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Spatial Integration Analysis of Rice Markets in the Six Geo-political Zones of Nigeria

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Abstract: The attainment of inter-regional price equilibrium is of immense importance in an economy to achieve the marketing and pricing objectives of a commodity. Since Nigeria has witnessed an established growing demand for rice as propelled by rising per capita consumption, the need for a well integrated rice marketing system arises due to high demand. This study therefore, described growth rate in retail prices, determined long-run and short-run price equilibrium among different pairs of spatially separated markets in Nigeria for imported and local rice varieties. Monthly retail prices of both rice varieties from January 2001 to December 2010 (120 months/state) were obtained for six geo-political zones of Nigeria from the statistical database of National Bureau of Statistics. Three (urban) markets were randomly selected from each zone, making eighteen markets across the six geo-political zones. Analytical techniques used were Augmented Dickey Fuller (ADF) unit root test, Johansen multivariate co-integration technique, Vector Error Correction Modelling (VECM) and Granger causality test. The findings revealed that for the imported rice markets, Ebonyi recorded the highest growth rate in retail prices (70.17%) and (85.52%) in 2004 and 2008, respectively. However, for the local rice markets, Bayelsa recorded the highest growth rate of 86.05% in 2003, followed by Lagos (72.01%) in 2005 and Bauchi (45.85%) in 2007. The results of ADF unit root test revealed that price series variables were non-stationary at levels but became stationary after the first-differencing for imported and local rice varieties at 5% level of significance. Also, about 85.00% of the imported rice markets exhibited long-run price equilibrium while the local rice markets exhibited 71.90% long-run price equilibrium. The imported and local rice markets were well spatially integrated with 83.00% shock in imported rice prices being transmitted to the local rice prices due to policy implications. The VECM results revealed moderate short-run price equilibrium among the imported rice markets while there was weak short-run price equilibrium in the local rice markets. The results of Pair-wise Granger causality test for imported and local rice market links in the same state showed that ten market links exist between imported rice and local rice markets in bi-directional (two- way) causality. The study showed that price signals were well transmitted across spatially separated markets for local rice varieties, thus indicating integration of rice markets in Nigeria between January 2001 and December 2010.

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1.0 Introduction

In the past three decades, rice has steadily increased in demand and its growing importance is evident given its important place in the strategic food security planning policies of many countries (FAO, 2000). Adesina (2014) recently revealed that Nigeria spends over ₦356billion on yearly importation of rice out of which about ₦1billion is used per day. Presently, Nigeria is a net importer of rice which also adversely affected local production tantamount to the cabal involved in rice importation. Rice production in Nigeria is faced with many challenges such as high input costs like cost of credit, imported equipment, agrochemicals due to taxes (legal and illegal), tarriffs and duties. The problem of policy instability (ban, unban tariffs) that makes decision making and planning highly uncertain and put investments at great risk. Other unattractive investments conditions include low technology base (mechanization), decaying infrastructure, high interest rates, weak institutions (such as poorly funded research institutes, public extension system and seeds certification) and corruption ridden fertilizer distribution system and low public sector investments in agriculture. However, policy has not been consistent, especially in terms of price that will encourage the sustainability of local rice producers, processors, marketers and consumers

Over the years, few studies have been devoted to examine the competitiveness and efficiency of the local rice market, invariably few research have contributed to rice marketing and distribution system than what these areas truly deserve hence making the market and the distribution systems work better for farmers, processors and consumers is a continuous challenge (Intal and Ranit, 2001) that should be adequately met through an expanded research programme. Unless agricultural markets are integrated, producers and consumers will not realize the gains from trade liberalization, since the correct price signals will not be transmitted between and among contiguous market locations. The consequence of this is that farmers will not be able to specialize according to long-term comparative advantage (Mafimisebi, 2012; Juselius, 2006). Examining the extent of interregional market integration, both spatial and

across marketing stages will provide insights on the speed of trader responses in moving this vital commodity from surplus to deficit areas, especially in the face of high demand. However, if there is integration in the prices of local rice at spatially separated market, that will give a signal of the steps to be taken to make the local rice varieties come up higher to supply the need of the growing population and to meet the taste of Nigerians. The study therefore, described the growth rates, examined the long-run and short-run spatial price equilibrium of local rice varieties between January 2001 and December 2010.

2.0 Literature Review

The conventional demand supply theory explains that the actual price of a commodity in a given market (rice market in this case) at a given point in time is higher than the equilibrium price when the product is ‘‘deficit’’ (i.e. excess demand where the demand is greater than domestic supply) and the price of which is lower than equilibrium when it is ‘‘surplus’’ (i.e. excess supply where the domestic supply is greater than demand). Consequently, there exists an opportunity for trade between these two types of markets (i.e. from surplus to deficit regional market) and ultimately these two markets become integrated by adjusting into a single price. In geo-politically separated markets for a homogenous commodity, prices are integrated if goods and information flow freely among them. As a result, prices are linked and arbitrage of activities will not allow prices to differ by an amount greater than the transfer costs. Where the spread of price between a pair of markets are larger than unit transfer cost, profitable opportunities are not being exploited, in which case these markets are not efficiently connected. In integrated markets however, price changes in one region are reflected in the other region’s prices. In an interregional set for a homogenous agricultural commodity such as rice, two regional markets belonging to this set up are said to be spatially integrated, whenever the following conditions are satisfied: when trade takes place between them, the nominal price at the receiving market is equal to the nominal price at the exporting market plus the transporting and other incidental costs required in moving unit amount of commodity between them.Co-integration analysis is a useful tool to give an answer about existence of a relationship between two econometric time series (Luu, 2003). Co-integration implies existence of long-run equilibrium and it also implies common stochastic trend. Markets that are not integrated may convey inaccurate price information, distorting the marketing decision of rice producers and contributing to inefficient product movements. Therefore, an important part of market performance analysis focuses on rice market integration between different market places. A series is described as non-stationary if its mean values changes over time and variance increases with sample size. In this circumstance, the series is described as possessing a unit-root. Such a series is said to be integrated of order “d” I(d) and shocks have permanent effects on it (Gujarati, 1995). There are three possible meaning of the word “integrated”. The first is a statistical one and reference is to the stationarity of a univariate time series. Secondly, its meaning is statistical with econometrics overtones and thirdly, it is an economic one which is based on arbitrage condition (Mafimisebi, 2012), Non-stationarity which leads to spurious regression and suggests the presence of causal relations in existent which is common with macro economic series (Nelson, 2006; Juselius, 2006). In testing the properties of macro-economic series, Phillip Perron, Dickey Fuller (DF) and Augmented Dickey Fuller (ADF), Co-integration Regression Durbin Watson (CRDW) and the Sargan – Bhargava Durbin Watson (SBDW) tests can be used (Mafimisebi, 2012). In this study ADF test was used to ascertain the non-stationarity condition which was revealed by the presence of unit-root. ADF was used because of the simplicity of its interpretation and it is the basic test for order of integration. A stationary series is one where the absolute value of α is greater or equal to one. Stationary series have a finite variance, transitory innovations from the means and tendency for the series to return to its value. In contrast, the non-stationary series is one where the absolute value of α is not greater or equal to 1. Non-stationary series have a variance which is asypotically infinite; the series rarely cross the mean (infinite samples) and innovations to series are permanent (Akande and Akpokodje, 2003).

Therefore, the study describes the growth rate in retail prices of imported and local rice varieties in the study area; determine the long-run and short-run spatial price equilibrium of local rice varieties and allso examine Granger causality between spatially separated local rice markets in the study area.

3.0 Methodology

3.1 Sources and type of data

The data for this study were from secondary source and were time series price variables obtained from the statistical database of the National Bureau of Statistics (NBS) which is the successor agency of the Federal Office of Statistics (FOS) merged with the National Data Bank (NDB). The study used the data between January 2001 and 2010 December.

3.2 Sampling technique and sample size

A multistage selection method was used as the sampling technique. Firstly**,** the six geo-political zones of Nigeria were selected for this study. Secondly, eighteen spatially separated state capital

(urban) markets across the six geo-political zones of Nigeria were randomly selected. The monthly retail prices of local rice varieties were obtained from January 2001 to December 2010. The sample size was one hundred and twenty observations per state. The markets considered were Lagos (Lag), Osun and Ekiti States (South West), Rivers, Bayelsa (Baye) and Akwa Ibom (Akwa) States (South South), Abia, Anambra (Ana) and Ebonyi (Ebon) States (South East), Abuja (FCT), Plateau (Plat) and Kogi States (North Central), Bauchi (Bau), Adamawa (Ada) and Yobe States (North East), Kan , Sokoto (Sok) and Zamfara (Zam) States (North West).

3.3 Analytical Techniques

3.3.1 Description of growth rate in retail prices

Growth rate is the subtraction of the past values from present value divided by past value multiplied by 100%. It is used to describe how retail prices of imported and local rice variables increase or decrease over the study period. It is calculated thus:

$$\frac{p_v - p_p}{p_p} \; x\,100 \qquad \ldots\ldots\ldots (1)$$

Where p_v the present value of rice retail price and p_p is the past value of rice retail price in (₦).

3.3.2 Test for order of econometric integration (unit root test)

Augmented Dickey Fuller statistic used in the test is a negative number, the more negative it is, the stronger the rejection of the hypothesis, that is, there is a unit-root at some levels of confidence. Before examining integration relationships between or among variables, it is essential to test for unit-root, and identify the order of stationarity, denoted as I(0) or I(1). This is necessary to avoid spurious and misleading regression estimates.

The framework of ADF methods is based on analysis of the following model;

$$\Delta\rho_t = \alpha + \beta\rho_{t-1} + \sum_{k=1}^{n} \delta_k \Delta\rho_{t-k} + \mu_t \ldots (2)$$

Where, ρ_t is the rice price series being investigated for stationarity, Δ is first difference operator, k is the lag lengths; α, β, γ and δ_k are the coefficient vectors. Unit-root tests were conducted on the parameters to determine whether or not each of the series is more closely identified as being I(1) or I(0) process. The test of the null hypothesis of equation (1) shows the existence of a unit-root when $\beta = 1$ against alternative hypothesis of no unit-root when $\beta = 0$. The null hypothesis of non-stationarity is rejected when the absolute value of the test statistics is greater than the critical value. When ρ_t is non-stationary, it is then examined whether or not the first difference of it is stationary (i.e. to test $\Delta\rho_t$-$\Delta\rho_{t-1}$~I(1) by repeating the above procedure until the data were transformed to induce stationarity.

3.3.3 Testing for Johansen Multivariate Co-integration (Trace and Maximal Eigen value tests)

If two series are individually stationary at same order, the Johansen and Juselius (1990) and Juselius (2006) model can be used to estimate the long-run co-integrating vector from a Vector Auto-regression (VAR) model of the form:

$$\Delta p_t = \alpha + \sum_{i=1}^{k-1} \Gamma i \;\; \Delta p_{t-1} + \Pi p_{t-1} + \mu_t \ldots . (6)$$

Where p_t is a nx1 vector containing the series of interest (rice price series) at time (t) is the first difference operator. $\Gamma i \;\; and \;\; \Pi \;\; are$ n x n matrix of parameters on the ith and kth lag of p_t $\Gamma i = \left(\sum_{i=1}^{k} A_i\right) - I_g$, $\Pi = \left(\sum_{i=1}^{k} A_i\right) - I_g$, Ig is the identity matrix of dimension g, α is constant term, is nx1 white noise vector. Throughout, p is restricted to be (at most) integrated of order one, denoted I (1), where I(j) variable requires jth differencing to make it stationary. Equation (2) tests the co-integrating relationship between stationary series. Juselius (2006) derived two maximum likelihood statistics for testing the rank of Π, and for identifying possible co-integration as shown in the equation below:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{m} In(1-\lambda_i) \ldots . (7)$$

$$\lambda_{\max}(r, r+1) = -TIn(1-\lambda_{r+1}) \ldots\ldots (8).$$

Where r is the co-integration number of pair-wise vector, λi is ith Eigenvalue's value of matrix Π. T is the number of usable observations after the lag adjustment and λ is the estimated values of the ordered Eigen values obtained from the estimated matrix. The first step is based on the trace of the stochastic matrix while the second step is based on maximal Eigen value. The λ_{trace} is not a dependent test, but a series of tests corresponding to different r -value. The $\lambda_{\max}$ test each Eigen value separately. The null hypothesis of the two statistical tests is that there is existence of r co-integration relations while the alternative hypothesis is that there is existence of more than r co-integration

Vector Error Correction Modelling (VECM)

The coefficient of error correction term (ECT) in the VECM is a measure of the adjustment speed toward LR equilibrium relationship between

markets. The large coefficient indicates the speed of adjustment toward the LR equilibrium and vice versa (Aryani and Yulius, 2012).

The ECM is expressed as follows:

$$\Delta P_{it} = y_1 + y_2 \Delta P_{jt} - \pi V_{it-1} + V_{ij} \ldots\ldots (9)$$

Where y2 is the impact multipliers (the short-run effect) that measures the immediate impact that a change in pit will have on a change in P jt , π is the feedback effect or the adjustment effect that shows how much of the disequilibrium is being corrected, that is the extent to which any disequilibrium in the previous period affects adjustment in pit period. Hence, $\widehat{V}_{t-1} - \widehat{P}_{it} - \widehat{P}_1 - \widehat{P}_2 P_{jt-1,}$ therefore from this equation we also have P2 being the long-run response.

3.3.5 Test for Granger- causality

A variable is said to Granger cause another variable j if past value of i help to predict the current level of j given all other appropriate information. This definition is based on the concept of causal ordering. Two variables may be contemporaneously correlated by chance but it unlikely that the past values of i will be useful in predicting j given all the past values of j, unless i does actually cause j in a philosophical sense. Similarly, if j in fact causes i, then given the past history of j it is unlikely that information on i will help predict j. Granger causality is not identical to causation in the classical philosophical sense, but it does demonstrate the likelihood of such causation or the lack of such causation more forcefully than does implies contemporaneous correlation (Geweke, 1984). Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. The Granger causality reflects the direction of influence between series (prices of local and imported rice). Granger causality has two assumptions, the first assumption is that the future cannot cause the past (the past causes the present or future), while the second one is that a cause contains unique information about an effect not available elsewhere. When two series have the same order of econometric integration and are co-integrated, test for causality can be carried out owing to the fact that at least one Granger -causality relationship exists in a group of co-integrated series (Granger, 1988; Alexander and Wyeth, 1994, France, 1994, Chirwa, 2001; Nielsen, 2006). The implication is that the evidence of co-integration indicates the existence of causality.

However, when the co-integration residuals are ignored this will lead to incorrect model specification (Mafimisebi, 2012). If prices in market i Granger causes price in market j and if j also Granger causes i, then prices are said to be determined by a simultaneous feedback mechanism (SFM). This phenomenon is called bi- directional causality. Also, if the Granger causality runs once, it is said to be uni-directional causality. Also, the market that Granger causes the other is referred to as the exogenous market (Mafimisebi, 2010).

$$\left[\Delta p_{jt} = \alpha_0 + \sum_{t-1}^{n} \beta_1 \Delta p_{(t-1)} + \sum_{t-1}^{n} \beta_j \Delta p_{(t-1)j} + \delta\, ECT_{t-1} + \mu_1 \ldots\ldots\ldots (10)\right]$$

$$\left[\Delta p_{jt} = \phi_0 + \sum_{t-1}^{n} \delta_j \Delta p_{(t-1)j} + \sum_{t-1}^{n} \delta_t \Delta p_{(t-1)t} + \lambda\, ECT_{t-1} + \varepsilon_1 \ldots\ldots\ldots (11)\right]$$

Where:

Δ is the difference operator, Pjt is the price series in the leading market (i=1), Pij is the price series in other markets (j = 2 … 18) μ1 and εt are white noise error terms, ECTt-1 is the error correction term (adjustment vector) derived from the long-run co-integrating relationship, while n is the optimal lag length orders of the variables which are determined by using the general to- specific modeling procedure (Hendry and Ericsson, 1999). The null hypotheses are; Pit will Granger – cause Pjt if $\mu 1 \neq 0$. Similarly, Pjt will Granger - cause Pit if $\varepsilon t \neq 0$. To implement the Granger causality test, F-statistics are calculated under the null hypothesis that all the coefficients of μ1 and εt = 0. The Granger causality tests between pairs of imported, local, imported and local rice markets were carried out for markets that are close in terms of distance. Also, Lagos market was used to Granger caused farther markets across the six zonal markets in Nigeria.

4.0 RESULTS AND DISCUSSION

4.1 Description of growth rates in retail prices of imported rice varieties

The findings in Table 1 revealed that for the imported rice markets, Ebonyi recorded the highest growth rates in retail prices, 70.17% and 85.52% in 2004 and 2008 respectively while Adamawa also recorded 73.82% in 2008. The implication is that the rice prices cost more in those states than other states in Nigeria during the stated years. However, in 2007, most of the imported rice markets revealed negative values in retail prices. Abia revealed the least negative growth rate in price (-27.70%), followed by Bayelsa (-27.50%), followed by Ebonyi (- 25.65%). Also, in 2010, most of the imported rice markets also revealed negative growth rate in prices. Anambra revealed the least value (-14.90%), followed by Adamawa (-11.64%), followed by Akwa Ibom (-10.55%). The negative value implies a fall in rice prices in the stated years, which may be as a result of government deliberate policy measures towards encouraging the consumption of home based commodity (local rice varieties) and to discourage importation of foreign rice into the country. The highest retail prices indicate high consumption rate

of imported rice in the stated places (Akande and Akpokodje, 2003). Moreover, the zero values implies that the retail prices of imported rice in 2002 remained constant in 2003.

4.2 Description of growth rates for retail prices of local rice markets

The findings in Table 2 showed that for the local rice markets, Bayelsa recorded the highest growth rate of 86.05% in 2003, followed by Lagos (72.01%) in 2005 and Bauchi (45.85%) in 2007. This implies that retail prices for local rice cost more in those states than other states in Nigeria for the stated years. Also, in 2002, Bayelsa recorded the least negative growth rates in prices (-28.46%), followed by Rivers (-26.82%) and -18.29% in Abia in 2007. The high average growth rates in retail prices during the period of study implies that the purchasing power of the rice consumers would be eroded. Thus, the consumers may opt for polished rice with better appearance in terms of cleanliness and colour. The consumers were able to purchased less than what they could have bought if the prices were lower. This could be as result of high demand for more qualitative rice in terms of appearance and cleanliness.

The implication of the negative growth rates in retail prices is that the welfare of the rice consumers may be secured because they could buy more quantity of rice than usual and be able to buy other commodity. However, the producers eventually may have little or no increase on the prices of their commodity. This may weaken the morale of local rice producers thereby reducing productivity and in some cases may lead to total stoppage of rice production in those areas (Care, 2004). If farmers do not receive fair prices for their production this may affect their opportunity for subsequent investment and expansion (Mmadubuchukwu *et al*., 2013). Thus, this may lead to increase importation of rice from other countries of the world.

Table 1: Growth Rates in Retail Prices of Imported Rice Varieties (%)

STATE	2002	2003	2004	2005	2006	2007	2008	2009	2010	AVERAGE
LAGOS	9.61	0.00	42.40	18.44	-3.53	-2.14	38.77	6.73	0.30	12.29
OSUN	1.9	0.00	56.67	18.91	9.17	-10.00	34.88	-4.71	-3.99	11.42
EKITI	2.77	0.00	57.91	13.80	4.40	0.00	28.37	10.80	-10.15	12.00
RIVERS	2.21	0.00	65.75	8.65	6.11	-12.47	40.31	18.28	1.94	14.53
BAYELSA	15.60	0.00	58.79	-11.45	23.17	-27.58	-0.11	60.25	0.00	13.19
AKWAIBOM	1.35	0.00	65.45	-8.72	23.71	-22.85	53.55	13.99	-10.55	12.88
ANAMBRA	9.28	0.00	63.97	14.52	1.04	0.36	45.42	4.60	-14.90	13.81
ABIA	4.80	0.00	65.89	21.87	-3.40	-27.70	55.39	21.84	3.47	15.80
EBONYI	-0.37	0.00	70.17	17.24	-3.71	-25.65	85.52	14.56	-0.13	13.44
FCT	-0.25	0.00	43.88	20.00	7.82	-12.00	42.05	10.80	-5.28	11.89
PLATEAU	6.41	0.00	56.17	13.38	4.78	-10.40	43.41	7.27	-0.08	13.43
KOGI	3.66	0.00	10.45	13.69	-3.90	5.25	34.70	1.95	8.72	8.28
BAUCHI	9.53	0.00	48.30	15.85	-0.32	-12.37	34.70	14.81	-6.03	14.39
ADAMAWA	-2.65	0.00	4.83	10.05	-0.32	-12.37	73.82	36.85	-11.64	12.25
YOBE	-0.50	0.00	49.21	13.78	8.19	-7.76	42.98	13.87	-7.80	12.44
KANO	0.24	0.00	49.09	60.49	22.97	2.87	19.27	18.95	-8.09	18.42
SOKOTO	11.85	0.00	32.77	22.36	5.20	9.51	62.37	14.86	-4.48	17.16
ZAMFARA	22.97	0.00	62.98	68.18	5.19	-22.40	62.38	15.76	-10.01	15.21

Source: Computed from National Bureau of Statistics (NBS) Data (2001-2010)

Table 2: Growth Rates in Retail Prices of Local Rice Varieties (%)

STATES	2002	2003	2004	2005	2006	2007	2008	2009	2010	AVERAGE
LAGOS	34.88	9.70	0.00	72.01	0.00	-14.80	34.90	10.73	-1.33	16.23
SUN	7.41	23.46	25.20	18.02	4.34	-12.60	26.11	10.61	-7.80	10.53
EKITI	2.62	0.00	41.25	20.54	11.70	-14.42	22.31	25.14	4.56	12.63
RIVERS	-4.71	34.33	27.62	3.73	8.78	-26.86	26.50	13.60	3.16	9.57
BAYELSA	-28.46	86.15	20.26	10.00	-18.55	38.90	39.82	3.94	2.85	17.21
AKWAIBOM	2.98	4.65	8.22	15.16	1.97	-24.25	26.46	14.60	12.63	6.94
ANAMBRA	16.59	18.04	21.30	23.70	-0.66	-13.77	33.49	4.89	1.31	11.65
ABIA	7.02	13.06	18.49	28.87	-3.52	-18.29	31.47	28.14	-3.37	11.32
EBONYI	7.02	4.40	6.63	26.96	7.94	-12.51	42.60	7.85	-3.47	11.67
FCT	5.90	31.13	16.37	9.19	7.94	38.93	13.62	-31.27	24.78	12.95
PLATEAU	2.79	7.21	44.06	17.22	0.93	29.81	5.33	-5.55	-1.49	10.92
KOGI	10.45	5.49	26.68	25.34	-5.48	25.72	19.76	4.03	2.54	12.73
BAUCHI	18.74	9.31	11.13	17.62	0.35	45.83	14.36	9.81	-28.40	10.97
ADAMAWA	2.40	9.31	30.81	6.91	8.82	39.58	20.69	-10.68	-5.17	11.41
YOBE	1.69	18.80	12.41	27.71	4.72	39.38	26.32	-6.40	-10.09	12.73
KANO	5.91	10.19	26.10	22.33	8.62	11.90	12.23	-3.42	-10.96	9.21
SOKOTO	20.41	10.72	15.66	8.46	11.48	11.47	7.04	0.05	12.59	10.85
ZAMFARA	12.74	12.11	26.18	8.47	8.72	33.93	21.19	-9.82	-13.90	11.07

Source: Computed from National Bureau of Statistics (NBS) Data (2001-2010)

4.3 Results of unit-root tests for price series

The results of Augmented Dickey Fuller unit-root test showed in Tables 3 and 4 revealed that all price series in the model were non- stationary at their levels I(0) for both imported and local varieties. All the price series of rice accepted the null hypothesis at their levels at 5% level of significance. This implies that the variables contain unit root at their levels and thus shock will have permanent effect on the variables. In the second stage, the price series were first differenced since the previous tests showed that non-stationarity was the case and the test was re- conducted. The results of the unit root test indicated that the null hypothesis of non-stationarity was rejected in favour of the alternative hypothesis by all the price series. This implies that all the price series were generated by similar stochastic processes and also exhibited the possibility of moving together on the long-run (Nielsen, 2006; Mafimisebi, 2007). The result is supported by previous findings which shows that food commodities price series in Nigeria and elsewhere are mostly stationary after first differencing (Mafimisebi, 2008; Okoroafor et al, 2010). This is probably due to the possession of series of trends arising from price inflation and cyclical variations from season leading to mean non-stationarity in food price series (Mafimisebi, 2008). Another implication of stationarity of variables is that if there is a disturbance in such \variables, they will revert back to equilibrium level at the same rate.

Table 3: Unit Root Test for Imported Rice Price Series in Nigeria

Variable	ADF 1(0) Statistics	p-Value	ADF1(1)Statistics	p-Value	Order Unit
Abia	-0.9570(NS)	0.7666	-16.169(S)	0.0000	1
Adamawa	-1.7031(NS)	0.6017	-18.4700(S)	0.0000	1
AkwaIbom	-1.19659(NS)	0.6745	-15.8616(S)	0.0000	1
Anambra	-1.3310(NS)	0.6134	-13.7086(S)	0.0000	1
Bauchi	-1.1507(NS)	0.6937	-9.7606(S)	0.0000	1
Bayelsa	-1.5295(NS)	0.5153	-17.4958(S)	0.0000	1
Ebonyi	-1.0841(NS)	0.7205	-14.6523(S)	0.0000	1
Ekiti	-0.9255(NS)	0.7771	-14.1599(S)	0.0000	1
FCT	-1.4251(NS)	0.5678	-14.8657(S)	0.0000	1
Kano	-1.6230(NS)	0.4677	-9.0830(S)	0.0000	1
Kogi	-0.9504(NS)	0.7688	-13.1207(S)	0.0000	1
Lagos	-1.2498(NS)	0.6510	-16.4420(S)	0.0000	1
Osun	-1.6732(NS)	0.4422	-8.6305(S)	0.0000	1
Plateau	-1.6521(NS)	0.4529	-14.7451(S)	0.0000	1
Rivers	-1.4372(NS)	0.5618	-11.1009(S)	0.0000	1
Sokoto	-1.8210(NS)	0.3688	-12.6268(S)	0.0000	1
Yobe	-1.5976(NS)	0.4806	-9.2854(S)	0.0000	1
Zamfara	-1.6514(NS)	0.4533	-15.7269(S)	0.0000	1

Source: Compiled from Result of Unit Root Test (2014)

Notes:

1. Critical values are -2.8859 and -2.8861 at level and first difference series respectively
2. If the absolute value of ADF is lower than 5% critical ADF statistics, the null hypothesis of non- stationarity is rejected.

Table 4: Unit-Root Test for Local Rice Price Series in Nigeria

Variable	ADF Stat. I(0)	p-Value	ADF Stat. I (1)	p -Value	Order unit
Abia	-2.1608(NS)	0.2218	-9.7929(S)	0.0000	1
Adamawa	-1.4633(NS)	0.5487	-9.8193(S)	0.0000	1
AkwaIbom	-1.5193(NS)	0.5205	-10.9270(S)	0.0000	1
Anambra	-1.9036(NS)	0.3297	-13.8193(S)	0.0000	1
Bauchi	-1.9987(NS)	0.2872	-15.2211(S)	0.0000	1
Bayelsa	-1.7987(NS)	0.3796	-11.3862(S)	0.0000	1
Ebonyi	-1.6398(NS)	0.4591	-10.7996(S)	0.0000	1
Ekiti	-1.6343(NS)	0.4619	-10.8114(S)	0.0000	1
FCT	-1.8052(NS)	0.3764	-15.0992(S)	0.0000	1
Kano	-1.7939(NS)	0.3820	-12.5465(S)	0.0000	1
Kogi	-1.6686(NS)	0.4445	-13.4145(S)	0.0000	1
Lagos	-1.4727(NS)	0.5441	-17.5849(S)	0.0000	1
Osun	-1.6599(NS)	0.4489	-10.7884(S)	0.0000	1
Plateau	-1.4970(NS)	0.5318	-11.1607(S)	0.0000	1
Rivers	-2.0383(NS)	0.2703	-10.0294(S)	0.0000	1
Sokoto	-1.2375(NS)	0.6565	-12.9032(S)	0.0000	1
Yobe	-1.4228(NS)	0.5689	-11.0251(S)	0.0000	1
Zamfara	-1.6938(NS)	0.4318	-15.3076(S)	0.0000	1

Source: Compiled from Result of Unit Root Test (2014)
Notes:
1. Critical values are -2.8859 and -2.8861 at level and first difference series respectively
2. If the absolute value of ADF is lower than 5% critical ADF statistics, the null hypothesis of non stationarity is rejected.

4.4 Results of long-run spatial price equilibrium for imported rice markets

In Table 5, the results of Johansen co-integration test showed that out of one hundred and fifty three market pairs subjected to test, only one hundred and thirty (130) market pairs co-integrated with one another at 1% and 5% levels of significance as postulated by their test statistics which are greater than their critical values. The proportion of the imported rice market pairs that exhibit long- run equilibrium was 85.0% and the remaining 15% market pairs were segregated. The high percentage of co-integration among the imported market pairs may be due to better appearance, homogenity in sizes and cleanliness of the commodity all over the nation.

According to Mafimisebi (2012), in recent time long-run notion of equilibrium of market price series has taken the lead in terms of development economists' analysis of market performance. This is owing to the fact that markets with price series stationary at same order and co-integrated are spatially economically integrated. In addition, modern developments in econometrics have shown that such series cannot drift far apart without bounds and hence, the existence of equilibrium between them (Nielsen, 2006; Mafimisebi, 2008). This further implies that there is a perfect transmission of price information in the rice market pairs in Nigeria, that means, there is a perfect transmission of price information in the market networks of producers, marketers and consumers of rice in the nation. Furthermore, appropriate gains from trade will be realized and be transmitted to the market chain, thus enabling the producers to specialize according to comparative advantage (Mafimisebi, 2008).

4.5 Results of long-run spatial price equilibrium for local rice markets

The results in Table 6 showed that out of the one hundred and fifty three market pairs subjected to test, only one hundred and ten (110) market pairs co- integrated with one another at 1% and 5% level of significance as shown by their maximum Eigen and Trace test statistics which are greater than their critical values. In local rice market pairs, this implies that (one hundred and ten) 110 local rice market pair were co- integrated of order (1) at 1% and 5% levels of significance in the six geo-political zones of Nigeria. It can also be deduced that 71.90% of the local rice markets have their prices moved together in the long run despite the divergence in prices in between them in the long run. However, the remaining market pairs that show segregation in the local rice market (28.10%) may be due to bad roads within the regional markets, there could be poor communication channels, market distortion, etc.

The results of the local rice market integration in Nigeria is supported by the findings of Mafimisebi *et al*.,(2013) which highlighted high degree of market integration of local rice market in the southwest states which is one of the six zones in this study. However, empirically the results in this study does not show wide differences when the samples of rice markets were taken across the six geo-political zones in Nigeria.

Table 5: Pair – wise Co-integration Test for order (1) Market Pairs (Imported Rice)

Market pairs P1-P2		Maximum –Eigen value Test Statistics	p-value	Trace Test Statistics	p-value
1.	Lag-Osun	18.703**	0.0093	20.0721**	0.0095
2.	Lag-Ekiti	15.288**	0.0343	16.4462**	0.0359
3.	Lag-Rivers	16.139**	0.0250	16.6405**	0.0335
4.	Lag-Baye	18.6094**	0.0097	19.1091**	0.0136
5	Lag-Akwa	15.1446**	0.0362	15.9153**	0.0432
6.	Lag-Ana	21.0795**	0.0036	22.1398**	0.0043
7.	Lag-Abia	19.2764**	0.0074	19.9903**	0.0098
8.	Lag-Ebon	21.0538**	0.0036	21.1992**	0.0049
9.	Lag-FCT	17.1446**	0.0171	18.4464**	0.0174
10.	Lag-Plat	16.7300**	0.0200	18.8866**	0.0148
11.	Lag-Kogi	17.8425**	0.0130	18.7423**	0.0156
12.	Lag-Ban	20.6712***	0.0043	21.9972**	0.0045
13.	Lag-Ad	23.2499***	0.0015	24.4846**	0.0017
14.	Lag-Yob	16.4089**	0.0226	16.4089**	0.0283
15.	Lag-Kan	17.5152**	0.0148	19.1291**	0.0135
16.	Lag-Sok	15.820**	0.0281	16.8615**	0.0310
17.	Lag-Zam	22.8203***	0.0021	23.7852***	0.0023
18.	Osun-Ekiti	41.5051***	0.0000	42.5024***	0.0000
19.	Osun-Rivers	22.8203***	0.0018	24.1354***	0.0020
20.	Osun-Baye	16.0704**	0.0256	17.9182**	0.0212
21.	Osun-Akwa	30.2403***	0.0002	28.8291***	0.0003
22.	Osun-Ana	30.2403***	0.0001	31.8506***	0.0001
23.	Osun-Abia	17.3436**	0.0154	18.3436**	0.0181
24.	Osun-Ebon	16.6714**	0.0204	17.7106**	0.0228
25.	Osun-FCT	33.9836***	0.0000	35.6953***	0.0000
26.	Osun-Plat	39.2996***	0.0000	41.5003***	0.0000
27.	Osun-Kogi	26.6890***	0.0004	28.5033***	0.0003
28.	Osun-Bau	24.2261***	0.0010	26.1634***	0.0009
29.	Osun-Ada	23.0369***	0.0016	25.0089***	0.0014
30.	Osun-Yob	33.1175***	0.0000	35.3018***	0.0000
31.	Osun-Kan	38.7709***	0.0000	40.6799***	0.0000
32.	Osun-Sok	26.5513***	0.0004	28.8068***	0.0003
33.	Osun-Zam	33.0603***	0.0000	35.0748***	0.0000
34.	Ekiti-Rivers	21.0474***	0.0037	21.7007**	0.0051
35.	Ekiti-Akwa	23.3744***	0.0014	23.8790***	0.0022
36.	Ekiti-Ana	36.1771***	0.0000	36.8154***	0.0000
37.	Ekiti-Ebon	16.1503**	0.0249	16.6655**	0.0332
38.	Ekiti-FCT	18.9198***	0.0085	19.9766**	0.0098
39.	Ekiti-Plat	24.9575***	0.0000	26.0566***	0.0009
40.	Ekiti-Kogi	24.4719***	0.0006	26.2767***	0.0008
41.	Ekiti-Bau	19.5732**	0.0066	20.4916**	0.0081
42.	Ekiti-Ada	20.0845**	0.0054	20.9457**	0.0068
43.	Ekiti-Yob	27.9504***	0.0002	28.9265***	0.0003
44.	Ekiti-Kan	35.2569***	0.0000	36.2467***	0.0000
45.	Ekiti-Sok	25.5853***	0.0006	26.4599***	0.0008
46.	Ekiti-Zam	27.4584***	0.0003	28.2804***	0.0004
47.	Rivers-Baye	22.9455***	0.0017	24.9966***	0.0014

4.6 Results Vector Error Correction Estimates

The results showed in Table 6 that the imported rice markets in the six regional markets in Nigeria, South West States (SWS), South South States (SSS), South East States(SES), North West States(NWS), North Central States(NCS) and North East States(NES) strongly react on the long-run co-integrating equations. The short- run adjustment of price changes at those market places react significantly on the deviation from the long-run equilibrium. North East States is the strongest 0.615010 (62.00%) following co-integrating equation (1), followed by North Central States as measured by the adjustment coefficients 0.581374 (58.00%) and 0.421609 (42.00%) for North Central States and North West States respectively. In the co-integrating equation (2), South South States has a stronger reaction than others with adjustment coefficient 0.254318 (25.00%). Also, in co-integrating equation (3), North West States and North East States have the stronger reactions than others with adjusted coefficients of 0.640780 (64.00%) and 0.476117 (48.00%) respectively. Finally, in the fourth co-integrating equation, North Central States exhibits the strongest reaction than other markets with adjustment coefficient of 0.707086 (71.00%).

The implication is that the price dynamics in the short- run shows that the imported rice markets in the northern parts of Nigeria were moderately integrated .This indicates that arbitrage is operational and efficient in the northern region of Nigeria to an extent.

Table 5: Pair – wise Co-integration Test for order (1) Market Pairs (Imported Rice)

Market pairs P1-P2		Maximum -Eigen value Test Statistics	p-Value	Trace Test Statistics	p-Value
48.	Rivrs-Akwa	26.8334***	0.0003	28.1035***	0.0004
49.	Rivers-Ana	28.8071***	0.0001	30.2954***	0.0002
50.	Rivers-Abia	18.7869**	0.0090	19.6260***	0.0112
51.	Rivers-Ebon	28.5896***	0.0002	29.5449***	0.0002
52.	Rivers-FCT	26.9182***	0.0003	28.9547***	0.0003
53.	Rivers-Plat	20.9375***	0.0038	23.4848***	0.0025
54.	Rivers-Kogi	42.6654***	0.0003	44.5861***	0.0003
55.	Rivers-Bau	27.0687***	0.0002	29.0970***	0.0002
56.	Rivers-Ada	28.2244***	0.0000	30.0630***	0.0000
57.	Rivers-Yob	35.3820***	0.0004	37.1627***	0.0003
58.	Rivers-Kan	26.4840***	0.0001	28.7506***	0.0001
59.	Rivers-Sok	30.8209***	0.0009	32.1561***	0.0009
60.	Rivers-Zam	24.5270***	0.0024	26.1902***	0.0022
61.	Baye 1 Akwa	22.0373**	0.0151	23.7959**	0.0142
62.	Baye-Ana	17.4657**	0.0031	18.9905***	0.0037
63.	Baye-Ebon	21.4224**	0.0228	22.5101**	0.0167
64.	Baye-FCT	16.3765**	0.0293	18.5538**	0.0223
65.	Baye-Kogi	15.7147***	0.0001	15.7147***	0.0001
66.	Baye-Bau	29.8591***	0.0005	31.9241***	0.0005
67.	Baye-Ada	25.9261***	0.0001	27.7711***	0.0001
68.	Baye-Yob	29.1174**	0.0160	31.1598**	0.0106
69.	Baye-Kan	17.3139***	0.0004	19.7761***	0.0004
70.	Baye-Sok	26.4204***	0.0002	28.2206***	0.0002
71.	Baye-Zam	27.5976**	0.0170	29.4967**	0.0171
72.	Akwa-Ana	17.1568**	0.0291	18.4967**	0.0343
73.	Akwa-Abi	15.7332***	0.0032	16.5734***	0.0040
74.	Akwa-Ebon	21.3435***	0.0004	22.3136***	0.0004
75.	Akwa-FCT	26.4492***	0.0060	28.1312***	0.0045
76.	Akwa-Plat	19.5020***	0.0011	22.0350***	0.0012
77.	Akwa-Kogi	23.8992***	0.0000	25.4669***	0.0000
78.	Akwa-Bau	34.1408***	0.0000	35.5944***	0.0000
79.	Akwa-Ada	31.7893***	0.0000	33.3239***	0.0000
80.	Akwa-Yob	44.1652***	0.0002	45.4973***	0.0001
81.	Akwa-Kan	28.6671***	0.0000	30.4902***	0.0001
82.	Akwa-Sok	31.7039***	0.0000	32.9405***	0.0000
83.	Akwa-Zam	34.5765***	0.0369	35.9109**	0.0353
84.	Ana-Ebon	15.6907***	0.0001	16.4898***	0.0001
85.	Ana-FCT	29.8463***	0.0002	31.5001***	0.0001
86.	Ana-Plat	28.6243***	0.0000	30.7789***	0.0000
87.	Ana-Kogi	32.1445***	0.0000	33.7105***	0.0000
88.	Ana-Bau	41.9179***	0.0004	43.5194***	0.0004
89.	Ana-Ada	14.2646***	0.0000	27.8823***	0.0000
90.	Ana-Yob	48.9591***	0.0000	50.5181***	0.0000
91.	Ana-Kan	36.9733***	0.0000	38.9502***	0.0000
92.	Ana-Sok	31.8642***	0.0002	33.412***	0.0002
93.	Ana-Zam	28.3954***	0.0035	30.4124**	0.0047
94.	Abia-Ebon	21.1865**	0.0282	21.9231**	0.0285
95.	Abia-Kogi	15.8167***	0.0002	17.0716***	0.0002

In Table 7, the results of Vector Error Correction estimates showed that, North Central States is the strongest with adjustment coefficient of 0.584096 (58.00%), following co-integrating equation (1); followed by North Central States as measured by the adjustment coefficient of 0.506433 (51.00%) and 0.230719 (23.00%) for South East States. In the co-integrating equation (2), North Central States is the strongest with 0.240595 (24.00%), followed by South West States with 0.202200 (20%) while South East States had 0.153780 (15.00%). In the co-integrating equation (3), South West States had 0.223805(22.00%), followed by South South States with 0.109170 (10.00%). This implies that price dynamics in the short-run for the local rice markets in the Nigeria within the period of the study was weakly integrated. This may be due to quality of rice in terms of appearance, cleanliness, etc. In the co-integrating equation (2), North Central States is the strongest with 0.240595 (24.00%), followed by South West States with 0.202200 (20%) while South East States had 0.153780 (15.00%). In the co-integrating equation (3), South West States had 0.223805(22.00%), followed by South South States with 0.109170 (10.00%). This implies that price dynamics in the short-run for the local rice markets in the Nigeria within the period of the study was weakly integrated. This may be due to quality of rice in terms of appearance, cleanliness, etc.

Table 5: Pair – wise Co-integration Test for order (1) Market Pairs (Imported Rice)

Market pairs P1-P2		Maximum -Eigen value Test Statistics	p-value	Trace Test Statistics	p-value
96.	Abia-Bau	28.1462**	0.0068	29.4846**	0.0068
97.	Abia-Ada	19.6971***	0.0013	29.9666***	0.0015
98.	Abia-Yob	23.6595**	0.0470	24.8049**	0.0413
99.	Abia-Kan	14.4370***	0.0015	16.0447***	0.0019
100.	Abia-Sok	23.2036***	0.0000	24.2444***	0.0001
101.	Abia-Zam	31.4781**	0.0290	32.8918**	0.0247
102.	Ebon-FCT	15.7446***	0.0001	17.4910***	0.0000
103.	Ebon-Kogi	22.5186***	0.0000	23.7818***	0.0000
104.	Ebon-Bau	41.2021***	0.0001	42.5411***	0.0001
105.	Ebon-Ada	31.0627***	0.0000	32.5277***	0.0000
106.	Ebon-Yob	34.2484**	0.0230	35.5817**	0.0200
107.	Ebon-Kan	16.3543***	0.0000	18.0701***	0.0000
108.	Ebon-Sok	32.6756***	0.0008	33.8425***	0.0009
109.	Ebon-Zam	24.8532***	0.0002	26.1869***	0.0001
110.	FCT-Plat	28.1618***	0.0002	30.5869***	0.0002
111.	FCT-Kogi	28.0878***	0.0000	30.0787***	0.0000
112.	FCT-Bau	38.2801**	0.0057	40.2536***	0.0046
113.	FCT-Ada	19.9422***	0.0000	21.9581***	0.0001
114.	FCT-Yob	49.0003***	0.0000	51.0481***	0.0001
115.	FCT-Kan	30.3789***	0.0001	32.4101***	0.0000
116.	FCT-Sok	31.0859***	0.0001	33.1950***	0.0001
117.	FCT-Zam	30.4038**	0.0311	32.3534**	0.0177
118.	Plat-Kogi	15.5570***	0.0000	18.4066***	0.0000
119.	Plat-Bau	32.6284**	0.0048	35.0892***	0.0032
120.	Plat-Ada	20.3606***	0.0000	22.9186***	0.0000
121.	Plat-Yob	36.1622***	0.0000	38.8714***	0.0000
122.	Plat-Kan	35.8784***	0.0001	38.4191***	0.0001
123.	Plat-Sok	29.6710***	0.0000	32.8561***	0.0000
124.	Plat-Zam	33.9723***	0.0002	36.4311***	0.0002
125.	Kogi-Bau	27.6102**	0.0078	29.7584**	0.0057
126.	Kogi-Ada	19.1637***	0.0001	21.4012***	0.0001
127.	Kogi-Yob	30.6426***	0.0029	32.7505***	0.0021
128.	Kogi-Kan	21.6190***	0.0004	23.9983***	0.0004
129.	Kogi-Sok	26.4190***	0.0045	28.3400***	0.0036
130.	Kogi-Zam	20.5342**	0.0311	22.5866**	0.0177

Source: Compiled from Result of Co-integration Test (2014)
Note:
(1) Only the 130 markets link with significant parameters are shown
(2) ***; ** means significant at 1% and 5% levels respectively
(3) Critical values for Trace and Maximum Eigen value tests are 15.495 and 14.265

4.7 Results of long-run spatial price equilibrium for imported and local rice markets

In Table 9, the result of the pair-wise co-integration test between the imported rice and local rice markets in the same state across the nation, showed that out of the eighteen market pairs subjected to test, fifteen market pairs were co- integrated of order (1) at 1% and 5% levels of significance as depicted by their maximum Eigen value and Trace statistics. The result implies that local rice price and imported rice price were well integrated in Nigeria, that means a shock in the imported rice markets can easily be transmitted to 83.00% of the local rice markets across the nation. The co-integration between the prices of the two rice varieties may be due to recent demand for local rice especially, because of the nutritional value of the local rice and the high quality of the imported rice. Also, the ease of rice preparation and consumers preference for rice which has risen tremendously at about 10.00% per annum may be responsible for the long-run spatial integration (Akande, 2007).

However, the segregations that occur in the remaining three market pairs (16.70%) may be due to variation in the consumers preference for polished rice while the prices of the local rice may be lower because the consumers are yet to know the nutritional components in local rice varieties or due to their nature of jobs which requires quick and less laborious cooking which is one of the features of the imported rice varieties (Odoema, 2008; USAID,2010).

Table 6: Pair –wise Co-integration test for order (1) Market Pairs (Local Rice)

Market pairs P1-P2		Maximum -Eigen value Test Statistics	p-value	Trace Test Statistics	p-value
1.	Lag- Osun	28.9423***	0.0001	31.3468***	0.0001
2.	Lag –Ekiti	21.339***	0.0032	23.4842***	0.0025
3.	Lag –Rivers	28.3103***	0.0002	30.1852***	0.0002
4.	Lag-Baye	35.9888***	0.0000	37.9401***	0.0000
5	Lag-Akwa.	27.6091***	0.0002	29.2776***	0.0000
6.	Lag-Ana	31.1585***	0.0000	33.6052***	0.0000
7.	Lag-Abia	38.5388***	0.0001	40.5219***	0.0001
8.	Lag-Ebon	28.9336**	0.0210	30.8968**	0.0143
9.	Lag-Kogi	16.5933**	0.0060	18.9883***	0.0043
10.	Lag-Ada	19.8191**	0.0453	22.1611**	0.0362
11.	Lag-Yob	14.5343**	0.0803	16.4196**	0.0572
12.	Lag-Zam	12.9328***	0.0013	15.1016***	0.0009
13.	Osun-Ekiti	23.5262***	0.0026	26.1133***	0.0016
14.	Osun-Rivers	21.9094***	0.0000	24.6703***	0.0000
15.	Osun-Baye	33.5113**	0.0108	36.1967**	0.0061
16.	Osun-Akwa	18.3242***	0.0001	21.239***	0.0001
17.	Osun-Ana	29.0252***	0.0018	31.7615***	0.0011
18.	Osun-Abia	22.7761***	0.0001	25.6691***	0.0001
19.	Osun-Kogi	19.6431**	0.0064	22.2692***	0.0041
20.	Osun-Bau	33.5113***	0.0000	36.1967***	0.0000
21.	Osun-Ada	22.5770***	0.0020	25.4129***	0.0012
22.	Osun-Yobe	18.4713**	0.0102	20.9638**	0.0068
23.	Osun-Kan	19.4735**	0.0068	21.8189***	0.0049
24.	Osun-Sok	19.2207**	0.0076	21.4794**	0.0055
25.	Osun-Zam	19.2222**	0.0076	21.5832**	0.0053
26.	Ekiti-Rivers	20.2130**	0.0051	22.7907***	0.0033
27.	Ekiti-Bay	35.7893***	0.0000	38.2602***	0.0000
28.	Ekiti-Akwa	24.1135***	0.0010	26.0008***	0.0009
29.	Ekiti-Ana	18.99387**	0.0085	22.2188***	0.0042
30.	Ekiti-Abia	32.0042***	0.0000	34.3096***	0.0000
31.	Ekiti-Ebon	28.6252***	0.0002	31.0401***	0.0001
32.	Ekiti-Bau	14.4157**	0.0473	16.6565**	0.0333
33.	Ekiti-Ada	17.8018**	0.0132	20.1519**	0.0092
34.	Ekiti-Yob	14.3013**	0.0493	16.1889**	0.0393
35.	Ekiti-Sok	17.7192**	0.0137	19.4994**	0.0118
36.	Ekiti-Zam	15.1442**	0.0362	17.4427**	0.0251
37.	Ekiti-Baye	26.2567***	0.0004	31.3838***	0.0001
38.	Rivers-Bay	26.2567***	0.0000	31.3838***	0.0000
39.	Rivers-Akwa	39.1808***	0.0000	43.3536***	0.0000
40.	Rivers-Ana	33.8627***	0.0003	37.2050***	0.0001
41.	Rivers-Abi	27.4186**	0.0223	31.0262**	0.0098
42.	Rivers-Ebon	16.4384**	0.0094	19.9949**	0.0055
43.	Rivers-Kogi	18.6689**	0.0477	21.4899**	0.0158
44.	Rivers-Ada	14.3935**	0.0207	18.7179**	0.0129
45.	Rivers-Sok	16.6338***	0.0020	19.2621***	0.0009

Table 6: Pair –wise Co-integration test for order (1) Market Pairs (Local Rice)

Market pairs P1-P2		Maximum -Eigen value Test Statistics	p-value	Trace Test Statistics	p-value
46.	Baye-Akwa	22.5143***	0.0000	26.1704***	0.0000
47.	Baye-Abia	30.0258***	0.0001	33.2973***	0.0000
48.	Baye-Ebon	32.3626***	0.0000	35.3300***	0.0000
49.	Baye-FCT	21.0894***	0.0036	23.5720***	0.0025
50.	Baye-Plat	16.3630**	0.0230	19.2595**	0.0129
51.	Baye-Kogi	27.0070***	0.0003	29.5713***	0.0002
52.	Baye-Ban	19.6593**	0.0064	22.7248***	0.0034
53.	Baye-Ada	17.1211**	0.0172	21.0259**	0.0066
54.	Baye-Yob	22.5905***	0.0020	25.1024**	0.0013
55.	Baye-Kan	21.5434***	0.0030	23.9505***	0.0021
56.	Baye-Sok	20.8357***	0.0040	23.431***	0.0026
57.	Baye-Zam	19.4832**	0.0068	22.3961***	0.0039
58.	Akwa-Ana	25.7419***	0.0005	29.0457***	0.0003
59.	Akwa-Abia	31.0707***	0.0001	34.1867***	0.0000
60.	Akwa-Ebon	17.7302**	0.0136	20.9399**	0.0068
61.	Akwa-Kogi	15.1586**	0.0360	18.3382**	0.0181
62.	Ana-Ebon	21.7164***	0.0000	24.8513***	0.0000
63.	Ana-Kogi	16.0124***	0.0028	18.8099***	0.0015
64.	Ana-Kan	14.8618**	0.0262	17.4763**	0.0152
65.	Ana-Sok	16.8921**	0.0402	19.3593**	0.0248

66.	Ana-Zam	14.6616**	0.0188	17.2793**	0.0124
67.	Abia-Ebon	24.3119**	0.0433	27.3988**	0.0267
68.	Abia-Kogi	15.2599***	0.0010	18.0079***	0.0005
69.	Ebon-Kogi	19.5848**	0.0347	22.2648**	0.0205
70.	Ebon-Ban	17.4851**	0.0347	20.5080**	0.0205
71.	Ebon-Ada	21.2975**	0.0065	25.2649***	0.0041
72.	Ebon-Yor	19.7389**	0.0062	22.24681***	0.0038
73.	Ebon-Kan	19.6812***	0.0033	22.5672***	0.0013
74.	Ebon-Sok	16.9762**	0.0063	19.6583***	0.0036
75.	Ebon-Zam	16.2452**	0.0182	18.9995**	0.0111
76.	FCT-Plat	26.8231**	0.0240	29.1096**	0.0142
77.	FCT-Ban	18.7485***	0.0003	21.2466***	0.0003
78.	FCT-Ada	30.2482**	0.0091	32.9811**	0.0061
79.	FCT-Yor	22.6135***	0.0001	25.0520***	0.0001
80.	FCT-Kan	15.6479***	0.0019	18.0822***	0.0014
81.	FCT-Sok	17.6679**	0.0300	20.1741**	0.0199
82.	FCT-Zam	24.7801**	0.0139	27.0893**	0.0091
83.	Plat-Kogi	15.8594***	0.0008	18.4349***	0.0006
84.	Plat-Ban	23.5594**	0.0277	25.9838**	0.0175
85.	Plat-Ada	34.0596***	0.0013	36.8618***	0.0009
86.	Plat-Yor	26.4020***	0.0000	28.7323***	0.0000
87.	Plat-Kan	31.6634***	0.0004	33.9411***	0.0003
88.	Plat-Sok	37.0120***	0.0000	39.9262***	0.0000
89.	Plat-Zam	30.6689***	0.0000	32.9451***	0.0000
90.	Kogi-Bau	21.9897***	0.0001	24.5097***	0.0001
91.	Kogi-Ada	22.9113***	0.0025	25.6945***	0.0017
92.	Kogi-Yobe	20.9101***	0.0017	23.3043***	0.0011

Table 6: Pair –wise Co-integration test for order (1) Market Pairs (Local Rice)

Market pairs P1-P2		Maximum -Eigen value Test Statistics	p-value	Trace Test Statistics	p-value
93.	Kogi-Kan	22.8078***	0.0039	25.0918***	0.0027
94.	Kogi-Sok	33.3393***	0.0018	35.5817***	0.0013
95.	Kogi-Zam	17.1622***	0.0000	19.5817***	0.0000
96.	Bau-Ada	30.0606**	0.0169	34.1197**	0.0114
97.	Bau-Yob	32.2401***	0.0001	35.1953***	0.0000
98.	Bau-Kan	48.3956***	0.0000	51.3881***	0.0000
99.	Bau-Sok	41.5046***	0.0000	44.1383***	0.0000
100.	Bau-Zam	37.1455***	0.0001	60.2724***	0.0003
101.	Ada-Yob	34.8444***	0.0000	38.1891***	0.0000
102.	Ada-Kan	48.6956***	0.0005	51.3881***	0.0001
103.	Ada-Sok	41.5046***	0.0000	44.1383***	0.0000
104.	Ada-Zam	57.3593***	0.0012	60.2724***	0.0008
105.	Yob-Kan	26.3561***	0.0000	28.7284***	0.0000
106.	Yob-Sok	31.8201***	0.0000	34.1108***	0.0000
107.	Yob-Zam	28.5201***	0.0004	31.1076***	0.0003
108.	Kan-Sok	37.2481***	0.0000	39.7198***	0.0000
109.	Kan-Zam	36.0265***	0.0002	38.4315***	0.0001
110.	Sok-Zam	24.1795***	0.0000	26.7029***	0.0000

Source: Compiled from Result of Co-integration Test (2014)
Note:
(1) Only the 110 market links with significant parameters are shown
(2) ***; ** means significant at 1% and 5% levels respectively
(3) Critical values for Trace and Maximum Eigen value tests are 15.495 and 14.265

Table 7: Results of Vector Error Correction Estimates for Imported rice by Zones

Error Correction	D(SW)	D(SS)	D(SE)	D(NC)	D(NW)	D(NE)
Coint Eq 1	-0.38106	0.127636	0.133928	0.581374	0.421609	0.615010
	(0.13073)	(0.15959)	(0.13535)	(0.14676)	(0.19357)	(0.14993)
	[-0.29149]	[0.79978]	[1.98949]	[3.96133]	[2.17812]	[4.102065]
Coint Eq 2	-0.013873	-0.254318	0.024855	0.041979	-0.097189	-0.066717
	(0.09030)	(0.11023)	(0.09349)	(0.10137)	(0.13370)	(0.10356)
	[-0.15364]	[-2.30717]	[0.26586]	[0.41412]	[-0.72693]	[-0.64426]
Coint Eq 3	-0.025842	-0.132430	-0.438961	0.208470	0.640780	0.476117
	(0.15081)	(0.18410)	(0.15614)	(0.16930)	(0.22330)	(0.17295)
	[0.17135]	[-0.71934]	[-2.81135]	[1.23134]	[2.86965]	[2.75285]
Coint Eq 4	0.10444	-0.262069	-0.035657	-0.707086	-0.109339	-0.213926
	(0.18476)	(0.22554)	(0.19129)	(0.20741)	(0.27356)	(0.21189)
	[0.56530]	[-1.16196]	[-0.18640]	[-3.40904]	[-0.39969]	[-1.00962]
D(SW(-1))	-0.468702	0.141120	-0.203305	-0.215404	-0.220767	-0.47825
	(0.14506)	(0.17708)	(0.15019)	(0.16285)	(0.21479)	(0.16636)
	[-3.23098]	[0.79691]	[-1.35366]	[-1.32269]	[-1.02784]	[-2.87472]

D(SS(-1))	-0.084814	-0.218540	0.011847	0.045542	-0.008306	-0.079177
	(0.10191)	(0.12440)	(0.10551)	(0.11440)	(0.15089)	(0.11687)
	[-0.83226]	[-1.75673]	[0.11229]	[0.39809]	[-0.05505]	[-0.67748]
D(SE(1))	0.095189	-0.306914	-0.193171	-0.179119	-0.359322	-0.053941
	(0.15391)	(0.18788)	(0.15935)	(0.17278)	(0.22788)	(0.17651)
	[0.61847]	[-1.63355]	[-1.21227]	[-1.03668]	[-1.57678]	[-0.30560]
D(NC(1))	0.027996	0.248670	0.230585	-0.082669	0.222717	0.296241
	(0.17080)	(0.20850)	(0.17684)	(0.19175)	(0.5290)	(0.19588)
	[0.16391]	[1.19264]	[1.30394]	[-0.43114]	[0.88066]	[1.51235]
D(NW(1))	-0.109736	-0.200762	-0.314206	-0.065912	-0.526436	-0.28134
	(0.15833)	(0.19328)	(0.16393)	(0.17775)	(0.23443)	(0.18158)
	[-0.69306]	[-1.03869]	[-1.91673]	[-0.37081]	[-2.24556]	[-1.54942]
D(NE(1))	-0.110968	-0.039396	0.141370	0.234174	0.452311	0.322692
	(0.17465)	(0.21320)	(0.18082)	(0.19607)	(0.25860)	(0.20030)
	[0.63536]	[0.18478]	[0.78181]	[1.19434]	[1.74910]	[1.61107]
C	1.269935	1.240084	1.361749	0.925734	1.175800	0.968878
	(0.86656)	(1.05783)	(0.89717)	(0.97282)	(1.28305)	(0.99379)
	[1.46549]	[1.17229]	[1.31783]	[0.95160]	[0.91641]	[0.97493]
R –squared	0.334998	0.426996	0.321637	0.286857	0.352217	0.387711
F-statistic	3.148468	4.657423	2.963350	2.514021	3.398286	3.957592

Source: Compiled from Vector Error Correction Estimates (2014).
Note: D – First Difference Operator
Adjusted Coefficient in first Row
Standard Error Value in ( )
t – Statistics Value in [ ]
SW: South West NC: North Central
SE: South East NW:North West
SS: South South NE: North East

The remaining nine market links between imported and local rice pricing shows uni-directional (one way). The markets that show one way causality include, Akwa - Ibom Imported rice market to Akwa Ibom Local rice market , Anambra Imported rice market to Anambra Local rice market, Bauchi Imported rice market to Bauchi Local rice market, Bayelsa Imported rice market to Bayelsa Local rice market, Ekiti Imported rice market to Ekiti Local rice market, Kano Local rice market to Kano Imported rice market, Kogi Local rice market to Kogi Imported, Rivers Imported rice market to Rivers Local rice market and Sokoto Local rice market to Sokoto Imported rice market. The implication of the result is that retail prices of imported rice is generally higher than those of local rice (Akande and Akpokodje, 2003). Also, the retail prices of imported rice exhibited leadership position in determining the retail prices of local rice in most rice markets in Nigeria. This may be due to high demand for better quality rice and the nature of work done in most of the urban areas, where people have less time for subsequent cleaning of the commodity before cooking which is one of the characteristic feature of local rice. Also, among the markets that assumed leadership position at (bi-directional and uni-directional), nine of them were local rice markets while the remaining ten were imported rice markets. This implies that local rice markets and imported rice markets in Nigeria interact to certain extent in the same center. It appears the local rice pricing and imported rice pricing depend on each other, which is against the findings of Akande and Akpokodje (2003).

Table 8: Results of Vector Error Correction Estimates for Local rice by Zones

Error Correction	D(SW)	D(SS)	D(SE)	D(NC)	D(NW)	D(NE)
Coint Eq 1	-0.375460	0.109760	0.230719	0.210072	0.506344	0.584096
	(0.10023)	(0.15651)	(0.11818)	(0.13092)	(0.17332)	(0.12606)
	[-3.74587]	[0.70129]	[1.95223]	[1.60461]	[2.92150]	[4.63338]
Coint Eq 2	0.202200	-0.233498	0.153780	0.240595	-0.251453	-0.194462
	(0.06920)	(0.10805)	(0.08159)	(0.09038)	(0.11965)	(0.08703)
	[2.92206]	[-2.16100]	[1.88481]	[2.66200]	[-2.10154]	[-2.23443]
Coint Eq 3	0.223805	0.109170	-0.408208	-0.470646	-0.310099	-0.467021
	(0.11899)	(0.18580)	(0.14030)	(0.15542)	(0.20575)	(0.14966)
	[1.88083]	[0.58755]	[-2.90952]	[-3.02822]	[-1.50714]	[-3.12062]
D(SW(-1))	-0.293560	0.260382	-0.116805	-0.196358	-0.642496	-0.276964
	(0.11049)	(0.17252)	(0.13027)	(0.14431)	(0.19105)	(0.13896)
	[-2.65697]	[1.50926]	[-0.89662]	[-1.36066]	[-3.36304]	[-1.99314]

D(SS(-1))	-0.258761	-0.364530	-0.207389	-0.267462	-0.05471	0.117599
	(0.07492)	(0.11699)	(0.08834)	(0.09786)	(0.12955)	(0.09423)
	[-3.45370]	[-3.11590]	[-2.34764]	[-2.73314]	[-0.42236]	[1.24800]
D(SE(1))	-0.88700	0.212948	0.023842	0.590589	0.367980	0.304462
	(0.12784)	(0.19962)	(0.15073)	(0.16698)	(0.22105)	(0.16079)
	[-0.69383]	[1.06676]	[0.158171]	[3.53694]	[1.66466]	[1.89359]
D(NC(1))	0.145106	-0.542403	-0.129229	-0.29322	-0.064264	-0.283433
	(0.10262)	(0.16023)	(0.12099)	(0.13403)	(0.17744)	(0.12906)
	[1.41406]	[-3.38506]	[-1.06807]	[-2.08400]	[-0.36218]	[-2.196121]
D(NW(1))	-0.023759	0.114554	-0.010050	-0.128841	0.177140	-0.110026
	(0.07340)	(0.11461)	0.08654	(0.09586)	(0.12599)	(0.09231)
	[-0.32372]	[0.99955]	[-0.11613]	[-0.11613]	[-1.39578]	[-1.19193]
D(NE(1))	-0.237858	0.143008	0.121629	-0.103092	-0.127901	-0.033503
	(0.10754)	(0.16791)	(0.12679)	(0.12135)	(0.16065)	(0.11685)
	[0.01952]	[0.85167]	[0.95928]	[-0.84954]	[-0.79615]	[-0.28672]
C	1.220332	0.347143	0.783672	0.953758	0.940443	0.757686
	(0.55542)	(0.86728)	(0.65488)	(0.72545)	(0.96040)	(0.69855)
	[2.19713]	[0.40027]	[1.19666]	[1.31471]	[0.97922]	[1.08466]
R –squared	0.421505	0.377929	0.2742258	0.295047	0.311450	0.332402
F-statistic	4.906065	4.090731	2.544533	2.818137	3.045675	3.352583

Source: Compiled from Vector Error Correction Test Results (2014).
Note: D: First difference operator
Adjusted Coefficient in first Row
Standard Error Value in ( )
t – Statistics Value in [ ]
SW: South West
SE: South East
SS: South South
NC: North Central
NW: North West
NW: North East

Table 9: Pair-wise Granger Causality Test (Imported and Local Rice Markets)

	Null Hypothesis	F-Statistics	Probability	Directional
1.	Abia Imp. → Abia Lo	12.7291***	1.0E-05	Bi-directional
2.	Abia Lo ↔ Abia Imp	5.0053**	0.0083	Bi- directional
3.	Ebon Lo ↔ Ebon Imp	3.9992**	0.0209	Bi-directional
4.	Ebon Imp ↔ Ebon Lo	6.5022***	0.0021	Bi-directional
5.	Lag Lo ↔ Lag Imp	3.4482**	0.0352	Bi- directional
6.	Lag Imp ↔ Lag Lo	8.1577***	0.0005	Bi-directional
7.	Osun Lo ↔ Osun Imp	12.8013***	9.7E – 06	Bi-directional
8.	Osun Imp ↔ Osun Lo	8.6989***	0.0003	Bi- directional
9.	Yobe Lo ↔ Yob Imp	9.8858***	0.0001	Bi-directional
10.	Yobe Imp ↔ Yobe Lo	5.1724***	0.0007	Bi-directional
11.	Akwa Imp → Akwa Lo	7.7881***	0.0007	Uni-directional
12.	Ana Imp → Ana Lo	4.2562**	0.0165	Uni-directional
13.	Bau Lo → Bau Imp	10.1031**	9.2E-05	Uni-directional
14.	Baye Imp → Baye Lo	5.5538***	0.0050	Uni-directional
15.	Ekiti Imp → Ekiti Lo	9.173***	0.0002	Uni-directional
16.	Kan Lo → Kan Imp	6.1876**	0.0143	Uni-directional
17.	Kogi Lo → Kogi Imp	11.6402***	2.5E – 05	Uni-directional
18.	Rivers Imp → River Lo	5.4929***	0.0053	Uni-directional
19.	Sok Lo → Sok Imp	6.3388***	0.0024	Uni-directional

Source: Compiled from the Result of Granger-Causality Test (2014).
Note: (**, ***) Means Significant at 5% and 1% respectively
↔ Indicates direction of causality (bi unidirectional)
→ Indicates direction of causality (uni- directional)
Lo Means Local Rice Imp Means Imported Rice

However, centers like Abia exhibited very strong exogeneity, while Ekiti, Osun and Lagos also exhibited strong exogeneity and others exhibited weak exogeneity in the imported rice markets. The markets that show very strong exogeneity in the local rice markets were Osun, Kogi and Bauchi. Also, Yobe shows strong exogeneity and the remaining markets show weak exogeneity. This implies that the markets that showed strong exogeneity may be as a result of low production of local rice and high demand for imported rice and better quality in those states respectively. Thus, the forces of demand were stronger than that of supply in such states.

5.0 CONCLUSION

The study explored spatial market integration for rice monthly retail prices in Nigeria, for the period of January 2001 to December 2010 (imported and local) rice varieties, using the Johansen multivariate co-integration technique and vector error correction modeling and Granger causality test. The results suggest that rice (both local and imported price series were well integrated

in the six geo-political zones of Nigeria) on the long-run.. The findings also discovered a co-integration between local and imported price series on the long- run. Thus, it means there is a flow of information and infrastructure to certain extent in the local and imported rice markets in Nigeria which is in line with the findings of Akande (2003). However, in the segregated market pairs, what the study uncovered is simply the lack of statistical alignment of prices in these regional pairs. In other words, there exist no long-run equilibrium relationship of the prices in the identified market pairs and that the price transmission mechanism is flawed. The results of the market integration analysis obtained by employing the vector error correction model (VECM) shows that price signal is transmitted in the short-run between the markets in the six geo-political zones in Nigeria. The results of the Granger causality tests conducted on all zonal market pairs identified what the theory predicts that at least a uni-directional causality exists in the integrated market pairs. Interestingly, market information in deficit regions were apparently being used in the price formation at the rice producing regions. In some deficit-surplus zonal pairs, significant feedback causality was also noted (bi-directional causality). However, this higher degree of spatial market integration of rice in Nigeria might contribute to economic development or a by-product of development process (Gonzalez – Rivers and Helfand, 2001).

5.2 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are highlighted towards an effective functioning of rice markets in Nigeria, especially, the local rice varieties:

The fall in growth rate of retail prices of local rice should be sustained to increase consumers purchasing power. At the same time, a well monitored subsidy should be given to rice producers in kind to keep them in production.

The use of high tariff and trade policy should be adequately monitored for effectiveness to discourage exporters of rice from other countries into Nigeria.

More awareness should be created for local rice varieties in terms of their nutritional value as against the imported rice.

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