

## **Price Transmission between Local and Imported Rice Markets in Southwest Nigeria: A Vector Error Correction Model (VECM) approach**

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### **Abstract**

High cost of importation in recent years has highlighted the desire by the government to encourage import substitution by encouraging increased local production after some positive import liberalization developments in Nigeria in late 2008 that resulted in increased rice exports in Nigeria. The Country has experienced a fairly dramatic increase in price of imported rice in past years. The effect of the reduction in import tariffs and liberalization of marketing channels on price transmission between agricultural commodity markets in Nigeria has been a source of a national trade conflict since the mid 1980s. The conflict is based on the view that import trade liberalization destroyed the domestic markets of import substitutes and one of Nigeria's import substitutes whose marketability, price and production are believed to be adversely affected by import liberalization is rice. To understand what role liberalization plays in this regard, the transmission of price signals between imported and local rice prices from 2004 to 2013 in Southwest Nigeria was examined. The results reveal the existence of long-run equilibrium relationships and complete transmission of price shocks from imported to local rice prices, but local rice dominates prices of the imported rice. Thus, banning rice imports is not an option to consider but rather encouraging quality improvement of local rice through improved processing techniques to enhance competitiveness between the two grades of rice should be a key concern of government.

**Keywords:** Local Rice; Imported Rice; Price Transmission; VECM

### **Introduction**

Rice is not a traditional Nigerian staple food, but it is fast becoming an important part of the daily Nigerian menu, both in terms of its caloric value and share of the household budget. Nigerians, urban and rural households eat rice not only as a source of calories but also as a convenient food. It is not surprising that rice is one of five staple crops recommended by Agricultural Transformation Agenda

towards the attainment of Millennium Development Goal on reduction of poverty and hunger. Rice consumption is increasing in Nigeria because of population growth and rising incomes. However, imported parboiled rice competes effectively and is highly favoured as against other basic food staples, which explains why import volumes have remained large. Rice is a regular item in the Nigerian diet, largely because of the convenience it provides and

the variety of ways it can be prepared. The bulk of parboiled rice imported into Nigeria come from India, Brazil, Thailand and China. Imported rice have dominated the urban markets across states in Nigeria because it meets consumer demand in urban areas where incomes are highest. The quality of locally produced rice has improved considerably. For instance, the locally produced Ofada rice in Ogun State Nigeria is a national delicacy and is offered to consumers at a premium. Local alternatives such as yam, cowpea, and maize, are in small supply and cost more than in years past. Despite recent efforts to boost domestic production of rice, it is unlikely to significantly affect imported rice. The annual rice demand in Nigeria is estimated at 5 million tonnes out of which only about 2.2 million tonnes is produced locally. The annual rice supply gap of about 2.8 million tonnes (or 56% of demand) is bridged by importation (Kassali *et al.*, 2010).

Over the years, most research efforts have been geared toward increasing local rice production with the quest for self-sufficiency in its production, the desire to make local rice compete favourably with imported rice, and also the desire to stop the excessive outflow of foreign exchange for importing rice and indeed the desire to raise local rice consumption in Nigeria (Daramola, 2005). Sadly, little importance has been given to research and development of the country's rice marketing and distribution system to the extent it deserves. Only few studies have been devoted to examining the competitiveness and efficiency of the local rice market in Nigeria.

According to Fafchamps *et al.* (2003), the liberalization of market varied from

place to place and that price movement affect both international and domestic markets. Staatz *et al.* (1989) observed that market liberalization is generally true in Africa and particularly in Nigeria that market prices do not increase proportionally with trade volume. Abalu (1986) observed that the presence of a large number of traders for a commodity grain suggests that competition is getting fierce and the proportions of sampled market participants shows that wholesalers and retailers are the two most dominant groups in the rice markets.

The dramatic increase in the price of rice across spatially separated markets over the years has generated a new interest in market integration and price transmission. The global issue of spatial market integration lies at the heart of many contemporary debates concerning market liberalization, price policy and parastatals reforms in developing countries. Integration of agricultural commodity in rural and urban food markets is also a precondition for effective reform in formerly centrally planned economies. Without spatial integration of market, price signals will not be transmitted among spatially separated markets usually from food surplus (rural/export) to food deficit (urban/import) markets (Goletti, *et al.* 1995; Barrett, 1996; Baulch, 1997). Market based policies for poverty alleviation and food security could be more effective if markets are integrated. Besides, if markets are integrated, the effect of policy intervention in one market would be transmitted to other markets that it avoids duplication of intervention and, as a result, decreases the fiscal burden on the budget (Baulch, 1997).

In a perfectly competitive market, the price difference between any two spatially

separated markets with regard to homogeneous commodities is expected to be equal to the transaction cost at equilibrium level. When the price difference exceeds the transaction cost between the two markets, arbitrage opportunities will be created and profit-seeking traders will exploit profitable opportunities by transporting commodity from a low-price to a high-price area. However, if traders do not have up to date information of prices in other market, they cannot respond quickly to profitable opportunities. This therefore, impede the process of spatial arbitrage that transmit price from one market to another (Minot, 2010). The role of a marketing system towards efficient contribution positively to the development of a country depends on the ease with which price changes and responses are transmitted spatially and temporally between different levels of markets reflecting the extent of market integration and extent to which market function efficiently.

The paper examined the transmission of price signals between retail prices of two distinct rice grades - imported and local rice to establish whether there is a long-run, equilibrium relationship between the two i.e. whether price changes of imported rice affects prices of local rice in Southwest Nigeria. Secondly, the study determine whether imported rice prices dominate local rice prices or vice versa. The research question is, do Southwest Nigeria local rice prices adjust to changes in the imported price of rice, and are these changes quickly or sluggishly transmitted to the local rice prices?. The markets under analysis include Southwest Nigeria biggest producer of local rice popularly called Ofada rice in Ogun State and the three neighbouring States ( Lagos, Ondo

and Oyo States).

The study hypothesized that changes in imported rice price signals do not affect prices of local rice in Southwest Nigeria, and that imported rice price changes lead to local rice prices in the price determination process. The analysis for imported rice/local rice prices within selected markets is tantamount to vertical price transmission with the two grades of rice representing different stages of the product; while the analysis assessing the linkage between imported rice prices in the reference state and local rice prices are similar in concept to spatial price transmission.

## **Methodology**

### **Sources of Data**

Time series data from Secondary source were used for this study, this employed the use of time series data. A monthly data of retailed rural and urban market prices of local rice and imported rice at N/kg between 2004 and 2013 obtained from five State's Agricultural Development Programmes in Lagos, Oyo, Ogun, Osun and Ondo (LASADA, OYSADEP, OGADEP, OSSADEP and ONSADEP). The data set was also restricted to the period January 2004 – December 2013, because this was the period for which complete data set for the analysis could be obtained. Ogun State was set as a reference market prices. This was based on the availability of data, geographical location of markets and levels of production of the local rice and it closeness to Seme border.

### **Analytical Techniques**

Vector Error Correction Model (VECM) was employed in the study. In addition the model includes unit root test

that determines the special time series properties of the data, while co-integration analysis is a prerequisite for applying the VECM, as well as analysis of Granger causality.

**Model Specification**

Most price transmission analyses are based on the “Law of One Price” (LOP) theory, in which an equilibrium price among spatially separated markets exists as defined by Enke (1951), Samuelson (1952), and Takayama and Judge (1971). The contemporaneous relationship between two prices,

$$P_t^m = P_t^l + D_t^{m,l} \dots\dots\dots(1)$$

Where  $D_t^{m,l}$  is the price differential between imported and local rice. The price differential represents the difference in the attributes of the two grades of rice as a result of consumers adjusting for quality. According to the LOP, perfect price transmission across the two grades of rice holds only if (1) is met.

It is assumed for this study that urban prices of selected food grains in a reference state is determined principally by its rural price, the rural price in the neighboring states and urban price of imported rice in case of rice. The economic model for this study is specified in double logarithmic form as follows:

$$\ln P_{it}^u = \beta_0 + \beta_1 \ln P_{it}^r + \beta_2 \ln P_{it}^m + \beta_3 \ln P_{it}^i + \varepsilon_i \dots\dots(2)$$

- $P_{it}^u$  = log of urban price of local rice (reference State) in N/kg
- $P_{it}^r$  = log of rural price of local rice (reference State) in N/kg

- $P_{it}^m$  = log of rural price of local rice (neighbouring States) in N/kg
- $P_{it}^i$  = log of urban price of imported Rice in reference State N/kg,
- $\beta_0$  is a constant term,  $\beta_1$  to  $\beta_3$  are estimated parameters in the model and  $i$  is a cross-section data for states referred to, and  $t$  is time and  $\varepsilon_{it}$  is an error term.

**Test for Order of Econometric Integration (unit root test)**

A stationary series is one with a mean value which will not vary with the sampling period i.e. time invariant. In contrast, a non-stationary series will exhibit a time varying mean (Juselius, 2006). 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 Augmented Dickey Fuller (ADF) methods is based on analysis of the following model;

$$\Delta P_{it} = \delta P_{t-1} + \beta_1 \Delta P_{t-1} + \dots\dots\dots(3)$$

- Where
- $\Delta$  = first difference operator (Difference term)
- $P_{it}$  = local and imported rice price series investigated for stationarity
- $t$  = time or trend variable.

The test of the null hypothesis of equation (1) shows the existence of a unit root when against alternative hypothesis of no unit root when  $\delta = 1$ . The null hypothesis of non-stationarity is rejected when the absolute value of the test statistics is greater than the critical value.

When is non-stationary, it is then examined whether or not the first difference is stationary.

**Long-run equilibrium Relationship**

Two or more variables are said to be co-integrated if each is individually, non-stationary (i.e. has one or more unit roots), but there exists a linear combination of the variables that is stationary. This implies the existence of long-run equilibrium between the variables. In any variables exhibiting co-integration, derivations from the short-run equilibrium may occur in the short-term, but their linear combination will return eventually to a constant mean.

If the prices for the imported and local grades of rice, denoted  $P_t^m$  and  $P_t^l$  time series variables that contain stochastic trends and are integrated of the same order e.g. I(d), then they can be said to be co-integrated in a long run. Equilibrium relationship between the two prices can be stated as:

$$P_t^m - \beta P_t^l - \varepsilon_t \sim I(0)$$

Johansen vector autoregressive (VAR) approach was used to test for the existence of a cointegration relationship between  $P_t^m$  and  $P_t^l$ . If the imported and local rice prices,  $P_t^m$  and  $P_t^l$  cointegrated, the VECM representation of price transmission between the two commodities is specified by stating the changes in each of the contemporaneous prices  $P_t^m$  and  $P_t^l$  as a function of the lagged short term reactions of both prices  $P_{t-k}^m$  and  $P_{t-k}^l$  and their deviation from equilibrium at period t-1 as used by Amikuzozo *et al.* (2013) is as follows:

$$\begin{pmatrix} \Delta P_t^m \\ \Delta P_t^l \end{pmatrix} = \begin{pmatrix} \alpha_m \\ \alpha_l \end{pmatrix} - \begin{pmatrix} \alpha_m \\ \alpha_l \end{pmatrix} (P_{t-1}^m - \beta P_{t-1}^l) + A_1 \begin{pmatrix} \Delta P_{t-1}^m \\ \Delta P_{t-1}^l \end{pmatrix} + \dots + A_k \begin{pmatrix} \Delta P_{t-1}^m \\ \Delta P_{t-1}^l \end{pmatrix} + \begin{pmatrix} \mu_t^m \\ \mu_t^l \end{pmatrix} \dots \dots \dots (4)$$

Where  $\Delta P_t^m$  and  $\Delta P_t^l$  are a vector of first differences of the imported and local rice prices respectively;  $\alpha^m$  and  $\alpha^l$  are a vector of constant terms that denote long-run, inter-market price margins. Because the prices are expressed in their natural log values, the  $\alpha^m$  and  $\alpha^l$  are the elasticity of the imported rice price with respect to the local rice price and the elasticity of the local price with the respect to the imported price respectively. The co-integrating equation  $(P_t^m - \beta P_{t-1}^l)$ , the error correction term; so named because it depicts deviations from the long run relationship or 'errors' that are 'corrected' by the price transmission process,  $\beta$  is the co-integrating vector  $\alpha^m$  and  $\alpha^l$  are called the loading or error correction coefficients since they measure the extent to which  $P_t^m$  and  $P_t^l$  error are correct i.e. adjust towards restoring the long run equilibrium relationship between them. The  $\alpha^m$  and  $\alpha^l$  are also known as the elasticity of price transmission or the speeds of price adjustment by the imported rice and local rice prices respectively, to deviations from long-run equilibrium. The coefficient  $\beta$  to random shocks. Finally  $\mu_t^m$  and  $\mu_t^l$  are white noise error terms and  $k$  is the number of lags included in the model.

The existence of co-integration between  $P_t^m$  and  $P_t^l$  implies Granger causality (Granger, 1987) and since co-integration between variables does not automatically imply causality between them, the evidence of causality between the variables must be provided by Granger causality analysis. The Granger causality models applied in this study are specified in equations (5) and (6) . The Granger causality model following Kareem *et al.* (2011) is specified below:

$$P_t^m = \sum_{k=1}^{11} \alpha_k P_{t-1}^l + \sum_{k=1}^{12} b_k P_{t-1}^m + \varepsilon_{1t} \dots\dots\dots(5)$$

$$P_t^l = \sum_{k=1}^{13} \alpha_k P_{t-1}^l + \sum_{k=1}^{12} b_k P_{t-1}^m + \varepsilon_{2t} \dots\dots\dots(6)$$

The equation (5) postulates that,  $P_t^m$  dependent on  $P_{t-1}^m$  and  $P_{t-1}^l$  conversely, equation (6) postulates the same (theoretically) for  $P_t^l$ . The  $\varepsilon_{1t}$  and  $\varepsilon_{2t}$  are uncorrelated error terms. A proof of causality between the imported and local rice prices implies that the variability of either price overtime can be explained by varying episodes of the other over the same period of time. The variant of the Granger causality tests run in this paper is based on VAR.

**Results and Discussion**

**Augmented Dickey Fuller Unit Root Results**

The results of the ADF test shows that at the 1%, 5% and 10% significance levels with critical values of -3.49, -2.89 and -2.57, the null hypothesis of unit root,  $H_0: r = 0$  i.e. the series is non-stationary, cannot be rejected for all the price series in their levels. As expected, the null hypothesis is rejected at first difference of all series and testing for stationarity. This implies that the price series are integrated of order one at  $p < 0.01$ . This confirmed that the price series are characterized by the same stochastic processes and capable of exhibiting long run relationship.

Having confirmed that the price series were stationary in their first difference, co-integration among the selected markets was performed using the Johansen's

multiple co-integration method. Results of the Johansen's test is presented in Table 2. The Johansen trace test for cointegration (Johansen, 1991) rejects the null hypothesis that there is no cointegrating vector in favour of the alternative hypothesis that there is one cointegrating vector in each of the local rice/imported rice price pairs in the selected markets. The test were conducted at the 95% confidence levels in a specification of the Johansen's VAR approach containing a constant and a trend term as revealed in the graphical plots of both types of price series.

The findings suggest that, there exists at least one equilibrium cointegration relationship ( $r = 1$ ) between imported and local rice prices in the selected rice markets over the period of the analysis. The strong evidence that local rice and imported rice prices within these Southwest Nigerian markets are integrated indicates that shocks on the international prices of rice may be passed on to local rice prices in the long run and that there may be causality at least in one direction, most probably from the imported rice price to the local rice price.

International price shocks may influence local price dynamics because of the low market share of local rice, the high levels of rice imports, and the small size of local rice market compared to the international market for rice. The results also suggest that participants in Southwest Nigeria local rice marketing system make full use of available market information (Alderman, 1992). This suggests that the markets may be efficient since market integration has been used as a measure of market efficiency.

**Table 1: ADF Unit Root Tests on the Monthly Price Series**

Series/ States	Test at level 1(0)					Test at First Difference 1(1)				
	Lagos	Oyo	Ogun	Osun	Ondo	Lagos	Oyo	Ogun	Osun	Ondo
<b>Local Rice</b>										
Rural	-1.96	-1.45	-2.45	-2.36	-2.19	-14.60**	-13.29**	-9.91**	-14.48**	-15.73**
Urban	-1.64	-1.76	-0.43	-1.65	-2.33	-15.92**	-11.20**	-9.66**	-13.18**	-16.93**
<b>Imported Rice</b>										
Rural	-1.72	-0.73	-0.51	-1.95	-2.39	-14.24**	-14.27**	-10.62**	-10.85**	-15.84**
Urban	-1.99	-2.43	-0.37	-2.67	-2.37	-10.04**	-10.53**	-9.99**	-14.39**	-14.50**

**Source:** Data analysis, 2013

\*\*\*, \*\* and \* denote rejection of the null hypothesis at the 1%, 5% and 10% significance levels. The respective critical values at the 1%, 5% and 10% significance levels are -3.49, -2.89 and -2.57 for the ADF test.

**Table 2. Results of Co-integration Tests**

Series	No. of Lags	Hypothesized No. of Co-integrating equations (CEs)	Trace Test		Hypothesized No. of co-integrating equations (CEs)	Maximum Eigen Test	
			Statistics	Critical value P(<0.05)		Statistics	Critical value (p<0.05)
Rice	2	None**	92.78224	88.80380	None**	47.67425	38.33101
		At most 1	62.10799	63.87610	At most 1	30.84417	32.11832
		At most 2	23.26381	42.91525	At most 2	13.53799	25.82321
		At most 3	9.725820	25.87211	At most 3	6.249677	19.38704

**Source:** Data analysis, 2013

In choosing the lag length, the studies focus on Hannan Quinn and Schwartz Information criteria as they are consistent particularly in large samples (Paulson 1984, Tsay 1984, Lutkepohl 1997).

**Degree and Speed of Price Transmission between Rural and Urban Local and Imported Markets**

The existence of co-integration between the dependent variables and their hypothesized determinants necessitated the specification of Vector Error Correction Model for this study. According to Gujarati (2004), if two variables X and Y are co-integrated, then the relationship between them can be expressed using the error correction mechanism.

VECM has a way of reconciling the long run and short run components. The coefficients in the co-integrating equation in each of the model give the estimated long run relationship among the price variables. Considering the changes in the prices of local and imported rice, attempt was made to understand transmission of price signals from one state to another and their degree of association. The estimated long run relationship (t-ratio in parentheses), based on normalization i.e. normalized equation in respect of the Urban prices of selected food grains and their hypothesized determinants are written below:

$$\ln UPLROGS_t = 167.22 - 0.00 \ln RPLRLS_{t-1} + 2.13 \ln RPLROGS_{t-1} + 0.45 \ln RPLRONS_{t-1} + 0.24 \ln RPLROY_{t-1} + 3.55 \ln UPIROGS_{t-1} \quad (1)$$

(-2.49)      (8.18)      (5.16)      (6.55)      (3.54)

The estimated co-integration elasticity coefficients (β) represent the long run responsiveness of urban price local rice in

reference State to their rural prices, the rural prices in the neighboring States and to imported rice prices. These are strongly and positively significant in all cases except one – rural price of local rice in Lagos State (RPLRLS). There is a low and negative sensitivity of urban price of local rice in Ogun State (RPLROGS) to rural price of local rice in Lagos State, which is in an area of deficit rice production.

The estimated elasticity of -0.001 implies that a 1% any price shock that raises the rural price of local rice in Lagos state will cause a 0.001% downward shock in urban price of local rice in Ogun state in the long run.

The estimated elasticity of 3.55 implies that a 1% any price shock that raises the urban price of imported rice in Ogun state (UPIROGS) will cause a 3.55% upward shock in urban price of local rice in Ogun state in the long run. This is case of complete price transmission between imported and local rice in the reference State.

A complete price transmission exist between urban prices of local rice in the reference state and their rural prices as well as the urban prices of imported rice in the long run. This implies that rural market prices in the references state (Ogun State) and urban market price of imported rice in the reference State (Ogun State) dominate urban price of local rice in the long run.

Having determined the co-integration relationships and long run elasticity coefficients, we estimate the Vector Error Correction Model (VECM) of price transmission to examine the extent of price transmission between local and imported rice prices within the major Southwest Nigeria rice markets. The VECM results in Table 3 showed that variables in the VECM

significantly explained short run changes in UPLROGS, RPLRLS and RPLROGS at  $p < 0.05$  accounting for 53%, 56% and 65% respectively of the short run variation in the series; but not those of Rural Price of Local Rice in Ondo and Oyo States (RPLRONS, RPLROYS) and UPIROGS. This implies that when urban market of local rice in Ogun State is the dependent variable, a greater percentage (53%, 56% and 65%) of its prices is explained by the current and previous prices in RPLRLS and RPLROGS as its previous prices.

The coefficients of the error correction term show the speed of convergence to the long run equilibrium as a result of shock of their own prices. The error correction coefficients in the UPLROGS, RPLRLS and RPLROGS were significant ( $p < 0.01$ ) and associated with the desirable negative signs. Hence, UPLROGS in Southwest, Nigeria adjusts significantly to shocks to its equilibrium relationship with its hypothesized determinants that are caused by exogenous changes in past values of UPLROGS, RPLRLS and RPLROGS. This implies that these variables significantly adjusted as to warrant their error correction modeling indicating any disequilibrium in the long run urban price would be corrected in the short run thus, the short run price movements along the long run equilibrium path may be stable.

The significant value implies that there is a conservative force tendency to bring the model back into equilibrium whenever it strays too far. Although the coefficient of the error correction term for Ondo and Oyo States has the incorrect signs and it is not significant showing that the short run price movements along the long run equilibrium path may be unstable. The coefficient of the error correction term for urban price of

imported rice in Ogun State has the correct signs and it is significant but it is low when compare to other significant coefficients.

Effects on UPLROGS of shocks that destabilizes the equilibrium relationship between UPLROGS and its determinants are corrected within 1.9 months (57 days). The speed of adjustment of 53%, 56% and 64% from the short run to the long run equilibrium is relatively high as compared to a perfect adjustment of 100% threshold. This indicates that there is a strong integration among the three markets.

Comparing the short and long term coefficients (elasticities), RPLRLS, RPLROGS, RPLROYS and UPIRLS significantly influence UPLROGS in the long run, their (RPLRLS and RPLROGS) short run impacts on UPLROGS were also significant with past values of UPLROGS, RPLRLS and RPLROGS being the main determinants of the current value of UPLROGS.

### **Direction of Causality between Local Rice and Imported Rice Prices**

This analysis was necessitated by the statement of Gujarati (2004) that although regression deals with the dependence of one variable on other variables, it does not necessarily imply causation. Tables 4 presents the results of pairwise Granger causality analyses for rice, cowpea and maize markets. Table 4 revealed that 38 rice market links were investigated for evidence of Granger causality. 21 markets links rejected their respective null hypotheses of no granger causality. Only 4 of the markets links exhibited bi-directional granger causality or simultaneous feedback relationship while 17 exhibited uni-directional granger causality. The results showed that Urban

Price of Imported Rice in Lagos State (UPIRLS) granger cause Rural Price of Local Rice in Ogun State (RPLROGS); Rural Price of Local Rice in Oyo State (RPLROYS) granger cause Urban Price of Local Rice in Lagos State (UPLRLS) and Urban Price of Imported Rice in Ogun State (UPIROGS) granger cause Rural Price of Local Rice in Oyo State (RPLROYS) bi-directionally. This implies that past values of UPIRLS, RPLROYS and UPIROGS have a predictive ability in determining the present/current values of RPLROGS, UPLRLS and RPLROYS and vice versa. It was also revealed that Rural Price of Imported Rice in Lagos State (RPIRLS) granger cause UPLRLS, RPLROGS granger cause UPIROGS and the Urban Price of Imported Rice in Oyo State (UPIROYS) granger cause RPLROYS uni-directionally. This implies that past values of RPIRLS, RPLROGS and UPIROYS have a predictive ability in determining the present/current values of UPLRLS, UPLROGS and RPLROYS.

Rural Price of Local Rice in Lagos State RPLRLS has a strong exogeneity over rural and urban market prices of other states. Some of the market series are spatially linked by trade. Therefore, there is moderate market integration between the rural and urban markets. The implication of this is that price changes in one market are manifested to an identical price response in other market (Goletti *et al.* 1995, Barrett, 1996, Adeoye *et al.* 2010). There is also adequate free flow of rice between the markets and the markets are moderately linked by efficient arbitrage.

The result of the granger causality test also confirmed that RPLRLS occupied the leadership position in price formation and

transmission. This is because price formed in RPLRLS is efficiently transmitted to the other (follower) markets (RPLROGS, RPLROSS and RPLROYS) with very minor distortions during the transmission process.

### Conclusion

This paper evaluated price transmission and integration between local and imported rice markets in Southwest Nigeria. The study investigated price transmission and integration of local and imported rice market price series. In determining long-run dynamics in price relationships, the study first established the order of econometric integration of the price series so as to be able to overcome the problem of spurious regression. All the price series showed econometric integration of the order I (1) meaning that similar stochastic processes generated these series.

Johansen (1992, 1995) system based co-integration tests revealed that linear combinations of the price series on urban prices of selected food grains in the numeraire states and their determinants were stationary, thus exhibiting long run equilibrium relationships. The study found one Co-integrating equation exist among their linear combination i.e. one co-integration vector in all variants of the VAR system specified. This suggests that the markets were efficient since market integration has been used as a measure of market efficiency.

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**Table 3: Result from Vector Error Correction Model for the selected rice markets**

Error correction	D(UPLROGS)	D(RPLRLS)	D(RPLROGS)	D(RPLRONS)	D(RPLROYS)	D(UPIROGS)
cm(-1)	-0.531629 (3.67661)	-0.61258 (-3.25526)	-0.549080 (3.18286)	0.108449 (0.72997)	0.468359 (6.07936)	-0.213397 (-3.33547)
Δ(UPLROGS(-1))	-0.352457 (-2.00292)	0.010029 (2.02306)	0.153996 (0.71170)	-0.406370 (-1.38644)	-0.429653 (2.82679)	0.087625 (0.76290)
Δ(UPLROGS(-2))	-0.466591 (-1.71745)	-0.000292 (0.00070)	-0.066880 (-0.36020)	-0.282089 (-0.99762)	0.007956 (0.19240)	0.081509 (0.73560)
Δ(RPLRLS(-1))	0.038867 (0.80278)	-0.370134 (-3.12881)	0.033068 (0.57172)	-0.073667 (-0.92380)	0.007956 (0.19240)	-0.007343 (-0.23449)
Δ(RPLRLS(-2))	0.023465 (0.48901)	0.095169 (0.81171)	-0.015150 (-0.25967)	-0.195100 (-2.46868)	0.022084 (0.53884)	0.000379 (-0.01222)
Δ(RRG(-1))	0.187118 (1.68003)	-0.185205 (-0.69525)	-0.430732 (-3.18058)	0.035193 (0.19184)	0.324231 (3.40823)	0.002490 (0.03464)
Δ(RRGL(-2))	0.140820 (1.12900)	-0.215268 (-2.70634)	-0.383267 (-2.52714)	0.115402 (0.56176)	0.289115 (2.71384)	0.088249 (1.09619)
Δ(RPLRONS(-1))	-0.202084 (-2.16889)	-0.089886 (-0.39284)	-0.201344 (-1.77723)	-0.540084 (-3.51930)	-0.166666 (-2.09429)	0.122306 (2.03377)
Δ(RPLRONS(-2))	-0.113975 (-1.23290)	-0.095928 (-0.42469)	0.250078 (-2.22480)	-0.207373 (-1.36194)	0.035504 (-0.44966)	0.072655 (1.21767)
Δ(RPLROYS(-1))	0.570096 (2.97006)	-0.194800 (-2.415353)	0.636110 (2.72505)	0.335513 (1.06124)	0.386105 (2.35508)	-0.319525 (-2.57913)
Δ(RPLROYS(-2))	0.540892 (3.22774)	-0.502526 (-1.22731)	0.713180 (3.50014)	0.169555 (0.61431)	0.432387 (3.02096)	-0.375198 (-3.46893)
Δ(UPIROGS(-1))	-0.120501 (-0.59615)	0.044474 (0.09059)	-0.215451 (-0.87662)	-0.232594 (-0.69863)	-0.234691 (-1.35939)	0.051624 (0.39569)
Δ(UPIROGS(-2))	-0.275526 (-1.48485)	0.714718 (1.57638)	0.350740 (-1.55454)	-0.204439 (-0.66892)	-0.098295 (-0.62021)	0.307202 (2.56501)
σ	0.021980 (2.25405)	0.029320 (1.23059)	0.037945 (3.20032)	0.022779 (1.41830)	-0.004975 (-0.59379)	0.003493 (0.55493)
adj.R-Squared	0.533554	0.560403	0.646641	0.091211	0.434856	0.149784
F-Statistics	3.141655	3.455363	2.936234	1.409493	4.139399	1.718781
log likelihood	-36.0551	-44.03624	-15.9192	-84.65831	-52.2972	-81.1514

Figures in parentheses are t-values associated with the respective parameters.

Source: Data analysis, 2013

RPLROSS and RPLROYS) with very minor distortions during the transmission process. These markets are the ones to be targeted for experimental pricing policy directed at reducing local rice price and boosting its consumption. By exercising exogeneity over other markets, prices formed in them will be efficiently transmitted to the follower markets with little or no distortions. If a follower market acts as the point of first implementation of such pricing policy, in spite of a good performance in the short-run, the effects will be aborted in the long-run and the

benefits will fail to reach the targeted beneficiaries such as market intermediaries, transporters, agents and end-users.

From the long run VECM results, it was also confirmed that positive relationship and complete price transmission exist between urban and rural prices of local rice and urban price of imported rice in the reference state in the long run. This implies that rural market prices in the reference states dominate and urban market price of imported rice in the reference state dominate urban price of

**Table 4. Pairwise Granger Causality Result of Rice Markets**

Null hypotheses	F-statistic	Probability
RPLROYS does not granger cause UPLROGS	0.4353	0.7828
UPLROGS does not granger cause RPLROYS	2.4049	0.0549*
RPLRONS does not granger cause RPLRLS	1.7469	0.1461
RPLRLS does not granger cause RPLRONS	4.9185	0.0012***
RPLRLS does not granger cause UPLRLS	3.9377	0.0225**
UPLRLS does not granger cause RPLRLS	0.4728	0.6246
RPLROYS does not granger cause UPLRLS	0.6982	0.4998
UPLRLS does not granger cause RPLROYS	3.5643	0.0319**
RPIRLS does not granger cause UPLRLS	9.0682	0.0002***
UPLRLS does not granger cause RPIRLS	1.0154	0.3659
UPIRLS does not granger cause RPLRLS	5.1031	0.0009***
RPLRLS does not granger cause UPIRLS	2.1351	0.0824*
RPLROYS does not granger cause RPLROGS	0.5305	0.7135
RPLROGS does not granger cause RPLROYS	2.7103	0.0346**
UPIROGS does not granger cause RPLROGS	0.6955	0.5969
RPLROGS does not granger cause UPIROGS	2.8533	0.0278**
RPLROYS does not granger cause RPLRONS	1.4738	0.2162
RPLRONS does not granger cause RPLROYS	4.2611	0.0032***
UPIROGS does not granger cause RPLRONS	1.2634	0.2898
RPLRONS does not granger cause UPIROGS	3.0638	0.0953*
UPIROGS does not granger cause RPLROYS	3.0262	0.0213**
RPLROYS does not granger cause UPIROGS	3.6254	0.0085***
RPLRLS does not granger cause UPLROYS	2.7260	0.0337**
UPLROYS does not granger cause RPLRLS	1.2670	0.2884
RPLROGS does not granger cause UPLROYS	2.0250	0.0970*
UPLROYS does not granger cause RPLROYS	0.3615	0.8353
RPLROSS does not granger cause UPLROYS	5.1350	0.0008***
UPLROYS does not granger cause RPLROSS	1.6190	0.1758
UPIROYS does not granger cause RPLROYS	5.4539	0.0005***
RPLROYS does not granger cause UPIROYS	1.1849	0.3224
RPLROSS does not granger cause RPLRLS	1.5296	0.1997
RPLRLS does not granger cause RPLROSS	3.4320	0.0115**
UPIROYS does not granger cause RPLRLS	0.9403	0.4441
RPLRLS does not granger cause UPIROYS	3.9891	0.0049***
RPLROYS does not granger cause RPLROSS	0.4470	0.7741
RPLROSS does not granger cause RPLROYS	5.8931	0.0002***
UPIROYS does not granger cause RPLROSS	5.4539	0.0005***
RPLROYS does not granger cause UPIROYS	1.1849	0.3224

\*\*\*, \*\* and \* implies statistic is significant at  $p < 0.01$ ,  $0.05$  and  $p < 0.1$

Source: Data analysis, 2013

local rice in the long run.

This paper concluded that RPLRLS occupied the leadership position in price formation and transmission. This is the central market influencing price transmission of Local and imported rice in southwest, Nigeria. Hence, prices in other markets were dependent on their past values and on current and past values of this central market price.

A strong markets integration and complete price transmission exist for urban and rural markets prices of local rice and urban market price of imported rice in the reference state. Although, because of the perceived quality difference between imported and local rice, the price move together to some degree but price transmission will not be perfect. Hence, elasticity coefficient ( $\beta$ ) of 1 is not always perfect price transmission.

### Recommendations

The policy issues ensued from this study include the following:

- i. When it is desired that a national pricing policy for increased consumption of local rice be implemented, the identified leader markets RPLRLS should be the target. This is because prices formed in this market are efficiently transmitted to the other (follower) markets with very minor distortions during the transmission process.
- ii. The banning of rice imports or increasing import tariffs in order to reduce imported rice in line with public opinion in Nigeria might not be an option to consider. Rather, encouraging quality improvement of local rice through modern

processing techniques and enhancing competition between local and imported rice has to be a key concern of government.

- iii. Government should strive to promote stable prices and an enhanced quality of local rice especially for export purpose.

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