

*Full Length Research Paper*

## Spatial integration and price communication in food grains markets in Ogun State of Nigeria

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Accepted 10 May, 2010

Grains are important food items amongst many households because of their nutritional values. Quite often, there are distinct disparities between the wholesale and retail prices of these commodities. This study therefore investigated the degree of integration and price communications in food grains markets. Data were collected from 240 food grains marketers who were randomly selected from the 4 divisions in Ogun State, Nigeria. Multiple regression model, supply elasticities and price correlation co-efficients estimates were done. For rice markets in Egba division of Ogun State, there were strong inter-relationships between the retail and wholesale prices of the commodities. Similarly for cowpea, the values of the regression coefficients are generally high. Mamu market, Ijebu division, recorded the highest regression coefficient value of 96% while Kuto market in Egba division recorded the least value of 56%. For maize, the regression results indicated low  $R^2$  values ranging between 43% in Lafenwa (Egba division) and 16% in Makun (Remo division). On the average, cowpea has the highest elasticities, followed by rice, while maize has the lowest. Thus, a 1% increase in the wholesale price of food grains resulted in 76.15, 75.77 and 59.49% increase for cowpea, rice and maize respectively. Generally, high price correlation co-efficient values were obtained for the pairs of retail prices of rice and cowpea. There should a stable agricultural policy that will ensure moderate wholesale prices, and by extension retail prices of food grains so that the average household consumption level of the commodities could be sustained at high levels.

**Key words:** Elasticity, food grains, integration, price communication, wholesale, retail prices.

### INTRODUCTION

The co-movement of price is an indication of the degree of market integration while dynamics of price adjustment give important information about the integration of the markets. Market integration is the inter-relationship between price movements in two markets and it ensures that a regional balance occurs among food-surplus regions and regions producing non food cash crops (Delgado, 1986). The degree of association between retail and wholesale markets and also between one retail market and another indicates the process of price determination. It is only in the short run that food price can be expected to be determined at the farm and

wholesale levels and in the long run, consumer demand is the decisive and dominant variable. This means that, in the long run, it is the retail price which determines the wholesale price (Damisa, 1999).

Prices move from time to time and their margins are subject to various shocks. When a long-run linear relation exists among different prices in series, these series are co-integrated. In a competitive market structure, prices in different markets are expected to move together since all are influenced by the same set of forces and are tied together by transfer costs. Despite this however, price disparity does occur. Even though an individual trader

may be unable to influence prices, the conditions of perfect homogeneity and knowledge of agricultural products (grains) may not be satisfied in actual market transactions. Imperfect knowledge may therefore result in inadequate flow of grains and hence in price difference that are greater than the costs of shipment.

The prices of agricultural products (grains) are influenced by changes in the marketing, government marketing policies, supply and demand situations, structure and concentration of marketing channels. The major causes of change in the price of grains (rice, maize, and cowpea) are due largely to transportation cost, storage facilities and market levy charges. The liberalization of grains markets in Ogun State of Nigeria has significantly changed the structure of the markets. In the post-liberalization period, the activities of private grains traders have tremendously increased. On the other hand, the government's role in the grains trading activity decreased and accounted only for less than 5% of the grains market. There is a new emerging grains marketing structure which is dominated by private traders as opposed to the pre-liberalization period of the government-controlled marketing system.

The monitoring of the impacts of market liberalization on grains (rice, maize and cowpea) prices in Ogun state of Nigeria is mainly limited at the wholesale level. There is limited information on the nature of price relationships between wholesalers and retailers in the vertical grains marketing system and spatial price linkages under the new emerging grains marketing structure. The outcome of such price transmission analysis is crucial for the understanding of the relationship between prices at different levels of marketing and locations, which provides insight into the new marketing issues and policies. The intuitive idea behind the measurement of the market integration is the interaction among prices in spatially separated markets. The lack of or insufficient market information flow through the marketing system and high costs of transportation negatively affects the price linkages. Most specifically, market integration is restricted to the interdependence of price changes across spatially separated locations in a market (Wyeth, 1992).

Middlemen are therefore, able to evaluate the amount of money consumers will have to spend when the products arrive at the retail markets so that distributors are able to speculate and anticipate demand at the retail end of the market. This study therefore, assessed the level of spatial integration and price communication in food grains (cowpea, maize, and rice) marketing system in Ogun State of Nigeria.

## LITERATURE REVIEW

Harriss and Palaskas (1991) defined market as, complex institutions encompassing hierarchies and interlinked

transactions, which may involve simultaneous considerations of various commodities. A number of factors may however, cause the prices of the same commodity to differ in a non-proportional manner between markets. Non-homogenous commodity quality (whether real or assumed) for instance, may cause prices of the same commodity to differ by more than the cost of commodity arbitrage between markets. In such a case, a market integration test becomes more complicated involving a test for homogeneity or commodity quality as well as a test for stable price differential. Delgado (1986) defined market integration as, the existence of stable price spreads between markets despite temporary price changes within seasons or over the years.

Fafchamps et al. (2003) stated that, market liberalization varied from place to place and that the movement had affected both international and domestic markets. This differs markedly across sectors and countries. Staatz et al. (1989) observed that, market liberalization is generally true in Africa and particularly in Nigeria that market fees 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 markets. This implies that there is vertical integration across the marketing chain.

## METHODOLOGY

### Study area

The study area is Ogun State with an estimated population of 3,738,098 (NPC, 2006). It is one of the six south western states in the country. There are two distinct seasons in the state: the dry and wet seasons. The dry season lasts for about 5 months (November to March) while wet season runs from April to October. The mean daily temperature ranges from 20°C to 30°C. The economic activities of the people of this state vary from trading to farming and civil services, with farming being the most dominant activity. The conducive climatic and physical environments have been generally supportive of farming as reflected in the varieties and quantities of crops grown in the state. The major food crops include rice, maize, cassava, yam and banana. The cash crops include cocoa, kola nut, rubber and timber. Ogun state is divided into four political zones namely: Egba, Yewa, Ijebu, and Remo.

### Data collection and analysis

Primary data, collected with the aids of structured questionnaire from the grains traders was used. The target middlemen were the wholesalers and retailers of grains traders. The data was drawn from 12 different markets spread across the 4 divisions in Ogun State. Multi-stage sampling technique was used in the collection of data which involved on-the-spot weighing of food grains. Specifically, information were obtained from grain marketers in Lafenwa, Kuto, and Obada-Idiemi markets (Egba division), Ayetoro, Tube, and Idiroko markets (Yewa division), Ago-Iwoye, Mamu and Ijebu-Igbo markets (Ijebu division), Makun, Akesan, and Falawo

markets (Remo division). Complete enumeration was done for the wholesalers and retailers and twenty respondents were randomly sampled from each of the twelve markets. Thus, a total of 240 respondents were analyzed for the study which lasted 6 months. Secondary data were also collected from published materials such as quarterly bulletins, annual reports of corporate institutions, textbooks, journals and other relevant materials. Secondary data was mainly the retail price series that was collected from the statistical division of the Ministry of Finance and Economic Planning covering the period between 1985 and 2008.

### Model 1

To investigate retail-wholesale price relationship, the regression model stated below, was used:

$$Pr = \alpha + \beta Pw \quad (1)$$

Where Pr is the retail price and Pw is the wholesale price of grains while  $\alpha$  and  $\beta$  are the regression coefficients. In computing the extent to which changes in the retail price of grain respond to change in their wholesale price, the model is represented by:

$$\frac{dp_r}{dp_w} = \frac{pw}{pr} \quad (2)$$

Where  $\frac{dp_r}{dp_w}$  and  $\frac{pw}{pr}$  represent the derivative of equation which measures the elasticity of the retail and wholesale prices of grains respectively.

### Model 2

The analysis of the nature of grains price transmission through different marketing levels and across markets was done to see the vertical and spatial integration of grains markets. The first approach in the analysis of grains price transmission was to determine which marketing levels (or locations) played an important role in determining the prices of grains. The directions of price movement were also tested empirically using Granger Causality Test (GCT). The model was used to test the null hypothesis that, in a given market the wholesale price caused changes in retail price is given as follows:

$$R_t = \theta_1 + \alpha_{1i} \sum_{i=1}^n R_{t-i} + \beta_{1i} \sum_{i=1}^n W_{t-i} + \varepsilon_{1t} \quad (3)$$

Where,  $R_t$  is the retail price time  $t$ ,  $\theta_1$ , is the intercept,  $\alpha_{1i}$ s are the coefficients on the lagged value of retail prices.  $\beta_{1i}$ s are the coefficients on the lagged values of wholesale price,  $i$  is the lag length used for retail and wholesale prices and  $\varepsilon_{1t}$  is the disturbance term at time  $t$ . On the other hand, to test the null hypothesis that the retail price does not cause changes in the wholesale price the model given in Equation 3 above is thus modified as follows:

$$W_t = \theta_2 + \alpha_{2i} \sum_{i=1}^n R_{t-i} + \beta_{2i} \sum_{i=1}^n W_{t-i} + \varepsilon_{2t} \quad (4)$$

Where,  $W_t$  is the wholesale price at time  $t$  and other variables are as defined in Equation 3. The analysis involving descriptive assessment of grain price levels and price spreads at different marketing stages (wholesale and retail) and market locations.

The magnitude of price spread and the differences in the

variability of price levels at different marketing levels and locations was used to give an initial insight into the efficiency of grain marketing.

### Price correlation as a measure of market integration

The inter-relationship between price movements in two markets is defined as: market integration (Engle and Granger, 1987). In order to have an overall impression of the extent to which the grains markets and retail level provide an integrated marketing system, price correlation coefficients of retail prices for each of the three grain crops in every pair of markets were calculated for the period 2000 to 2008. Price correlation coefficient was also used to see the strength of price linkages between different marketing levels and across markets. These correlations are the easiest way to measure co-movements of prices in spatial market.

## RESULTS AND DISCUSSION

For rice markets in Egba division of Ogun State, there were strong inter-relationships between the retail and wholesale prices of the commodities. This was manifested by the values of the adjusted  $R^2$  as indicated in Table 1. Strongest price relationship was however noted for the product in Kuto market with adjusted  $R^2$  value of 71%. Similar trends were also observed in the other three divisions with the highest  $R^2$  value of 83% in Makun market and the least value of 41% in Ijebu-Igbo market. High  $R^2$  values indicated that wholesale prices of rice had appreciable effects on their retail prices. This high correlation is expected because the retailers' main source of supply for the commodity is the wholesale market, so that the marketing system for rice approximates rather closely the redistributive model.

Similarly for cowpea, the values of the regression coefficients are generally high. Mamu market, Ijebu division, recorded the highest regression coefficient value of 96% while Kuto market in Egba division recorded the least value of 56% (Table 2). High regression coefficient values indicated that, for all the markets these values are significantly different from zero. This implies that, the wholesale price of cowpeas also has an effect on the retail price of the commodity. This crop comes from areas of specialized production both in the Northern and Eastern states. Little quantities of cowpeas are also often supplied by the local farmers in the State.

For maize, the regression results showed very low  $R^2$  values ranging between 43% in Lafenwa (Egba division) and 16% in Makun (Remo division). This is shown in Table 3. The implication of this is that, the wholesale price of maize has no appreciable influence on its retail price. This is probably because the retailers obtain their supplies, not only from the wholesale distributors, but also from the local farmers who often take part of their maize to the central markets for sale. It should be noted that, maize is unarguably the most popular food grain among the farmers in Ogun State because of its agro-ecological advantages.

**Table 1.** Regression of retail-wholesale prices for rice. Regression:  $Pr = \alpha + \beta Pw$ .

Market/Town	Constant	Coefficient	Adjusted R <sup>2</sup>	T-value
<b>Egba division</b>				
Lafenwa	13.89	3.13(0.2266)	0.67	13.81*
Kuto	47.11	1.22(0.1092)	0.71	11.17*
Obada-Idiemi	53.02	2.34(0.3933)	0.56	5.95*
<b>Yewa division</b>				
Ayetoro	63.23	1.88(0.1484)	0.68	12.67*
Tube	55.45	4.10(0.2497)	0.60	16.42*
Idiroko	26.44	2.55(0.1082)	0.77	23.56*
<b>Ijebu division</b>				
Ago-Iwoye	12.23	2.23(0.4364)	0.82	5.11*
Mamu	8.99	4.80(0.1325)	0.58	36.22*
Ijebu Igbo	25.12	3.57(0.1515)	0.41	23.56*
<b>Remo division</b>				
Makun	65.45	6.11(0.8754)	0.83	6.98*
Akesan	73.23	1.67(0.5819)	0.77	2.87**
Falawo	55.42	6.23(1.3227)	0.63	4.71*

Figures in parentheses are standard errors. \*: significant at 1% level, \*: significant at 5% level, source: survey data, February 2009.

**Table 2.** Regression results of retail-wholesale prices of cowpeas. Regression:  $Pr = \alpha + \beta Pw$ .

Market/town	Constant	Coefficient	Adjusted R <sup>2</sup>	T-value
<b>Egba division</b>				
Lafenwa	43.86	1.05(0.1477)	0.62	7.11*
Kuto	87.45	3.93(0.6528)	0.56	6.02
Obada-Idiemi	73.96	3.92(0.7762)	0.64	5.05*
<b>Yewa division</b>				
Ayetoro	69.12	9.10(0.0130)	0.91	6.99*
Tube	85.12	1.95(0.0867)	0.83	22.48*
Idiroko	58.43	1.11(0.0614)	0.59	18.07*
<b>Ijebu division</b>				
Ago-Iwoye	112.01	3.56(0.7463)	0.75	4.77*
Mamu	45.80	3.01(0.0456)	0.96	66.06*
Ijebu Igbo	63.80	3.95(0.2129)	0.72	18.55*
<b>Remo division</b>				
Makun	89.75	6.96(0.8614)	0.71	8.08*
Akesan	59.08	2.99(0.9373)	0.79	3.19*
Falawo	18.95	3.12(0.6166)	0.68	5.06*

Figures in parentheses are standard errors. \*: significant at 1% level, source: survey data, February 2009.

The estimation of the food grains elasticities enables us to know the extent to which changes in the wholesale

**Table 3.** Regression results of retail-wholesale prices of maize. Regression:  $Pr = \alpha + \beta P_w$ .

Market/town	Constant	Coefficient	Adjusted R <sup>2</sup>	T value
<b>Egba division</b>				
Lafenwa	8.49	4.82(0.7006)	0.43	6.88*
Kuto	31.67	2.56(0.3694)	0.39	6.93*
Obada-Idiemi	15.56	2.90(2.5893)	0.29	1.12
<b>Yewa division</b>				
Ayetoro	43.12	6.94(2.639)	0.23	2.63**
Tube	34.88	5.67(0.3453)	0.48	16.42*
Idiroko	59.09	1.63(0.3280)	0.26	4.97*
<b>Ijebu division</b>				
Ago-Iwoye	8.67	4.32(0.5414)	0.31	7.98*
Mamu	4.90	1.85(0.0806)	0.22	22.96*
Ijebu Igbo	45.76	1.53(0.0349)	0.35	43.76*
<b>Remo division</b>				
Makun	34.76	8.65(0.1590)	0.16	54.41*
Akesan	28.75	3.67(0.9787)	0.24	3.75*
Falawo	77.93	4.31(0.5483)	0.30	7.86*

Figures in parentheses are standard errors. \*: significant at 1% level, \*\*: significant at 5% level, source: survey data, February 2009.

**Table 4.** Elasticity of retail- wholesale price of grains.

Market/town	Rice	Maize	Cowpeas
Lafenwa	0.600	0.2895	0.8203
Kuto	0.610	0.4044	0.9446
Obada-Idiemi	0.8867	0.2791	0.6108
Ayetoro	0.5308	0.3240	0.8100
Tube	0.7051	0.7430	0.5378
Idiroko	0.8112	0.4783	0.5468
Ago-Iwoye	0.9556	0.9843	0.9873
Mamun	0.9758	0.5334	0.9749
Ijebu-Igbo	0.9845	0.8900	0.7799
Makun	0.6101	0.4637	0.8316
Akesan	0.6252	0.8724	0.8203
Falawo	0.7976	0.8761	0.4732
Average	0.7577	0.5949	0.7615

Source: survey data, February 2009.

price of grains are manifested in the changes in the retail price. The underlining assumption here is that, in the short-run, the retail price of grains is a function of its wholesale price. The elasticities of wholesale-retail price of rice, cowpeas and maize is presented in Table 4 and it is shown that, all the estimated elasticities of the selected

food grains are below unity. This indicates that, a change in the wholesale price of food grains resulted in less than a proportionate change in the retail price.

On the average, cowpeas have the highest elasticities, followed by rice, while maize has the lowest. Thus, a one-percentage increase in the wholesale price of foodgrains

**Table 5.** Bivariate correlation between prices for rice in Ogun State.

Market/Town	A	B	C	D	E	F	G	H	I	J	K	L						
A	1.0																	
B	0.67	1.0																
C	0.63	0.85	1.0															
D	0.86	0.60	0.68	1.0														
E	0.78	0.76	0.79	0.86	1.0													
F	0.88	0.75	0.69	0.77	0.85	1.0												
G	0.82	0.67	0.85	0.76	0.71	0.73	0.83	0.61	1.0									
H	0.75	0.95	0.68	0.90	0.55	0.84	0.76	0.77	0.75	0.87	1.0							
I	0.56	0.70	0.64	0.61	0.83	0.75	0.65	0.94	0.79	0.78	0.56	0.70	1.0					
J	0.91	0.59	0.75	0.69	0.74	0.85	0.88	0.68	0.76	0.68	0.75	0.70	0.65	0.85	1.0			
K	0.74	0.94	0.69	0.68	0.69	0.74	0.91	0.60	0.66	0.85	0.74	0.74	0.69	0.78	0.57	1.0		
L	0.85	0.66	0.80	0.84	0.69	0.69	0.71	0.60	0.87	0.91	0.59	0.79	0.89	0.60	0.74	0.89	0.59	1.0

**Table 6.** Bivariate correlation between prices for cowpea in Ogun state.

Market/Town	A	B	C	D	E	F	G	H	I	J	K	L						
A	1.0																	
B	0.91	1.0																
C	0.83	0.61	1.0															
D	0.71	0.55	0.71	1.0														
E	0.65	0.88	0.93	0.66	1.0													
F	0.91	0.95	0.58	0.49	0.83	1.0												
G	0.66	0.77	0.93	0.69	0.88	0.73	0.94	0.75	1.0									
H	0.78	0.66	0.58	0.74	0.57	0.81	0.76	0.94	0.69	0.71	1.0							
I	0.83	0.78	0.68	0.93	0.67	0.83	0.78	0.95	0.71	0.87	0.56	0.58	1.0					
J	0.67	0.63	0.77	0.68	0.78	0.65	0.94	0.71	0.88	0.96	0.66	0.76	0.55	0.89	1.0			
K	0.54	0.78	0.53	0.85	0.76	0.88	0.95	0.67	0.66	0.87	0.84	0.92	0.88	0.85	0.67	1.0		
L	0.75	0.89	0.78	0.67	0.75	0.89	0.77	0.66	0.57	0.92	0.87	0.64	0.69	0.90	0.78	0.74	0.67	1.0

resulted in 75.77, 59.49 and 76.15% increase for rice, maize and cowpeas respectively. The implication of this is that, not all the increases in the wholesale price of grains are transferred to the consumers/retailers. Cowpeas recorded the highest elasticity value because the retailers of the commodity are able to pass on to the consumers a greater percentage of any increase in the wholesale prices. This is prompted by the fact that the consumers are mainly depended upon them (retailers) for those commodities

#### Price correlation as a measure of market integration

Market integration is a measure of the level of inter-relationship between price movements in two markets. To fully capture the extent to which the grains retail markets provide an integrated marketing system, simple correlation co-efficient of retail prices of each of the three grains crops in every pair of markets were calculated for the period 2000 to 2008. The results are shown in Tables 5 to 7. Generally, high price correlation co-efficient values were obtained for the pairs of retail prices of rice and

cowpea. This was indicated in Tables 5 and 6. The case of maize, as shown in Table 7, is however quite different as low price co-efficient values were obtained for the pairs of retail prices in the markets. Since the correlation co-efficient values are the manifestation of the level of flow of information and price communication between markets, the marketing system for rice and cowpeas are seen to be well integrated. Thus, the commodities that come mainly from areas of specialized production tend to have high correlation values. It has therefore been noted that, rice and cowpeas feature more prominently in the inter-state trade and there is high level of competition amongst the retailers for available supplies from the wholesalers from the specialized producing areas in the northern and eastern parts of the country. The case of maize is however different as most of its supply is obtained from the retailers who sell it fresh and green from the producers or after it has been sundried.

#### CONCLUSION AND RECOMMENDATIONS

This paper has investigated the extent of spatial

**Table 7.** Bivariate correlation between prices for maize in Ogun State.

Market/Town	A	B	C	D	E	F	G	H	I	J	K	L							
A	1.0																		
B	0.38	1.0																	
C	0.28	0.48	1.0																
D	0.18	0.39	0.25	1.0															
E	0.28	0.25	0.39	0.46	1.0														
F	0.18	0.15	0.28	0.38	0.34	1.0													
G	0.29	0.12	0.23	0.38	0.41	0.29	0.32	0.38	1.0										
H	0.29	0.42	0.39	0.23	0.48	0.21	0.46	0.24	0.31	0.19	1.0								
I	0.16	0.26	0.38	0.25	0.10	0.43	0.28	0.31	0.13	0.27	0.22	0.26	1.0						
J	0.27	0.23	0.20	0.39	0.22	0.28	0.30	0.21	0.28	0.35	0.32	0.42	0.20	0.44	1.0				
K	0.18	0.19	0.29	0.21	0.35	0.30	0.47	0.37	0.33	0.37	0.30	0.39	0.32	0.37	0.35	1.0			
L	0.28	0.29	0.37	0.48	0.54	0.20	0.50	0.31	0.20	0.39	0.47	0.39	0.31	0.20	0.32	0.26	0.35	1.0	

Legend: A = Commodity price at Lafenwa market, B = Commodity price at Kuto market, C = Commodity price at Obada-Idiemi market, D = Commodity price at Ayetoro market, E = Commodity price at Tube market, F = Commodity price at Idiroko market, G = Commodity price at Ago-Iwoye market, H = Commodity price at Mamu market, I = Commodity price at Ijebu-Igbo market, J = Commodity price at Makun market, K = Commodity price at Akesan market, L = Commodity price at Falawo market.

integration and price communication in food grains markets in Ogun State of Nigeria. Results have indicated the, there is a strong relationship between the wholesale and retail prices of food grains. This is however not so for maize since it could also be sourced from the local farmers in the neighbourhood. High elasticity values for wholesale-retail prices again indicated that, an increase in wholesale prices was capable of provoking a rise in retail prices in all the divisions in the State. This is thus, a matter of concern for the policymakers as they are needed to be interested in all matters that may mitigate the trends of household consumption of the consumers.

The estimated price correlation co-efficients again indicated that there was a strong relationship between the pairs of market prices of rice and cowpeas as these commodities are mainly supplied by the producers in the specialized producing areas of the country. The case is however different for maize which, apart from the specialized producers, could also be supplied by the nearby local farmers.

In conclusion therefore, there should a stable agricultural policy that will ensure moderate wholesale prices, and by extension retail prices, of food grains so that the average household consumption level of the commodities could be sustained at high levels. If this is done, the quality of nutritional intake of food grains and the health of the consumers will improve.

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