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ANALYSIS OF MARKET INTEGRATION OF MAIZE IN RURAL AND URBAN MARKETS OF OYO STATE, NIGERIA

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Abstract

The study analyzed market integration of maize in the rural and urban markets of Oyo State, Nigeria. The specific objectives were to: determine the market integration of maize price series, ascertain the market that causes integration and identify the direction of causality in the rural and urban markets of Oyo State, Nigeria. Average monthly price series of maize spanning from January 2008 to December 2018 were collected and analyzed using Augmented Dicky Fuller test to test for stationarity, Johansen co-integration test to test for co-integration, Index of Market Concentration (IMC) to determine market integration as well as the Granger causality test to find out the market that causes integration. The result of ADF test showed that the price series were non-stationary at levels but became stationary after first differencing and the co-integration test revealed the presence of co-integration between the rural and urban market price of maize. The Index of Market Concentration was less than one ($p \leq 0.05$) which implies the existence of short-run market integration between rural and urban markets in the study area. Also, the result of Granger causality shows both uni-directional and bi-directional causalities between rural and urban markets in the study area. The study concludes that there were both short and long run market integration between rural and urban markets with uni-directional and bi-directional causalities between the stated markets in the study area and therefore recommended that, government should establish market information centres and awareness programmes on mass media to facilitate efficient information flow among maize producers and consumers in the state.

Keywords: Integration, Market, Maize, Oyo, Price, Stationarity.

Introduction

In a developing economy like Nigeria, the dynamics of the exchange of information and its effect on the pricing processes are not well understood. The cropping pattern is no longer dictated by what the producers need for personal consumption but what is responsive to the market in terms of prices received by the farmers (Sadiq *et al*., 2017). According to Abdulhameed and Onuk (2016), market integration is the co-movement of prices and the smooth transmission of price signals and information across spatially separated markets. Several researchers have dealt on food crop price transmission and market integration issues in Nigeria. In separated markets, when there is significant price difference between homogenous goods, such that the differences exceeded the transfer cost; the arbitrage activities will be activated. The arbitrageur

purchases commodities from lower-price markets and resell in higher-price markets. This is a situation where spatial markets are not integrated but on the other hand, two markets are integrated when there is a significant long-run relationship between prices of homogenous goods due to the smooth transmission of price signals and information across the two markets (Ani *et al*., 2017). Market integration could be perfect if price changes in one market are fully and instantaneously reflected in the alternative markets.

Hence, understanding the direction and magnitude of the price transmission of maize between the rural and urban markets in Oyo State will provide indispensable input to policy makers to formulate workable policies for the agricultural sector in the state. It will also, promote the achievement of the food self-sufficiency goal and help in minimization of the poverty menace among the citizens in the state and the nation at large. Therefore, such information can help government at all tiers to decide the extent to which price transmission can be considered as efficient across different geo-political zones in their domains (Ani *et al*., 2017).

Maize (*Zea mays*) is one of the major staple foods, whose prices are highly unstable between seasons in the Western part of Nigeria. Consumers pay different amounts for the same product in different markets separated by few kilometres. According to Ani *et al*., 2017, price instability of agricultural commodity would be considered a normal phenomenon if it does not significantly differ from one market to another. On the contrary, if products prices are significantly different among markets it will distort resources flow, which might have adverse effect on the food security goal of the federal government.

In recent years, research works on agricultural price transmission, such as Ani *et al*., (2017), Sadiq *et. al.*, (2017), Ibrahim *et al*., (2016), Marco and Chuma, (2015), Ojo *et al*., (2015), Akpan *et. al*., (2014) among others has gathered considerable attention. Interest in this topic unquestionably increased after the so-called food crisis of 2007-2008 in which international agricultural markets were shocked by increased volatility, which is a rapid rise and fall of the "price bubbles" as well as a possible change in the long-term downward trend of agricultural prices. The boom and subsequent decrease in food prices that took place around 2008 raised numerous questions about the impact of such variations on populations' welfare and on the economic sector which directly concerns the agricultural sector (Mkpado *et al*., 2018). Therefore, if governments are to take adequate measures to ensure food security, they need to have good knowledge of the functioning of their markets. This means that among other things, it is important to know the state of price transmission along the marketing chain within the country and between international and domestic markets (Sadiq *et al*., 2017). Based on the above, this study provides answers to the following research questions: What is the level of price relationship between integrated markets in the study area? Which market causes the movement of prices, and in what direction?

Objectives of the Study:
The aim of this study is to analyze the market integration of maize in the rural and urban markets of Oyo State, Nigeria. The specific objectives are:

1. To determine the market integration of maize price series in the rural and urban markets of Oyo State
2. To find out the market that causes integration and determine the direction of causality in the study area.

Empirical Review:

Several studies about price transmission and market integration have been conducted by various researchers in Nigeria. Some of the major studies include: Bako *et al*., (2021) who conducted a study on price dynamics of local and imported rice in Lagos State Nigeria, using unit root test, Granger causality test and index of market concentration (IMC); revealed that all the price series became stationary after 1st differencing with an order of integration of I(1), implying that the prices of both local and imported rice in rural and urban markets were trending upwards in an irregular pattern. Mpkado *et al*., (2018) studied price transmission and market integration of rural and urban rice market in Nigeria. Primary and secondary data were collected and analyzed using co-integration analysis, market integration function and descriptive statistics. The result showed that price series were integrated but the level of integration was low. Ohwo and Adeyemi (2018) conducted their study on price transmission and market integration of sawn wood in Delta State Nigeria and the results revealed that prices of sawn wood were not integrated. Ani *et al*., (2017) studied market integration of retail prices of soyabeans in Benue and Enugu States. The results indicated that retail prices of soyabean in Benue State did not granger cause the retail prices in Enugu State. Marwa *et al*., (2017) investigated market integration of agricultural products at both producer and consumer levels and showed that prices of agricultural products were integrated at both levels with bi-directional causalities between producer and consumer prices. Oladapo and Momoh analyzed food price differences and market integration in Oyo State and revealed that prices of food in Oyo State were not stationary at their various levels but became stationary at first difference with the existence of co-integration among the price series in the study area.

Methodology

The Study Area:
The study was conducted in Oyo State, Nigeria. It is in the South-Western part of Nigeria and lies between latitude 7^0 and 9.3^0N and longitude 2^0 and 4^0E. The state is made up of 33 Local Government Areas with a total population of 5,591,585 which was projected to be about 7,594,071 in 2020 at 2.5% growth rate according to the National Bureau of Statistics (NBS), (2016). The Oyo State rural markets are representing different communities and villages in the rural areas, while the urban markets are representing different towns and cities in the urban areas. The major ethnic group mainly comprises of the *Oyos*, the *Oke-Oguns*, the *Ibadans* and the *Ibarapas*, all belonging to the Yoruba family. Both annual and perennial crops are grown in the region, and this includes but not limited to maize, cassava, yam, oranges, cocoa, tobacco, cashew, and sugar cane.

Methods of Data Collection and Analytical Techniques:
Secondary data such as average monthly prices of maize spanning from January 2008 to December 2018 were used for this study. The data was collected from the National Bureau of Statistics and the Oyo State Agricultural Development Programme. The study applied series of statistical and econometric techniques to analyze the relationship between rural and urban market price of maize in Oyo State, Nigeria. The tests include Augmented Dickey Fuller (ADF) test, Johansen Co-integration test, Index of Market Concentration (IMC) as well as Granger causality test.

Augmented Dickey Fuller (ADF) Unit Root Test: As first step in the analysis involving time-series data, the investigation of the presence of unit root in the data is very important because it helps to ensure that the variables used for the analysis do not result in spurious regression. The ADF unit root test was carried out

on the data to test for the stationarity of each time series data set. The test also enables the determination of the order of integration of the series, which is the number of times a series must be differenced for it to become stationary. The ADF unit root test is represented in equations 1 and 2.

$$\Delta P_{Bt} = \beta_0 + \beta_t P_{Bt-i} + \sum C_j \Delta P_{Bt-I} + \varepsilon_i \quad 1$$

$$\Delta P_{At} = \gamma_0 + \gamma_t P_{At-i} + \sum d_j \Delta P_{At-I} + \varepsilon_i \quad 2$$

Where Δ = first difference operator and ε_t= stochastic error term that follows the classical assumptions. The decision rule is that, if the value of the ADF statistic is less than the critical value at a specified significance level then the series (P_t) is said to be non-stationary and vice versa.

Index of Market Concentration (IMC): The index of market concentration presented in equation 3 was used to measure the price relationship between integrated markets.

$$P_t = \beta_0 \beta_1 P_{t-1} + \beta_2 (R_t - R_{t-1}) + \beta_3 R_{t-1} + \varepsilon_t \quad 3$$

Where: R_t = urban, P_t= rural price, R_{t-1} = lagged price for urban markets, R_t-R_{t-1} = difference between urban price and its lag, $\in_t$ = error term or unexplained term, β_0= constant price, β_1 = coefficient of rural lagged price, β_2 = coefficient of $R_t - R_{t-1}$ and β_3 = coefficient of urban lagged price.

$$IMC = \beta 1/\beta 3 \quad 4$$

Where $0 \leq IMC \leq \infty$

IMC < 1 implies high short-run market integration, IMC > 1 implies low short-run market integration, IMC = ∞implies no market integration, and IMC = 1 implies high or short-run market integration (Patrick *et al*., 2016).

Johansen Co-integration Test: The next logical step was to test for co-integration using Johansen co-integration techniques (Trace and Eigen-value Test). It was used to test the hypothesis:

H_0: The time series variables are not co integrated (r=0)

As stated in equation 5, if two series are individually stationary at same order, the theories of Johansen and Juselius (1990) and Juselius (2006) can be used to estimate the long run co-integrating vector from a Vector Autoregression (VAR) model of the form:

$$\Delta_{pt} = \propto + \sum_{i=1}^{k-1} \tau_i \Delta P_{t-1} + \pi P_{t-1} + \mu_t \quad 5$$

Where: P_t is a (n x 1) vector containing the price series at time (t), Δ is the first difference operator. Γ_I and Π are (m x n) matrix of parameters on the i^{th} and k^{th} lag of p_t,$\tau_i = (\sum_{i=1}^{k} A)$-$I_g$, $\pi_i = (\sum_{i=1}^{k} Ai)$- I_g, I_g is the identity matrix of dimension g, α is constant term, μ_t is (n x 1) white noise vector. Throughout, p is restricted to be (at most) integrated of order one, denoted by 1(1), where 1(j) variable requires j^{th} differencing to make it stationary.

Granger Causality Test: If a pair of series is co-integrated, then there must be Granger-causalities in at least one direction, which reflects the direction of influence between series (in this case, price) (Ojo *et al*., 2015). Theoretically, if the current or lagged terms of a time-series variable, as in equation 6, determine another

time-series variable, as in equation 7 then there exists a Granger-causality relationship between equations 6 and 7 in which equation 7 is Granger caused by equation 6:

$$\Delta P_{Bt} = \theta_{11}\Delta P_{Bt-1} + ... + \theta_{In}\Delta P_{Bt-n} + \theta_{21}\Delta P_{At-1} + \theta_{2n}\Delta P_{At-n} - \gamma_1(P_{Bt-1} - \alpha P_{At-1} - \delta) + \varepsilon_{1t} \quad 6$$

$$\Delta P_{Bt} = \theta_{31}\Delta P_{Bt-1} + ... + \theta_{3n}\Delta P_{Bt-n} + \theta_{41}\Delta P_{At-1} + \theta_{4n}\Delta P_{At-n} - \gamma_2(P_{Bt-1} - \alpha P_{At-1} - \delta) + \varepsilon_{2t} \quad 7$$

The following two assumptions, as in (Equations 8 and 9) must be tested using the above two models as stated in (equations 6 and 7) to determine the Granger causality relationship between prices.

$\theta_{21} = \Delta = \theta_{2n} = \Delta = \gamma_1 = 0$ (No causality from P_{Bt} to P_{At}) 8

$\theta_{41} = \Delta = \theta_{4n} = \Delta = \gamma_2 = 0$ (No causality from P_{Bt} to P_{At}) 9

The causality test procedures offer a framework for the assessment of which market (rural or urban) cause the integration and in which direction is the movement (Ojo *et al.*, 2015).

Results and Discussion

Summary Statistics of Variables used for Analysis:

The descriptive statistics of the price series used in the empirical models for investigation in this study are presented in Table 1. The results showed that the average price of dry maize was ₦68.43/kg and ₦105.00/kg in the rural and urban markets respectively while the minimum and maximum values were ₦64.59/kg and ₦175.00/kg and ₦50.96/kg and ₦90.92/kg for rural and urban prices respectively. The findings also revealed that, there was a significant deviation between the rural and urban price of maize in the study area as indicated by the standard deviation of ₦31.46/kg and ₦14.42/kg for rural and urban markets respectively. In addition, the coefficient of variation in price of maize in the rural and urban markets was 98.90% and 20.70% respectively, which showed that, the rural price of maize exhibited higher variations compared to the urban price.

Time Series Properties of Maize Price Series in Oyo State:

As first step in the analysis involving the use of time series data, the stationarity of the variables is required. The properties of the time series data were tested using Augmented Dickey Fuller (ADF) test to determine the stationarity of the price series under consideration as presented in Table 2. The ADF test shows that the maize market price series were non-stationary at levels but became stationary after first differencing with order of integration 1, That is, I (1). The results as presented shows that only the market price series of *Aarada* was significant at the 0.05 probability level ($P < 0.05$), while other markets price series namely *Bodija, Sabo, Omi – Adio, Iluju* and *Ilora* were all significant at the 0.01 probability level ($P < 0.01$). This implies that the market price series for the analysis were all stationary at first difference, leading to the acceptance of the null hypothesis of non-stationarity of the market price series at levels in the study area. This finding supports the findings of Oladapo and Momoh (2017) that examined food price differences

and market integration in Oyo State, Nigeria and reported non stationarity of food price series at their respective levels, but only became stationary at first difference.

Johansen Co-integration Test for Maize Markets in Oyo State:
The results of Johansen co-integration test for maize markets in Oyo State presented in Table 3 shows a trace statistic of 320.54 which is greater than the critical value of 94.15 at 5% level of significance ($P < 0.05$) and a max statistic of 134.31, which is also greater than the critical value of 39.37 at 5% level of significance. The result shows that there was at least one co-integration equation among the market price series. Therefore, based on the decision rule, the null hypothesis of no co-integration among the maize market series was rejected. This implies that there is a long run relationship among the maize market price series in the study area and the variables in the model are co-integrated. Ojo *et al*., (2015) also reported the existence of co-integration at 5% significant level for rice market price series in Niger State thereby implying the presence of long run relationship among the variables.

Index of Market Concentration (IMC) for Maize Markets in Oyo State:
To determine the market integration between rural and urban maize markets in Oyo State, the Index of Market Concentration (IMC) was used, and the results obtained are presented in Tables 4. The result of Index of Market Concentration (IMC) shows the IMC values of 0.8300 for maize in the study area. This result is less than unity ($IMC < 1$) and statistically significant at 5% level of significance, which implies the existence of high short-run market integration between rural and urban markets for maize in Oyo State and thereby indicated the presence of perfect price transmission mechanism in the short-run between rural and urban markets of maize in Oyo State, Nigeria. This is a strong indication that price changes in the rural markets of maize do cause immediate change in the prices of maize in the urban markets. This result is in concordance with the assertion of Akpan *et al*., (2014) in their study on monthly price analysis of cassava derivatives in rural and urban markets of Akwa-Ibom State reported that there was high short-run market integration between rural and urban prices of cassava products in the study area.

Granger causality test on maize markets in Oyo State:
The results of granger causality tests for maize price series as presented in Table 5 shows that the F-statistics for the listed market pairs in Oyo State were statistically significant at 1% level of significance and as such, the null hypotheses of no granger causality between the stated markets pairs was rejected. The results also show that, there were uni-directional causalities between the market pairs of *Bodija–Aarada* and *Bodija–lora*, while the market pairs of *Bodija–Iluju, Aarada–Iluju, Aarada–Ilora* and *Iluju-Ilora* shows a bi-directional causality. The implication of the uni-directional causalities between two markets is that, a change in price in the former market in each pair granger causes the price formation in the latter market, whereas the price change in the latter market is not fed back by the price change in the former market in each pair, while the bi-directional causalities implies that the former market in each pair granger caused the price formation in the latter market which in turn provides the feedback to the former market as well. This result further substantiates the strong co-movement of the price of maize in the rural and urban markets and strong evidence of market integration in Oyo State. Ohwo and Adeyemi (2018) investigated price transmission and market integration of sawn wood in Delta State, Nigeria and reported bi-directional causalities between the rural and urban markets within State.

Conclusion and Recommendations

The study analyzed the dynamics of market integration of maize in the rural and urban markets of Oyo State, Nigeria and concludes that there were both short and long run market integration between rural and urban markets with uni-directional and bi-directional causalities between the stated markets in the study area. Based on the research findings, the study therefore, recommended that government should establish market information centers and awareness programmes on mass media to facilitate efficient information flow among maize producers and consumers in Oyo State.

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Table 1: Descriptive statistics of maize price series used in the study.

	Maize Price Series (₦/Kg)	
Parameters	**Rural Market**	**Urban Market**
Mean	68.429	105.002
Minimum	64.590	50.960
Maximum	175.000	90.920
Standard Deviation	31.459	14.422
Coefficient of Variation	0.989	0.207
Skewness	0.907	0.492
Kurtosis	3.595	1.943

Source: Data Analysis, 2020.

Table 2: Results of augmented Dickey Fuller (ADF) unit root test

Market price series	**Level**	**1st Difference**	**Order of Integration**
Bodija	-2.661	-4.486***	I (1)
	(0.081)	(0.005)	
Aarada	-2.646	-3.360**	I (1)
	(0.040)	(0.034)	
Sabo	-2.761	-4.636***	I (1)
	(0.064)	(0.005)	
Omi-Adio	-2.509	-5.622***	I (1)
	(0.113)	(0.000)	
Iluju	2.411	-4.142***	I (1)
	(0.138)	(0.000)	
Ilora	-2.308	-4.929***	I (1)
	(0.169)	(0.000)	

Source: Data Analysis, 2020.

Note: ***and** implies 1% and 5% level of significance respectively.
Figures in parentheses are probability values.

Table 3: Johansen co-integration rank test for maize market

Hypothesized No. of CE(s)	Trace Statistics	Critical Value (5%)	Max Statistics	Critical Value (5%)
r = 0*	320.54	94.15	134.31	39.37
r = 1	186.24	68.52	91.11	33.46
r = 2	95.13	47.21	32.94	27.07
r = 3	62.19	29.68	31.13	20.97
r = 4	30.06	15.41	22.29	14.07
r = 5	7.76	3.76	7.76	3.76

Source: Data Analysis, 2020

Denotes rejection of null hypothesis at 5% significant level.

Table 4: Results of index of market concentration (IMC) for maize

Markets	β_1	β_2	β_3	**IMC**
Maize	0.0836	0.1050	0.1006	0.8300
	(2.26) **	(2.23) **	(2.10) **	

Source: Data Analysis, 2020.

Note: *** and ** implies significant at 1% and 5% level of significance respectively.
Figures in parenthesis are t-values.

Table 5: Pair-wise Granger causality test on maize markets in Oyo State

Null Hypothesis	F-Statistics	P-Value	Direction of Causality
Bodija → Aarada	8.2725***	0.0003	
Aarada → Bodija	1.4135	0.262	Uni-directional
Bodija → Iluju	5.0495***	0.0048	
Iluju → Bodija	6.1743***	0.0017	Bi-directional
Bodija → Ilora	2.6549	0.0602	
Ilora → Bodija	11.536***	0.0000	Uni-directional
Aarada → Iluju	2.1452	0.1092	
Iluju → Aarada	15.414***	0.0000	Bi-directional
Aarada → Ilora	5.2521***	0.0040	
Ilora → Aarada	49.265***	0.0000	Bi-directional
Iluju → Ilora	19.353***	0.0000	
Ilora → Iluju	71.277***	0.0000	Bi-directional

Source: Data Analysis, 2020

→: indicates direction of causality,

*** and** means significant at 1% and 5% level of significance respectively.