Analysis of Monthly Price Transmission of Local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State, Nigeria (2005 to 2013)

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Abstract   The study examined the price transmission and market integration of local and foreign rice in rural and urban markets of Akwa Ibom State in Southern region of Nigeria. Average monthly prices (measured in naira per kilogram) of local and foreign rice in rural and urban markets were used in the analysis. The data came from the quarterly publication of the Akwa Ibom State Agricultural Development Programme (AKADEP). The data covered January 2005 to June 2013. The findings show that, prices of local and foreign rice in rural and urban markets has constant exponential growth rate of 0.59% which suggests perfect co-movement for rural and urban prices of local and foreign rice in the study area. Also, the Pearson correlation coefficient matrix revealed that, the rural price of local and foreign rice has linear symmetrical relationships with their corresponding urban prices. The result connotes the existence of symmetric market information flows between the rural and urban rice markets in the state. The Granger causality test revealed bidirectional relationship between rural and urban price of local and foreign rice in Akwa Ibom State, Nigeria. The results of the co-integration test revealed the presence of co-integration between the rural and urban prices of local and foreign rice as well as support the hypothesis of perfect price transmission between the two markets in the study area. The coefficients of the price variable in the co-integration equations for local and foreign rice markets converge to unity which connotes perfect market integration in the long run. The results of the error correction model (ECM) also confirm the existence of the short run market integration between the rural and urban prices of local and foreign rice in the study area. In addition, the result shows that, the price of local rice in both rural and urban markets adjusted faster than prices of foreign rice once there is an exogenous shock in the marketing process of rice in Akwa Ibom State. The index of market concentration (IMC) supports the high short run market integration between prices in rural and urban markets for local and foreign rice commodities and the quick adjustment of rural price of local rice in relative to rural price of foreign rice. Based on the finding, it is recommended that, the state government should continue to provide marketing infrastructures to improve the symmetric nature of information among participants in rice marketing in the state. Attempt should be made to reduce excessive externality costs in rice marketing in order to fully reap the benefit of rice market integration in the state.

Keywords   Market, Rice, Integration, Agricultural, Akwa Ibom, Nigeria

1. Introduction

Parboiled rice, once a ceremonial food for few privileged homes is now one of the staple foods among rich and rural poor populace in Nigeria. According to the World Bank report in 1995, the poorest urban households obtained about 33% of their cereal-based calorie from rice in Nigeria. The share of rice in cereals consumed in the country has grown from 15% in 1970s to 26% in 1990s in Nigeria[15]. In addition, the per capita rice consumption has risen from 3kg in 1960s to 18kg in 1980s and 23kg-34kg in 1990s[8 and 15].

Average growth in per capita rice consumption is likely to continue for some times partly due to increase in population and the proliferation of varieties of processed forms[12].

Rice market in Nigeria consists of the local and predominantly foreign or imported rice. Market price is a major endogenous determinant of supply and demand for both local and foreign rice. Prices are signals that direct and coordinate not only the production and consumption decisions but also the marketing decisions over time, form, and space[27]. The magnitude of market or retailed price of rice serves as a signal to relative scarcity or abundance of the commodity at a particular time and place. Price differential among markets also serve as incentive to allocate resources among spatial markets[5]. Consequently, prices of agricultural products like rice varies from month to month; region to region and even from day to day, due to problems

associated with seasonality, poor storage, consumer preference and marketing cost among others[17, 39 and 7]. From this perspective, rice marketing in a developing economy like Nigeria assumes an important economic activity.

Agricultural commodity price fluctuations and deviations among markets are normal phenomena across Nigeria. In spatially separated markets, when there is significant price difference between homogenous goods in different markets, such that the differences exceed the transfer cost; the arbitrage activities will be stimulated. The arbitrageur will purchase commodities from lower-price markets and resale in higher-price markets. This is a situation where spatially separated markets are not integrated. On the other hand, market is integrated when there is co-movement or there exist a long-run relationship among prices due to the smooth transmission of price signals and information across spatially separated markets[32]. Market integration could be perfect if price changes in one market are fully reflected in the alternative markets[19].

Several literature have provided diverse opinions on agricultural commodities market integration in Nigeria[6; 11; 32; 33; 34]. Before and early 1990s, most of the researches on market integration in Nigeria employed correlation and trend analyses. For instance, Amusa,[42] in her study of the trend analysis of agricultural food prices in Nigeria reported that food items such as vegetable, grains and oil based crops experienced increase and fluctuations in their prices. Subsequently, time series analysis was employed in the study of agricultural commodity market integration. For example, Okoh *and* Egbon[32] examined the integration of Nigeria's rural and urban foodstuffs markets. The study concludes that, the rural and urban foodstuffs markets were well integrated. The results further suggested that the urban market price drives the rural market price. The size of the adjustment coefficient for the rural foodstuffs price showed that the speed of adjustment to disequilibrium was moderate. Akintunde *et al.,*[5] studied the long run price integration of grains in Oyo state, western Nigeria. Empirical results revealed that, the price series in all the markets were non-stationary at their levels at 5% significance level. The integration test showed that none of the markets examined had prices tied together in the long- run. The Index of market connection (IMC) indicated that, the markets exhibited low short run market integration. Also, Debaniyu,[46] investigated grain (cowpea) market integration in Niger State, northern Nigeria. He employed time series methodology and discovered that some markets in the study area were integrated in the long run. Elsewhere, Jezghani *et al.,*[43] used vector error correction model (VECM) to investigate the spatial market integration in Iranian rice market from March 2000 to February 2009. The result revealed significant market integration between Iran and Thailand rice market, with Thailand market been the lead market. Chirwa[9] studied the food marketing reforms and integration of maize and rice markets in Malawi. He discovered that the rice market was more integrated than

maize market. Suryaningrum *et al.,*[44] investigated the spatial market integration of Thailand and Vietnam rice market in Indonesia by using real price monthly data expanded from January 2000 to December 2012. Johanson co-integration test approach was employed to examine the long-run price relationship, while the short-term relationship was examined by vector error correction model (VECM). The results showed that, the long-run relationships existed among Thailand, Vietnam, and Indonesian rice markets. Furthermore, Dawson and Dey[45] studied the spatial market integration among major domesticrice markets in Bangladesh. An integrated empirical framework tested long-run spatial market integration between price pairs using a dynamic vector autoregressive model and co integration. Hypotheses tests of market integration, perfect market integration, and causality were conducted sequentially using monthly prices from rice markets in Bangladesh since trade liberalization in 1992. The results showed that rice markets in Bangladesh were perfectly integrated with each other.

Specifically in Nigeria, majority of these researches were conducted in the Western region of the country[3; 4; 11; 32; 33] and results were used to generalize for all regions in the country. This situation might give wrong signal to marketing policies for other regions in the country. To avert this phenomenon in South –South region, there is need to verify assertions postulated by studies conducted in western region and other regions in the country. Also, most of these researches neglect comparison analysis of various methods of measuring market integration. For instance, Mafimisebi [28], Adeoye *et al.,*[4], Ifeanyi *et al.,*[23], Akintunde[5], Abunyuwah[1] and Ifejirika *et al.,*[23]; have employed time series analysis, but there were no comparative results with the previous methodology used in the country. This study tried to bridge this gap in agricultural commodity market integration study in the country by employing correlation, trend and time series analyses simultaneously and making comparative results. Secondly, it will be the first attempt to use time series techniques in the study of price transmission in Akwa Ibom State, one of the oil rich States located in the South-South region of Nigeria.

Fundamentally, spatial market integration contributes to efficiency of the market and also indicates the proficiency of marketing infrastructures in the region under consideration [14]. Understanding market integration is important particularly in needs assessments as policy makers need to avoid over-estimating or under-estimating the ability of markets to respond to price or any exogenous shock. Market integration helps in the optimization of resource use; increase in farm incomes; widening of markets; promote growth of agro-based industries, encourage value addition and also create employment[2]. The prevalence of spatial integrated markets also promotes production specialization among farmers and enhances economies of scale[40]. Market integration provides the basic data for understanding how specific markets work which is the basis for marketing policies. In addition, since markets integration implies that a deficit or surplus in one market will be transmitted to other

markets, an improvement in spatial integration of food markets will ensure regional balance among food-deficit and food-surplus regions in the country[16]. The analysis of spatial market integration, thus, provides indication of competitiveness, the effectiveness of arbitrage, and the efficiency of pricing[38]. Contrary, markets that are not integrated may convey inaccurate price signal that may result in distortion in producers' marketing decisions and inefficient product movement[19]. It could also increase poverty level among low income earners in the society and negate government objectives on self-food sufficiency[7; 37].

Rice is among staple foods whose price is highly unstable in Akwa Ibom State in the South-South region of Nigeria. The state government had initiated several policy interventions to boost the performance of the rice sub-sector in the state. Understanding the magnitude of rice market integration in the state will provide indispensable input to policy makers to formulate workable policies for the sub-sector in the state. This area of research had not received wide empirical patronage among researchers in the region. As such, a study like this will provide useful literature and serve as basis to stimulate wider researches on this issue in the region and the country at large. Hence, the study's objectives were; to examine the trends in price of local and foreign rice in the State. The study also sought to determine the efficiency of information flow or price transmission between rural and urban markets in Akwa Ibom State. In addition, it accessed the extent of market integration between the rural and urban prices for local and foreign rice in the state.

2. Research Methodology

2.1. Study Area and Data Source

The study was conducted in Akwa Ibom State which is located in the coastal South-South region of Nigeria. The region is popularly called the Niger Delta region or the oil rich region of Nigeria. The state is located between latitudes $4°32^1$ and $5°33^1$ north and longitudes $7°25^1$ and $8°25^1$ east. It has a total land area of areas of 7,246km^2. The mean annual temperature of the state lies between 26°C and 29°C and average sunshine of about 1,450 hours per year. The mean annual rainfall ranges from 2,000mm to 3,000mm, depending on the area. Naturally, maximum humidity is recorded in July while the minimum occurs in January. The state is bordered on the east by Cross River State, on the west by Rivers State and Abia State, and on the South by the

Atlantic Ocean. Akwa Ibom State has a population of about 3,902,051[29]. The state is basically an agrarian society where crops like maize, okra, cassava, yam and rice are cultivated in large quantities. Politically and for ease of administration, the state is divided into 31 Local Government Councils or Areas; it has six distinct Agricultural Development Project (ADP) Zones. These are: Oron, Abak, Ikot Ekpene, Etinan, Eket and Uyo zones.

2.2. Source of Data

Secondary data were used in this study. The data came from the quarterly publication of the Akwa Ibom State Agricultural Development Programme (AKADEP). It consisted of the average monthly retailed price in naira per kilogram of local and foreign rice from sampled markets in rural and urban areas of Akwa Ibom State. The study period covered January 2005 to June 2013. A total of 102 weeks' retailed average monthly prices (₦/Kg) of local and imported rice from rural and urban markets were used in the study.

2.3. Analytical Techniques

The study applied series of statistical and econometric techniques to test for the relationship between rural and urban prices of local and imported rice in Akwa Ibom State. The tests applied ranges from; the trend analysis, bi-variate correlation analysis, Granger causality tests, co-integration and Error Correction Model (ECM) as well as Index of Market Concentration analysis. Each of the tests is explained in both explicit and implicit forms as shown below:

2.4. The Trend Analysis of Average Monthly Retailed Prices of Local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State in Nigeria

To investigate the nature of growth rate in prices of local and foreign rice in Akwa Ibom State, we specified the exponential growth rate equation as thus:

$$P_t = b_o e^{bt} e^{ut} \qquad (1)$$

$$log_e P_t = log_e b_0 + b_1 t + U_t \qquad (2)$$

Where exponential growth rate (r) $=(e^{b1} - 1) * 100$. To ascertain whether the growth rate in prices of local and foreign rice did increase at accelerated or decelerated rates over the period considered, the quadratic exponential trend equation was specified as thus:

$$log_e P_t = b_o + b_1 t_1 + b_2 t_2^2 + u_t \qquad (3)$$

If $b_2 > 0$; the variable investigated had accelerated growth rate: when $b_2 < 0$; the variable has decelerated growth rate over time. In this study, "P_t" was represented by:

$P_{1t} = Average\ monthly\ Price\ of\ local\ rice\ in\ rural\ market\ in\ naira/Kg$

$P_{2t} = Average\ monthly\ Price\ of\ local\ rice\ in\ Urban\ market\ \ in\ naira/Kg$

$P_{3t} = Average\ monthly\ Price\ of\ foreign\ rice\ in\ rural\ market\ in\ naira/Kg$

$P_{4t} = Average\ monthly\ Price\ of\ foreign\ rice\ in\ urban\ market\ in\ naira/Kg$

t = time trend (1, 2… 102)

The exponential growth rate equation was adopted in this study to investigate the growth in prices of local and foreign rice

because, several literature have supported continuous inflated prices of agricultural commodities for some years in Nigeria[7; 13, 30]. We proposed that, changes in prices of agricultural commodities like rice in Akwa Ibom State should also be tested in a non-linear form.

2.5. Pearson Correlation Matrix of Average Monthly Retailed Prices of Local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State in Nigeria

To test for the symmetrical and linear relationship between rural and urban prices of local and foreign rice in Akwa Ibom State, the Pearson correlation coefficients were estimated. The formula is as described below:

$$P_r = \frac{n\sum P_{1t}P_{2t} - (\sum P_{1t})(\sum P_{2t})}{\sqrt{\{n\sum P_{1t}^2 - (\sum P_{1t})^2\}\{\sum P_{2t}^2 - (\sum P_{2t})^2\}}} \tag{4}$$

Where, "Pr" is the correlation coefficient between urban and rural market prices of local and foreign rice in the study area. A significant relationship between the considered variables suggests perfect price transmission or the presence of market integration between the two markets; while insignificant association suggests otherwise.

2.6. Bilateral Granger Causality Test on Average Monthly Retailed Prices of Local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State in Nigeria

Granger causality test is one of the important econometric tools used to determine whether past change in time series variable say "X" has impact on the current variable "Y" or whether the relation works in the opposite direction[36]. The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F- test on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y[20]. If a time series is a stationary process, the test is performed using the level values of two (or more) variables. If the variables are non-stationary, then the test is done using first (or higher) differences. The number of lags to be included is usually chosen using an information criterion, such as the Akaike information criterion or the Schwarz information criterion. This test assumes that the information relevant to the prediction of X and Y is contained solely in the time series data on these variables[22]. In this study, the bilateral Granger Causality tests were conducted on the average monthly retailed prices of local and foreign rice in urban and rural markets in Akwa Ibom State. The primary model in Vector Autoregressive Regression forms are represented as thus:

$$\Delta LnP_{1t} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\sum_{i=1}^{n}\Delta LnP_{1t-1} + \boldsymbol{\beta_2}\sum_{i=1}^{n}\Delta LnP_{2t-1} + \boldsymbol{\varepsilon_{1t}} \tag{5}$$

$$\Delta LnP_{2t} = \boldsymbol{\delta_0} + \boldsymbol{\delta_1}\sum_{i=1}^{n}\Delta LnP_{2t-1} + \boldsymbol{\delta_2}\sum_{i=1}^{n}\Delta LnP_{1t-1} + \boldsymbol{\varepsilon_{2t}} \tag{6}$$

$$\Delta LnP_{3t} = \boldsymbol{\gamma_0} + \boldsymbol{\gamma_1}\sum_{i=1}^{n}LnP_{3t-1} + \boldsymbol{\gamma_2}\sum_{i=1}^{n}\Delta LnP_{4t-1} + \boldsymbol{\varepsilon_{3t}} \tag{7}$$

$$\Delta LnP_{4t} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\sum_{i=1}^{n}\Delta LnP_{4t-1} + \boldsymbol{\alpha_2}\sum_{i=1}^{n}\Delta LnP_{3t-1} + \boldsymbol{\varepsilon_{4t}} \tag{8}$$

For equation 5 and 6, there is a bilateral Granger causality from urban markets price to rural market price for local rice, if $\beta_2 \neq 0$ and $\boldsymbol{\delta_2} = 0$. Similarly, there is Granger causality from the rural market price to urban market price for local rice if $\beta_2 = 0$ and $\boldsymbol{\delta_2} \neq 0$. These situations imply asymmetric price movement between the two spatial markets. The causality is considered as mutual or bidirectional if $\beta_2 \neq 0$ and $\boldsymbol{\delta_2} \neq 0$. Finally, there is no link between average monthly price of local rice in rural markets and average monthly price of local rice in urban markets if $\beta_2 = 0$ and $\boldsymbol{\delta_2} = 0$. The same interpretation follows for the rest of the equations. The variables are as defined previously in equation (3). A bidirectional Granger causality test indicates the presence of symmetric price movement or efficient price transmission between the two spatial markets. This connotes market integration or perfect price transmission between prices of rural and urban markets for local and foreign rice in Akwa Ibom State.

2.7. Co- integration Test for the Average Monthly Retailed Prices of Local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State in Nigeria

The concept of co- integration as developed by Granger[21] involves the determination of the static or long-run associations among non-stationary time series. If the geographically separated markets are integrated, then there exists an equilibrium or long run relationship among these markets[19; 18; 38]. The study applied the Engle and Granger two-step technique and Johansen co-integration approach to examine the co-integration relationships between rural and urban market prices of local and foreign rice in the study area. For the local rice market, $\boldsymbol{P_{1t}}$ and $\boldsymbol{P_{2t}}$ represent prices of rural and urban at time t. If the two markets are perfectly spatially integrated, then $\gamma_1 = 1$ $in\ equation\ 9\ (law\ of\ one\ price)$. In this case, price changes in rural market are fully reflected in the urban market. When $\gamma_1 \neq 1$ ($\gamma_1 1\ or\ \gamma_1 1$), then the degree of integration needs to be determined by investigating the variance of γ_1 from the threshold mark of 1. Hence, the time

dependent rural price equation for local and foreign rice is specified as follows:

$$LnP_{1t} = \gamma_0 + \gamma_1 \sum_{i=1}^{n} LnP_{2t} + U_{1t} \tag{9}$$

$$LnP_{3t} = \varphi_0 + \varphi_1 \sum_{i=1}^{n} LnP_{4t} + U_{2t} \tag{10}$$

Following the Granger Representation Theorem, we specify the ECM model for the co-integrating series in the study. The general specification of the ECM that was estimated for the rural price equations for local and foreign rice in the state is shown below:

$$\Delta LnP_{1t} = \gamma_0 + \gamma_1 \sum_{i=1}^{n} \Delta LnP_{1t-1} + \gamma_2 \sum_{i=1}^{n} \Delta LnP_{2t-i} + \gamma_3 ECM_{t-1} + U_{1t} \tag{11}$$

$$\Delta LnP_{3t} = \vartheta_0 + \vartheta_1 \sum_{i=1}^{n} \Delta LnP_{3t-1} + \vartheta_2 \sum_{i=1}^{n} Ln\Delta P_{4t-i} + \vartheta_3 ECM_{t-1} + U_{2t} \tag{12}$$

The dependent variables are as defined previously in equation (3), and the coefficient (γ_3) and (ϑ_3) of the ECM_{t-1} (-1< γ_3, ϑ_3< 0) measures the deviations from the long-run equilibrium in period (t_{-1}) in both P_{1t} and P_{3t}. In order to obtain a parsimonious dynamic ECM for the rural price equation, the study adopted Hendry's (1995) approach in which an over parameterized model is initially estimated and then gradually reduced by eliminating insignificant lagged variables until a more interpretable and parsimonious model is obtained.

2.8. Index of Market Concentration (IMC)

The index of market concentration (IMC) was used to measure the degree of price transmission or price relationship between integrated markets. Following Oladapo and Momoh,[35] methodology, the relationship between the price of local and foreign rice in rural market and urban market is given by the equations below:

$$P_{1t} = \delta_0 + \delta_1 P_{1t-1} + \delta_2(P_{2t} - P_{2t-1}) + \delta_3 P_{2t-1} + \varepsilon_{1t} \tag{13}$$

$$P_{3t} = \varphi_0 + \varphi_1 P_{3t-1} + \varphi_2(P_{4t} - P_{4t-1}) + \varphi_3 P_{4t-1} + \varepsilon_{2t} \tag{14}$$

Table 1.   Result of the unit root test for price variables used in the analysis

| | Augmented Dicker Fuller Test for unit root | | | | | |
| | With Constant | | | Constant and Trend | | |
Logged Variables	Level	1st diff.	OT	Level	1st diff.	OT
LnP_{1t}	-2.141	-12.95**		-3.805	-12.89**	
LnP_{2t}	-2.114	-14.29**	1(1)	-3.983	-14.21**	1(1)
LnP_{3t}	-2.115	-12.69**	1(1)	-3.668	-12.63**	1(1)
LnP_{4t}	-1.917	-11.93**	1(1)	-3.597	-11.87**	1(1)
			1(1)			1(1)
1%	-3.50	-3.50		-4.05	-4.50	

Note: OT means order of integration. Critical value (CV) is defined at 1% significant level and asterisks ** represent 1% significance level. Variables are as defined in equation 3.

Then IMC = δ_1/δ_3 for local rice and = φ_1/φ_3 for foreign rice.

When IMC < 1 implies high short run market Integration; IMC > 1 implies low short run market Integration; IMC = ∞ implies no market integration; IMC = 1 high or short run market integration. Other variables are as defined in equation 3.

3. Result and Discussion

3.1. Augmented Dicker Fuller Unit Root Test Result

In time series analysis, stationarity of series is examined by the unit root tests. One of the most commonly used tests in the literature to ascertain the stationary levels of series is ADF test developed by Dickey and Fuller in (10). The ADF test was conducted by including constant on one part and constant and trend on the other part. Only 1% critical value (or 99% of repeatability) was used to determine the unit root of variables used in the study. A price series is stationary if

its mean and variance are constant over time under consideration. The result of the ADF root tests as presented in Table 1 shows that, all price variables were non-stationary at levels but stationary at first difference.

The result implies that, the specified price variables should be tested for the existence of co-integration[25 and 26]. This result however conforms to the findings of Chirwa[9], Yusuff *et al*[41] and Acquah and Rebecca[2] that agricultural commodity prices in Sub-Saharan Africa are integrated at the first order.

Descriptive Analysis of Urban and Rural average monthly Prices of Local and Foreign Rice in Akwa Ibom State (from January 2005 to June 2013)

The descriptive statistics of price variables used in the analyses is shown in Table 2. The average prices of local and foreign rice in rural and urban markets in Akwa Ibom State were ₦155.57/kg and ₦152.16/kg respectively. Also, the average prices of foreign rice were ₦213.51/kg and ₦208.06/kg in rural and urban markets respectively. The

coefficient of variability in prices of local and foreign rice in both rural and urban markets was about 20% for each price variable.

Table 2. Descriptive Statistic of variables used in the model

Parameters	Local Rice		Foreign Rice	
	Rural Market (₦/Kg)	Urban Market (₦/Kg)	Rural Market (₦/Kg)	Urban Market (₦/Kg)
Mean	155.57	152.16	213.51	208.06
Median	163.01	157.78	228.89	219.49
Minimum	100.42	98.75	129.63	139.17
Maximum	217.87	215.67	299.00	301.05
Standard deviation	31.97	30.79	43.58	42.43
Coefficient of Variation	0.206	0.202	0.204	0.204
Skewness	-0.085	-0.039	-0.168	-0.003
Kurtosis	-1.243	-1.147	-1.402	-1.211

Note: Computed by authors, and prices are expressed in nominal terms.

3.2. Exponential Trend Analysis of Average Monthly Prices of Local and Foreign Rice in Rural and Foreign Markets in Akwa Ibom State (2005 to 2013)

The exponential trend equation for each of the price variables specified in equations 2 and 3 is shown in Table 3. The result also contains the calculated exponential growth rate for each of the price variables and the nature of such growth rate over time (i.e. from January 2005 to June 2013). The result revealed that, trends in prices of local and foreign rice in rural and urban markets in the study area showed positive significant linkage with time. This implies that, fluctuation in prices of local and foreign rice in rural and urban markets in Akwa Ibom State is affected by time. In the period under consideration, we discovered a constant exponential growth rate of 0.59% for all the four price variables investigated. This result suggests that, variance in prices of local and foreign rice in rural and urban markets in the study area has been relatively constant for some years now. Alternatively, the result has revealed that, the growth rate in price of local and foreign rice in both rural and urban markets are similar and relatively stable over time in Akwa Ibom State. This result further suggests the prevalence of perfect price transmission or market integration between rural and urban price of local and foreign rice in the state. The nature of growth in each price variable showed that, over time the price of local and foreign rice in rural and urban markets decline in the state, but it was statistically significant in rural price of foreign rice. To further substantiate the result graphically; Figure 1 shows the linear trend in average monthly prices of local rice in rural and urban markets in Akwa Ibom State. The price trends show undulated fluctuations throughout the study period. Both prices experienced steady decline from June 2005 to January 2007. On average the rural and urban price of local rice exhibited similar pattern of fluctuations in the study period; which further suggests that both prices move together or were co integrated in the period of investigation. This result is in consonance with the report of Amusa[42].

Figure 2, shows the linear trend in price of foreign rice in rural and urban markets of Akwa Ibom State. The result is similar to what was obtained for the local rice. The pattern of fluctuations in price of foreign rice was similar for urban and rural markets in the study area. The fluctuations in price of foreign rice in both markets assumed an average downward trend from July 2005 to April 2007. Thereafter, both prices assumed upward trend till April 2008. From May 2008 to June 2013, fluctuations in both prices were undulated or did not exhibit any regular pattern. In summary, there was no significant deviation of rural market price from urban market price throughout the study period. The nature of fluctuation in rural and urban price of foreign rice, also suggests the existence of perfect price transmission mechanism for foreign rice marketing in the state.

3.3. Pearson Correlation Matrix of Average Monthly Prices of Local and Foreign Rice (₦/Kg) in Rural and Urban Markets in Akwa Ibom State, Nigeria

The linear and symmetric association between average monthly prices of local and foreign rice in rural and urban markets in Akwa Ibom State was captured by the estimation of the Pearson correlation coefficient presented in equation 4. Table 4 shows the correlation matrix of rural and urban average monthly prices of local and foreign rice from January 2005 to June 2013 in Akwa Ibom State, Nigeria. The result revealed that, prices of local and foreign rice in rural markets have positive significant (at 1% probability level) association with their corresponding prices in urban markets. This means that, the price of local rice in rural market has a strong linear relationship with its own price in urban market in Akwa Ibom State. The same result was also applicable to the foreign rice market. These results imply that, there is existence of price integration or perfect price transmission between rural and urban markets for local and foreign rice in the state. It could also be deduced from the result that, factors that influence price of local and foreign rice in the rural markets are similar to those in the urban markets in Akwa Ibom State. The result further indicates the insignificant roles of arbitrage activities and government interventions as well as activities of market/trade unions in the rice marketing business in Akwa Ibom State.

3.4. Bilateral Granger Causality Test for Prices of Local and Foreign rice in Rural and Urban Markets in Akwa Ibom State

The long run causality relationship between rural and urban prices for local and foreign rice was investigated in Akwa Ibom State. The result of the analysis is presented in Table 6. The result in Table 5 shows the optimal lag period needed in the causality equations specified in equations 5 to 8. The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.
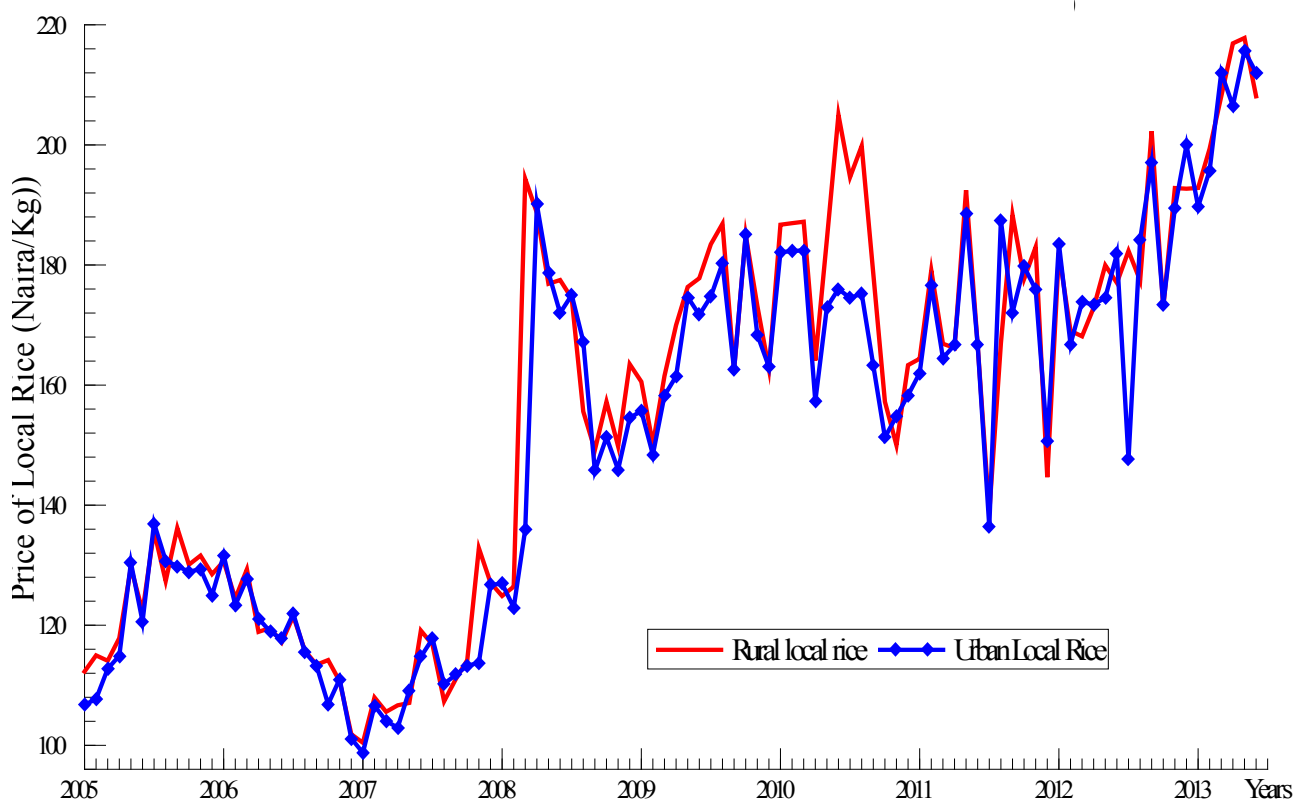
Figure 1. Trend in Prices of Local Rice in Rural and Urban Markets in Akwa Ibom State (2005-2013)
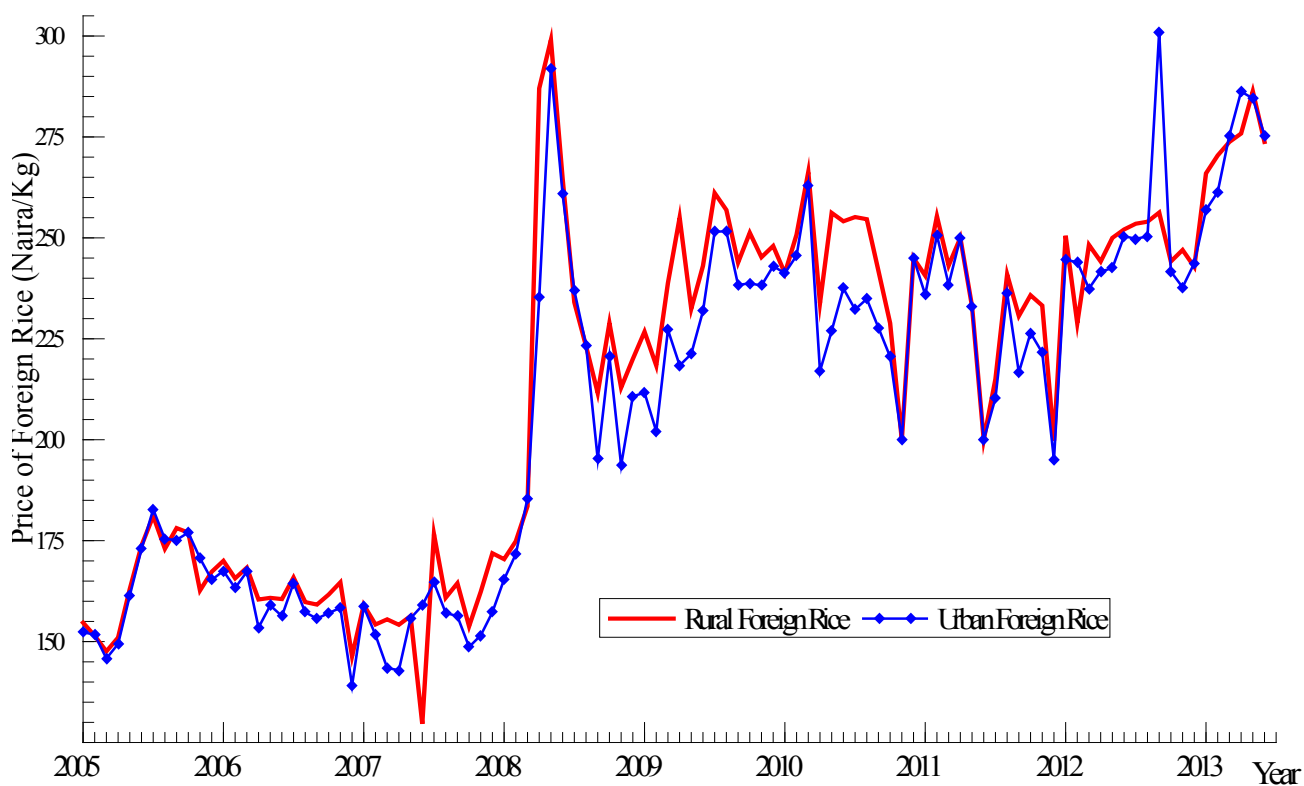

Figure 2. Trends in Prices of Foreign Rice in Rural and Urban Markets in Akwa Ibom State (2005-2013)

Table 3. Exponential Trend Analysis of Monthly Average Prices of local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State (January 2005 to June 2013)

Variables	LnP_{1t}	LnP_{2t}	LnP_{3t}	LnP_{4t}
Constant	4.72(189)***	4.70 (201.0)***	5.04 (203)***	5.01(215.0)***
Time	0.0059(13.9)***	0.0059(14.9)***	0.0059(14.1)***	0.0059(15.0)***
F- cal.	193.3***	221.1***	197.4***	225.8***
R-square	0.659	0.689	0.664	0.690
Exponential GR (%)	**0.59**	**0.59**	**0.59**	**0.59**
		Nature of Growth Rate		
Constant	4.69(124)***	4.69 (131)***	4.96(137)***	4.97(141)***
Time (b_1)	0.0077 (4.56)*	0.0066 (4.14)***	0.01 (6.36)***	0.008(5.09)***
Time (b_2)	-1.81e-05(-1.13)	-7.25e-06 (-0.48)	-4.37e-05(-2.85)***	-2.06e-05 (-1.31)
F- cal.	97.56	109.8	109.8***	114.9***
R-square	0.663	0.689	0.689	0.699
Inference	**Decelerated GR**	**Decelerated GR**	**Decelerated GR**	**Decelerated GR**

Note: Values in bracket represent t-values. The asterisks * and *** represent 10% and 1% significance levels respectively. Variables are as defined in equation 3.

Table 4. Pearson Correlation Matrix of Average Monthly Prices of Local and Foreign Rice in Rural and Urban Markets in Akwa Ibom State, Nigeria

Variables	LnP_{1t}	LnP_{2t}	LnP_{3t}	LnP_{4t}
LnP_{1t}	1.000	0.959 (0.000)***	0.927 (0.000)***	0.926 (0.000)***
LnP_{2t}		1.000	0.938 (0.000)***	0.946 (0.000)***
LnP_{3t}			1.000	0.970 (0.000)***
LnP_{4t}				1.000

Note: variables are as expressed in equations 3. Values in bracket are t-value probabilities; while values not in brackets are bi-variate correlation coefficients.

Table 5. The optimal Lag length for the causality equation

Lag	Loglikelihood	P(LR)	AIC	BIC	HQC
1	148.30	-	-2.935*	-2.857*	-2.904*
2	148.31	0.862	-2.916	-2.811	-2.873
3	148.38	0.732	-2.897	-2.765	-2. 843

Table 6. The Vector Autoregressive Regression Granger Causality estimates

Hypotheses	Lag	Sample size	F-Statistic	Prob.	Decision
ΔLnP_{1t} does not Granger Cause ΔLnP_{2t}	1	100	10.156	0.000***	Rejected
ΔLnP_{2t} does not Granger Cause ΔLnP_{1t}	1	100	3.622	0.030**	Rejected
ΔLnP_{3t} does not Granger Cause ΔLnP_{4t}	1	100	3.303	0.041**	Rejected
ΔLnP_{4t} does not Granger Cause ΔLnP_{3t}	1	100	3.099	0.049**	Rejected

Note: Variables are as defined in equation 3.

Table 7. Long run Relationships between prices of local and foreign rice in urban and rural markets in Akwa Ibom State

Variable	$LnP_{1t} = f(LnP_{2t})$	Variable	$LnP_{3t} = f(LnP_{4t})$
Constant	0.0919 (0.702)	**Constant**	0.0779 (0.647)
LnP_{2t}	0.9859 (37.74)***	LnP_{4t}	0.9901 (43.8)***
F-cal	1424.2***	**F-cal**	1917***
R^2	0.934	**R^2**	0.950
DW- test	1.967	**DW- test**	1.64
	ADF test for errors from above equations		
ECM_t	-9.775***		-8.234***

Note: the equation for the ADF test include constant and trend. Critical value at 1% = -4.05, Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are as defined in equation 3.

The corresponding lag length indicates the best lag length for generating a more parsimonious causality equation for the specified series. The result of the exercise indicated that lag 1 was more appropriate for the causality equations. This implies that, the causality equations generated were done by using one period lag of the variables involved. The bilateral Granger Causality estimates are presented in Table 6.

The result in Table 6, suggests that there is evidence of bi-directional Granger causality between urban price and rural price of local and foreign rice from January 2005 to June 2013 in Akwa Ibom State. This means that, the causality runs from urban market to rural market and vice versa. Alternatively, the urban price impact positively on the rural price; and in the same manner the rural price influences the urban price. The result could also be seen this way, that the previous price in urban market significantly predicted the current price in the rural market for both local and foreign rice in Akwa Ibom State. In a similar way, the previous price in rural market significantly determined the current price in the urban market for both local and foreign rice. For the local and foreign rice sub sectors in Akwa Ibom State, the urban market is the lead or stimulant market. This implies that, the bulk quantity of local rice consumed in Akwa Ibom State is not produced in the state. The presence of the bi-directional Granger Causality between the rural and urban prices of local and foreign rice indicate that the rural and urban market are co-integrated or there is a perfect price transmission mechanism between the two markets. The flow of markets information between rural and urban markets for local and foreign rice segment in this situation could be described as symmetric because the effect of externality costs are minimized. In addition, the result implies a perfect competitive market situation and strong endogeneity in rural and urban prices for local and foreign rice markets in the region. This result corroborates reports of Okoh *and* Egbon [32] in Nigeria and Dawson and Dey[45] in Bangladesh.

3.5. Co-integration Model for the Rural Price of Local and Foreign Rice in Akwa Ibom State

The result of the Engle and Granger two-step technique of co-integration regression tests for the residuals (ECM) generated in the long run equations specified in equations 9 and 10 is presented in the lower portion of Table 7. The results show that at 1% probability level of significance, the ADF for the residuals is greater than the critical value (-4.05). Thus the Engle–Granger co-integration tests reject the null hypothesis of no co-integration for the two equations. Hence, there exist long run equilibrium relationships between the rural and urban prices of local and foreign rice in the study area.

The Johansen co-integration test was used to verify the Engle Granger two-step methodology. The Johansen co-integration test result showed that, the trace and maximum eigenvalues were significant at first rank level. The result is presented in Table 8 for equation 9 and Table 9 for equation 10. The two results are similar, the calculated

trace test and maximum eigenvalue test statistics are greater than the critical values at 1% probability level. These further confirm the presence of at least one co-integration relationship among the specified price variables in the two equations. The upper part of Table 7 presents the long run estimates of equation 9 and 10.

Table 8. Results of Johansen Cointegration Test (unrestricted constant) for $LnP_{1t} = f(LnP_{2t})$

Rank	EigenValue	Trace test	p-value	Lmax. test	p-value
0	0.50189	92.132	[0.0000]	68.997	[0.0000]
1	0.20839	23.135	[0.0000]	23.135	[0.0000]

Unrestricted constant; Log-likelihood = 585.456 (including constant term: 304.506)

Table 9. Results of Johansen Cointegration Test (unrestricted constant) for $LnP_{3t} = f(LnP_{4t})$

Rank	EigenValue	Trace test	p-value	Lmax. test	p-value
0	0.43929	79.004	[0.0000]	57.277	[0.0000]
1	0.19705	21.727	[0.0000]	21.727	[0.0000]

Unrestricted constant; Log-likelihood = 589.194 (including constant term: 308.244)

Table 10. ECM estimates for $LnP_{1t} = f(LnP_{2t})$

Variable	Coefficient	Standard Error	t- value
Constant	-0.00022	0.00557	-0.03979
ΔLnP_{1t-1}	0.02908	0.11025	-0.26380
$\Delta Ln\ LnP_{2t}$	0.87903	0.07238	12.14000***
$\Delta Ln\ LnP_{2t-1}$	0.06906	0.10380	0.66530
ECM$_{t-1}$	-0.88130	0.15065	-5.85000***

R^2 = 0.643; F-cal. = 42.83***; DW = 1.985; Normality test = 36.419***; RESET test = 4.497**

Note: Values in bracket represent t-values. The asterisks * and *** represent 10% and 1% significance levels respectively. Variables are as defined in equation 3.

3.6. Error Correction Model for the Rural Price of Local and Foreign Rice in Akwa Ibom State

The presence of the co-integration among specified variables demanded the specification of the Error Correction Model. Table 10 contains estimates of the error correction model (ECM) generated for equation 11; while Table 11 contains estimates of ECM generated for equation 12. For equation 11 and 12, coefficients of the error correction term is negative and statistically significant at 1% probability level respectively. The result validates the existence of the long-run equilibrium relationship between the rural and urban market prices of local and foreign rice in Akwa Ibom State. The result further implies that, the rural prices of local and foreign rice are sensitive to departure from their equilibrium states or levels in the previous periods. For the

local rice, the slope coefficient of the error correction term (-0.881) represents the speed of adjustment and also is consistent with the hypothesis of convergence towards the long-run equilibrium once the price equation is disturbed. This means that, it will take the rural price of local rice about five weeks to adjust fully to equilibrium position in the long run due to disturbances in the marketing system in the study area.

The diagnostic test for the ECM model revealed R^2 value of 0.643 which means that the specified explanatory variables explained about 64.30% of the adjusted total variations in the rural price of local rice in Akwa Ibom state, Nigeria. The F-statistic of 42.83 is significant at 1% probability level, indicating that the R^2 is significant and this implies that the equation has goodness of fit.

Table 11. ECM estimates for $LnP_{3t} = f(LnP_{4t})$

Variable	Coefficient	Standard Error	t- value
Constant	0.00119	0.00476	0.2499
$\Delta\, LnP_{3t-1}$	-0.10705	0.10523	-1.0170
$\Delta Ln\, LnP_{4t}$	0.90806	0.06238	14.5600***
$\Delta Ln\, LnP_{4t-1}$	0.04245	0.10578	0.4013
ECM$_{t-1}$	-0.70426	0.13295	-5.2970***

R^2 = 0.715; F-cal. = 59.63; DW = 1.998; Normality test = 128.41***; RESET test = 8.428***

Note: Values in bracket represent t-values. The asterisks * and *** represent 10% and 1% significance levels respectively. Variables are as defined in equation 3.

For foreign rice, the slope coefficient of the error correction term is (-0.7043) and is statistically significant. The coefficient of the error correction term shows the speed of convergence to the long run equilibrium as a result of shock in the rural price of foreign rice. This indicates that, any disequilibrium in the long run of rural price of foreign rice would be corrected in the short run. The significant value implies that, the urban price will always react to bring stability in the rural price whenever there is significant variation in the rural price of foreign rice. About 70.43% of the rural price adjustment takes place within every month due to exogenous shock. The length of full adjustment is about five weeks. The result suggests that the urban price of foreign rice is strongly exogenous to the rural price of foreign rice in Akwa Ibom State. By implication, movements in the rural price of foreign rice are significantly detected by urban price. The diagnostic test for the ECM model for foreign rice revealed the R^2 value of 0.715; this means that the explanatory variables contained in the equation explain about 71.50% of the total variations in the rural price of foreign rice in Akwa Ibom state, Nigeria. The F-statistic of 59.63 is significant at 1% probability level, indicating that, the equation has goodness of fit.

The empirical results revealed that, the long run model for rural price of local and foreign rice in Akwa Ibom State converges to the postulate of the law of one price. The market integration coefficient for each of the commodity is approximately unity. This confirms the existence of the long run market integration between prices in rural and urban areas for local and foreign rice commodities in Akwa Ibom State. The constant terms in the two long run equations give the picture of the transfer cost or the extent of price differential between the rural and urban market due to arbitrage activities. The result further revealed insignificant influence of the transfer cost in the marketing process of local and foreign rice in the state. This perhaps suggests high efficiency in information transmission between rural and urban markets and improvement in the marketing infrastructures in the state. Okoh *and* Egbon[32] and Debaniyu,[46] have reported similar results for food stuffs in Nigeria. The result is however contrary to results reported by Akintunde *et al.,*[5] for other grains crop in Nigeria. Jezghani *et al.,*[43] in Iran, Chirwa[9] in Malawi, Suryaningrum *et al.,*[44] in Indonesia and Dawson and Dey[45] in Bangladesh obtained similar result in their respective country.

For the short run model, the result revealed that, the behavior of the rural and urban price of local and foreign rice also tended to the postulate of the law of one price. The coefficient of urban price was significant and also approached unity for both local and foreign rice. These results imply that, in the short run, there is high degree of market integration between rural and urban prices of local and foreign rice commodities in the State. Also, the degree of adjustment of the rural price of local and foreign rice to previous equilibrium once there is exogenous shock is 88.10% and 70.43% respectively. On the other hand, the adjustment of the urban price of local and foreign rice to exogenous shock was 88.39% and 67.28% respectively (Note, the summary of urban price ECM results are not presented in this report). The result shows that, the rural price of local rice appears to respond faster relative to foreign rice once there is an exogenous disturbance in the marketing process. Also, the urban price of local rice adjusted faster than its rural price counterpart. In addition, the rural price of foreign rice responded faster compared to urban price. These results imply that, the price transmission mechanism between rural and urban markets is faster and more efficient in local rice relative to foreign rice in Akwa Ibom State. This result is in agreement with research reports of Okoh *and* Egbon[32] and Debaniyu,[46] in Nigeria; Jezghani *et al.,*[43] in Iran, Chirwa[9] in Malawi, Suryaningrum *et al.,*[44] in Indonesia and Dawson and Dey[45] in Bangladesh.

3.7. Index for Market Concentration (IMC) for Local and Foreign Rice in Akwa Ibom State, Nigeria

The IMC was estimated for local and foreign rice commodities in the State. The estimates of IMC regression is shown in Tables 12 and 13 for local and foreign rice respectively. The IMC were 0.126 and 0.366 for local and foreign rice respectively.

The IMC for these commodities were less than unity. This implies that, there is high short run market integration between rural and urban markets for local and foreign rice

commodities in the state. The short run market integration was faster in the local rice relative to the foreign rice. This however confirms the ECM results discussed previously and further substantiates the perfect price transmission mechanism between rural and urban areas for rice market in Akwa Ibom State. Akintunde *et al.,*[5] had reported similar result for other grain crops in Nigeria.

Table 12. Estimates of IMC Regression for Local Rice in Akwa Ibom State, Nigeria

Variable	Coefficient	Standard Error	t- value
Constant	1.860860	4.7150	0.395
P_{1t-1}	0.112427	0.1080	1.041
$(P_{2t} - P_{2t-1})$	0.851705	0.0714	11.929***
P_{2t-1}	0.896000	0.1149	7.798***
$R^2 = 0.922$; F-cal. = 382.5***; DW = 1.970			

Note: Values in bracket represent t-values. The asterisks * and *** represent 10% and 1% significance levels respectively. Variables are as defined in equation 3.

Table 13. Estimates of IMC Regression for Foreign Rice in Akwa Ibom State, Nigeria

Variable	Coefficient	Standard Error	t- value
Constant	15.25561	5.3520	0.982
P_{3t-1}	0.264442	0.1051	2.516**
$(P_{4t} - P_{4t-1})$	0.902780	0.0633	14.262***
P_{4t-1}	0.730154	0.1099	6.644***
R2 = 0.9244, F-cal. = 547.9***; DW = 2.06			

Note: Values in bracket represent t-values. The asterisks * and *** represent 10% and 1% significance levels respectively. Variables are as defined in equation 3.

4. Summary and Recommendations

The study employed statistical and econometric techniques to analyze the price transmission and market integration of rural and urban prices of local and foreign rice in Akwa Ibom State, Southern Nigeria. The findings showed that, prices of local and foreign rice in rural and urban markets have positive relationship with time and constant exponential growth rate of 0.59%. The graphical analysis showed that, both rural and urban prices co-moved together with minimal deviations within the period under consideration. The result suggested the prevalence of efficient price transmission between rural and urban market for local and foreign rice in Akwa Ibom State. Also, the Pearson correlation coefficient matrix revealed that, the rural price of local and foreign rice have linear symmetric relationships with their corresponding urban prices in the study area. The result connotes the existence of symmetric market information flows between rural and urban markets in the state. The Granger causality test revealed bidirectional relationship between rural and urban price of local and foreign rice in Akwa Ibom State, southern Nigeria. This also

suggested that, the price transmission mechanism between the rural and urban markets for rice commodities is efficient; and a high tendency for market integration for the rice sub-sector in the state. The results of the co-integration test revealed the presence of co-integration between the rural and urban prices of local and foreign rice as well as expressed support to the hypothesis of perfect or fast price transmission between the two markets in the study area. The coefficients of the price variable in the co-integration equations for local and foreign rice market converged to unity which connotes market integration in the long run. The results of the short run model or ECM also confirm the existence of the short run market integration between rural and urban prices of local and foreign rice in the study area. In addition, it shows that, the rural price of local rice adjusted faster than the rural price of foreign rice once there is exogenous shock in the marketing process of rice in Akwa Ibom State. It was discovered that, the urban price of local rice adjusted faster than its corresponding rural price. Also, the rural price of foreign rice responded faster than urban price. The estimation of index of market concentration (IMC) supported the high short run market integration between prices in rural and urban markets for local and foreign rice commodities and the quick adjustment of prices in rural and urban markets of local rice relative to prices in rural and urban markets of foreign rice.

Based on the finding, it is recommended that, the Akwa Ibom State government should continue to improvise marketing infrastructures to improve the symmetric nature of information among participants in rice marketing in the state. The presence of excessive externality costs could distort the free flow of rice in rural and urban markets and bring about significant price differential between the two markets in the state; thus government should endeavor to dismount all sources of such costs in the state. The Akwa Ibom State is surrounded by rice producing areas and major commercial towns in the region. The uncontrolled infiltration to the state of rice commodities might induce undue competition on local producers. In as much as rice market integration is a healthy economic situation, there is overwhelming need to check excessive inflow of rice commodities from the neigbouring states in order to boost local production.

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