When first-differenced, however, the null hypothesis of non-stationarity was rejected in favour of the alternative as the values of the ADF t-statistics were greater in absolute term than the critical value. This result is necessary and sufficient for a test of co-integration of the price series.

Comment [DJA26]: Explain to make meaning.

Table 7: Unit Root Test on Rice Price Series

Market	Price Levels I(0)	First differences I(1)
Osogbo	-1.850	-7.664
Erin Ijesa	-1.813	-6.223
Telemu	-1.884	-8.390
ADF Test Critical values at 5%	-3.893	-3.460
ADF Test Critical Values at 1%	-3.63964	-3.63964

Source: Rice price series from January, 2000 to December, 2010 collected from OSSADEP

As presented in Table 8 below, ADF test statistics calculated at the price level for the rural markets were -1.42 for Erin and -1.36 for Telemu, while it was -1.72973 at Osogbo (an urban market). In the first difference, the statistics were calculated as -5.33634 and -5.923 for rural and

-6.760 for the urban markets. When compared with the ADF test critical value, the result showed that all the series were non-stationary and integrated of order one, that is, they were also I(1) series.

Table 8: Unit Root Test on Maize-maize Price-price Series

Market	Test as Level I(0)	Test at First differences I(1)
Osogbo	-1.7295473	-6.760
Telemu(Rural)	-1.42244	-5.33634
Erin Ijesa(Rural)	-1.36737	-5.92893
ADF Test Critical values at 5%	-3.893	-3.460
ADF Test Critical Values at 1%	-4.061	-4.062

Source: Maize price series from January, 2000 to December, 2010 collected from OSSADEP (date)

The results of stationarity test for the local rice and white maize, using Augmented Dickey-Fuller (ADF) unit roots tests indicated that all the variables were not stationary at their levels. The calculated ADF statistic was less than the critical ADF values at both 5% and 1% levels of significance. Therefore, the null hypothesis of non-stationary was accepted for all the variables at their levels. When first-differenced, however, the null hypothesis of non-stationarity was rejected in favour of the alternative as the calculated ADF values became higher than the critical values at both 5% and 1% levels. The findings here corroborate earlier findings that food commodity price series are mostly stationary of order 1 i.e. I(1) (Chirwa, 2000; Okoh and Egbon, 2005; Oladapo and Momoh, 2007 and Mafimisebi, 2008). The result was explained by the fact

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that most food price series had trends in them because of inflation and therefore exhibited ~~mean~~ non-stationarity.

Selection of ~~Lag-lag Lengthlength~~

Akaike ~~(date)~~ Information Criterion (AIC) test suggested that the value $K = 1$ is the appropriate specification for the order of VAR model. The use of one lag on the model of the economy means implies that all variables in the model influenced each other not only in the ~~present period~~, but these variables were also interrelated in ~~a previous period~~. These results are in line with the findings of Desi and Yulius ~~(2012)~~ ~~which -who opined~~ showed that the use of lag 1 is suitable in the co-integration procedure.

Comment [DJA27]: Which period are referring to?

Comment [DJA28]: Which period are referring to?

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Testing for ~~Coco-Integration-integration~~ between ~~Urban-urban~~ and ~~Rural-rural~~ Market ~~Priceprice~~

Both Trace and Maximum Eigen value statistics indicate the existence of co-integrating relationship at 5% significant level for both products. The result of the Johansen's Maximum Likelihood co-integration test is shown in Table 9. The result, based on the both the trace test and maximum Eigen value test, showed the existence of two co-integrating vectors and the rejection of the null hypothesis of $r = 0$. Comparing the trace and Eigen statistic with the corresponding critical values, it can be seen that the null hypothesis of no co-integrating relationship can be rejected at the 5% significance level for the local rice market prices.

Market integration lends itself to co-integration interpretation with its presence being evaluated by means of co-integration tests (Rapsomaniks *et al.*, ~~2005~~). Thus, the result indicates that the grain markets in Osun State during the study period were co-integrated, and there ~~exists-existed~~ long-run equilibrium. This finding is supported by the earlier studies carried out by Oladapo *et al.* (2007), who concluded that grain market prices within Oyo State are highly co-integrated

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and the findings of Ojiako *et al.* (2012), that long-run equilibrium existed within the spatial integration of cassava products market in Nigeria.

Table 9: Testing for Number-number of Cocco-Integration-integration Relations relations (Rice)

H ₀ :	H _A :		5%	Prob**	Hypothesized
λ Trace tests		λ Trace value	Critical value		No. of CE(s)
$r = 0$	$r > 0$	70.2696827	29.7970780	0.0000	None*
$r \leq 1$	$r > 1$	35.3672137	15.4947150	0.0000	At most 1*
$r \leq 2$	$r > 2$	2.073284	3.841466	0.149915	At most 2
λ Max- λ max tests		λ Max-max value			
$r = 0$	$r = 1$	34.90247	29.7970780	0.0000	None*
$r = 1$	$r = 2$	33.29393	15.4947150	0.0000	At most 1*
$r = 2$	$r = 3$	2.073284	3.841466	0.149915	At most 2

Source: Price series from January, 2000 to December, 2010; collected from OSSADEP (date)

Table 10: Testing for Number-number of Cocco-Integration-integration Relations relations (Maize)

H ₀ :	H _A :		5%	Prob**	Hypothesized
λ Trace tests		λ Trace value	Critical value		No. of CE(s)
$r = 0$	$r > 0$	52.5868259	29.7970780	0.0000	None*
$r \leq 1$	$r > 1$	20.2945530	15.4947150	0.00187	At most 1*
$r \leq 2$	$r > 2$	4.801782	3.841466	0.028403	At most 2
λ Max- λ max tests		λ Max-max value			
$r = 0$	$r = 1$	32.29228	29.7970780	0.0000	None*
$r = 1$	$r = 2$	15.49276	15.19276	0.008701	At most 1*
$r = 2$	$r = 3$	4.801782	3.841466	0.028403	At most 2

Source: Price series from January, 2000 to December, 2010; collected from OSSADEP (date)

The result of the Johansen's Maximum Likelihood Co-Integration test is presented in Table 11.

Comparing the trace and Eigen statistics with the corresponding critical values, it can be seen that the null hypothesis of no co-integrating relationship can be rejected at the 5% significance level for the local rice market prices. The results from the trace and Eigen test indicate that there

are co-integrating vectors. This implies that there exists a long-run relationship between the variables.

Testing for ~~Short-short-Run-run~~ Market-market Integration-integration with a Vector Error Correction Model

The result of the Vector Error Correction Model shows that if there is a positive deviation for the long-run equilibrium, the market tends to respond with a decrease in the rural price or an increase in the urban price. The urban price appears to respond faster than the rural price. The adjustment coefficient is statically significant at 1% for urban market price for both local rice and white maize suggesting that the rural price is weakly exogenous, This implies that movement in the rural price was less affected by price in the urban market while movement in the urban price was dictated by events in the rural markets. This means that the long-run equilibrium in the local rice and white maize market, after an exogenous shock, is restored primarily by corrections made by the urban market prices

Table 11: Estimation of the ~~Dynamics-dynamics~~ in the ~~Short-short~~-run by using VECM for ~~Rice-rice~~ and ~~Maize-maize~~

Error correction	Δ OSO	Δ ERIN	Δ TEL
Rice			
CointEq1	0.03786504 (0.1783118) [-2.12358]	-0.18095 (0.18061) [1.76120]	0.05638206 (0.1798018) [0.31359]
Maize			
CointEq1	0.04076 (0.21434) [-1.90192]	-0.13267 (0.19421) [-1.68241]	-0.15130 (0.20017) [1.75507-76]

Source: Price series from January, 2000 to December, 2010; collected from OSSADEP ([date](#))

Note: All figures in brackets (...) are standard errors and all figures in parenthesis [...] are t-values.

Granger ~~Causality-causality~~ Testtest

The result of the Granger causality analysis (Table 12) ~~indicates~~ indicated that, Osogbo (urban) local rice market price did not determine the Erin Ijesa (rural) market price. Although, Erin Ijesa market price determined the urban market price, while Osogbo local rice market price determined Telemu market price. This result is consistent with the findings of Ojiako *et al.*

(2012), in the study of spatial integration and price transmission in selected cassava products' markets in Nigeria, that Granger causality runs from rural to the urban markets and not the other way round.

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TABLE 12: Pair-wise Granger Causality Test for Local Rice Market

Null hypothesis	F – statistics	Probability Value
MERIN does not Granger Cause MOSO	6.31 ~~32~~	0.00 ~~24~~ ***
MOSO does not Granger Cause MERIN	0. ~~36~~ ~~98~~ ~~37~~	0. ~~66~~ ~~80~~ ~~67~~
MTEL does not Granger Cause MOSO	0. ~~32~~ ~~65~~ ~~33~~	0. ~~76~~ ~~72~~ ~~77~~
MOSO does not Granger Cause MTEL	10.19 ~~18~~	0.00 ~~30~~ ***
MTEL does not Granger Cause MERIN	0. ~~57~~ ~~57~~ ~~58~~	0.78 ~~28~~
MERIN does not granger cause MTEL	6. ~~13~~ ~~96~~ ~~14~~	0.00 ~~10~~ ***

Source: Rice price series from January, 2000 to December, 2010; collected from OSSADEP (date)

Comment [DJA30]: Indicate the meaning under the table.

The result of Granger causality test for white maize at 5% significant level is shown in Table 13. From the result of the analysis, Osogbo white maize market price did not determine Erin Ijesa and Telemu market price. Although, Erin Ijesa and Telemu market prices determined the Osogbo market price.

Table 13: Pair-wise Granger Causality Test for ~~White-white Maize-maize Market-market Priceprice~~

Null Hypothesis	<u>?</u>	<u>?</u>
ERIN does not Granger Cause ROSO	4. ~~26~~ ~~63~~ ~~92~~ ~~7~~	0. ~~01~~ ~~61~~ ~~02~~

Comment [DJA31]: No title

ROSO does not Granger Cause RERIN	0.18355	0.216922
RTELE does not Granger Cause ROSO	5.83220	0.0038
ROSO does not Granger Cause RTELE	0.0405	0.0206
RTELE does not Granger Cause RERIN	0.1748818	2.117912
RERIN does not granger cause RTELE	0.219422	0.536254

Source: Maize price series from January, 2000 to December, 2010; collected from OSSADEP (date)

Wald Test for ~~Market-market~~ Integrationintegration

The Wald test restriction of the F-statistic was applied to determine market integration in the local rice and white maize markets (Tables 14 and 15). The F statistical values of 0.02 and 0.19 with probability values of 0.86502 and 0.7521, respectively, for local rice whereas it was 0.25 and 0.57 F statistic value with probability values of 0.9573 and 0.6210 for white maize show that they are not significant even at 1%.

The long-run and short-run null hypotheses that local rice and white maize market prices are integrated and a price change in a market is immediately transmitted to other markets, respectively, therefore cannot be rejected. The results mean that there existed both long-run and short-run market integrations between Osogbo and the other selected markets. Thus, changes in food grain price in rural markets would cause food grain price in urban markets to adjust immediately.

Table 14: Wald Test for ~~Local-local Rice-rice~~ Marketmarket

Null hypothesis	F-statistics	p- value
Long-run market integration	0.20	0.8502
Short-run market integration	0.19	0.7521

Comment [DJA32]: Change all to tally with the values in the table

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Table 15: Wald Test for white Maize Market

Null hypothesis	F-statistics	~~P~~ -p-value
Long-run market integration	0.25	0.957396
Short-run market integration	0.57	0.6240

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CONCLUSION AND RECOMMENDATIONS

Conclusion

This study is an evaluation of market integration and price variation in marketing of local rice and white maize in Osun State, Nigeria. The trend analysis showed that the prices of food grain in the markets studied, moved in an upward trend every year. This is due to the fact that prices were higher in one year compared to another years. Results of Pearson correlation coefficient indicated that the rural and urban market price series for both product types were positively and significantly correlated. The stationary test indicated that the prices were not stationary at level form. The results from of the maximum likelihood test showed that there were co-integrating vectors, which suggested that rice and maize markets were co-integrated and had short-run and long-run relationships. The result of the Granger causality test confirmed rural grain markets occupying the leadership position in price formation and transmission.

Recommendations

Based on the results of the study, the following are recommended:

- There is the need for efficient transmission of price information among the operators in the urban and rural markets through the establishment of market information centers to facilitate adequate communication and flow of information between markets.
- Accurate and timely information on food grain conditions will enable quicker response to market shocks, and market channel members could then be empowered to efficiently and effectively distribute food grain from surplus to deficit markets
- Nigerian government should intensify price policy measures that will enhance increased agricultural output.
- Rural areas which have been shown in this study to be the market leaders should be the target of government developmental reforms. Incomes of rural people can be greatly enhanced with such incentives by government to intensify their production and marketing of grains which will create greater opportunities for economic growth and development and eventually leads to market efficiency, increase technical and allocative efficiency of grain producers.

Comment [DJA34]: Not coming from your findings

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