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SPATIAL PRICE EFFICIENCY OF MAIZE IN BORNO STATE, NIGERIA

E. A. ALI AND A. C. IHEANACHO

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ABSTRACT

The study determined spatial price efficiency of maize for eight rural and urban markets of Borno state of Nigeria. Weekly time series and cross sectional data were used in the study. The time series price data were collected over a period of nine months and the cross sectional data were through questionnaires and interview schedule. Forty respondents, five for each market were used. Descriptive statistic, spatial price efficiency model and ordinary least squares (OLS) regression techniques were used to analyse the data. The results show that there was great variability in prices of maize among the markets. Monthly price differentials of maize in the supplying markets were significantly different from zero. It ranged from as low as – ₦200 in Baga road to as high of ₦1060 per 100kg bag in Peta market. The degree of integration between markets revealed that 43% of maize wholesale price association was 0.9 and above, implying high degree of price association between markets. For retail-wholesale price relationship, Monday market and Baga road markets had r^2s of 0.9 and above indicating that the wholesale price of maize had an effect on the retail price. The price elasticity of maize in Baga road market was greater than one (Ep>1). It was recommended that improvement of the existing roads is necessary to improve market integration. The emphasis on infrastructural development should, therefore, not simply be on the construction of new roads, but on the improvement of the existing ones by the government.

KEYWORDS: Spatial price, Efficiency, Maize, Market.

INTRODUCTION

The existence and performance of markets are very important in pricing efficiency. Spatial price analysis focuses on the price movement or difference, which occurs between two locations with different prices through space. This provides important information on how the markets work. Bressler and King (1970) were of the view that marketing efficiency is based on the premise that an efficient (commodity) market will establish prices that are interrelated through space by transportation costs and through time by storage costs. Thus, price transmission studies are ostensibly an empirical exercise, testing the predictions of economic theory and providing important insights as to how changes in one market are transmitted to another, thus reflecting the extent of market integration as well as the extent to which markets function efficiently (Rapsomanikis *et al.*, 2004). When trade between two markets (spatial trade) is efficient, food shortages in deficit regions are transmitted to surplus regions via prices, and arbitrage triggers flows of food across space. Through efficient spatial arbitrage, the risk of crop failure in some regions can be shared over a large market area, prices are more stable and food shortages may be prevented (Tostoa, 2002).

In the Nigerian grain markets and Borno State in particular, understanding the nature of the existing maize price transmission gives insight into the pricing efficiency, price relationship across space and extent of trade flow between and within the markets. Maize is a major grain widely produced in all ecological zones of Nigeria and Borno State in particular, both in the rural and urban areas.

Past studies in Nigeria laid emphasis on spatial price efficiency measurement for different agricultural commodities without linking rural and urban markets. Such empirical analyses include; Hays and McCoy, (1978), Okereke, (1988), Adekanye, (1988), Dittoh, (1994) and Balami and Bumba, (1995) and in other parts of the world studies by Sanjuan and Gil, (1998), Abdulai, (2000), Balcombe and Morrisson, (2002) and Rashid, (2004) are examples.

The main objective of this study is to determine the spatial price efficiency of maize for rural and urban markets of Borno State of Nigeria.

The specific objectives are to:

(i) determine spatial price differential of maize in rural and urban markets of Borno State;

(ii) determine the degree of integration among and within the markets.

METHODOLOGY

Study area and data collection

The study was conducted in Borno State of Nigeria and covered eight selected markets of the state. The markets include Peta, Kwaya, Lassa, Uba, Banki, Bama, Baga road and Maiduguri Monday market. Samples of five respondents were selected at random from each market, totaling forty (40) respondents. In addition, time series data were collected weekly for nine months.

Analytical Techniques

Descriptive statistics, spatial price model and ordinary least squares (OLS) regression techniques were used for data analysis.

Spatial price differential analysis

The spatial price relationship model developed by Hays and McCoy (1978) was employed to determine the spatial price efficiency in the study area.

First, parity price at Maiduguri Monday market (central market) was calculated. It was estimated by deducting from the price at parity market (central market) the transfer costs from each of these markets, and the actual price in each supplying market was subtracted from the parity price.

Specifically, the price spread is computed as follows:

$$PP_{ij} = P_i - (Hc_{ji} + Tc_{ji} + As_{ji}) \quad \text{----------(1)}$$

Where:

PP_{ij} = The calculated parity price of 100kg bag of maize in the ith market in relation to the jth market, where j (1 ---- n).

P_i = The actual wholesale price of 100kg bag of maize at the ith market.

Hc_{ji} = Handling costs involved in moving 100kg bag of

E. A. Ali, Department of Agricultural Economics and Extension, University of Maiduguri, Nigeria.
A. C. Iheanacho, Department of Agricultural Economics and Extension, University of Maiduguri, Nigeria.

the maize from jth market to ith market.

Tc_{ji} = Transport cost for moving a 100kg bag of maize from jth market to ith market.

As_{ji} = Charges for the assembler's service in moving 100kg bag of maize from jth market to ith market.

The actual price spread between any two markets is expressed as:

$$PS_{ij} = PP_{ij} - P_j \text{ ----------(2)}$$

Where:

PS_{ij} = The price spread for 100kg bag of maize between the ith market and the jth market.

P_j = The actual wholesale price of 100kg bag of maize in the jth market.

In a perfectly competitive market, where the commodity moves from the jth to ith market, P_i should be equal to P_j after deducting the transfer cost, and $PS_{ij} = 0$

Degree of market integration Analysis

Ordinary Least Squares (OLS) linear regression techniques adopted by Adekanye, (1988); Okereke, (1988); and Zhou *et al.*,(1999) was used to analyse co- movement of price over space. It is expressed as follows:

$$P_{ix} = b0 + b_1P_{1x} + b_2P_{2x} + b_3P_{3x} + b_4P_{4x} + b_5P_{5x} + b_6P_{6x} + b_7P_{7x} + u \text{ ---------- (i)}$$

Where:

x = crop under study (maize)

P_{ix} = price in dependent market

bo = constant

$b_1 - b_7$ = coefficients

$P_{1x} - P_{7x}$ = price in independent markets

u = error term

Using a summary of the values of the multiple correlation coefficient (r), the strength of significant and non-significant relationships were indicated. Frequency distribution of the r- values were used for comparison with result of previous studies of market integration. When r is greater than 0.9, very high degree of price association exists. A value exceeding 0.8 was an indication of high relationship, while between 0.7 - 0.8 suggests moderate integration and below 0.7 suggests low integration. A very low coefficient means that the series involved moved independently of each other (Lele, 1967; Thodey, 1969; Blyn, 1973; Adekanye, 1988; Okereke, 1988). A weak degree of integration indicates that, despite the institutional efforts to achieve a unified market, prices are not perfectly transmitted, and, therefore, misallocation of resources and distortions of production and distribution might occur. The greater the degree of integration, the more efficient are the interacting markets (Sanjuan and Gil, 1998; Zhou et al., 1997, 2000; Abdulai, 2000; Goodwin and Piggott, 2001; Gonzalez-Revira and Helfand, 2001).

The degree of vertical integration were measured using the model below expressed as follows:

$$Y = a + bx_1 + u \text{ -------- (ii)}$$

Where:

Y = price in dependent market (retail price)

x_1 = price in independent market (wholesale price)

b = coefficients

a = constant

u = error term.

The elasticity of retail – wholesale price was used to determine the extent of changes in wholesale price on the retail price. The elasticity was calculated as follows:

$$\frac{dy}{dx} \cdot \frac{x}{y}$$

Where: dy = change in retail price

dx = change in wholesale price

y = mean retail price

x = mean wholesale price

RESULTS AND DISCUSSION

Spatial Price Differential

The spatial price efficiency examines how prices in different markets over space are related through transportation cost. The results of the spatial price relationships are presented in table 1 and figure 1.

Table 1: Average price differential for 100kg bag maize between Monday market and the supplying markets: January- September 2004(₦ /100kg bag)

Supplying Markets	Distance (Km)	Transfer cost (₦ 100kg/bag)	Price Differential
Peta	271	440	741.67
Kwaya	237	370	698.61
Lassa	252	350	502.5
Uba	215	320	360.56
Banki	138	250	221.94
Bama	75	220	169.89
Baga road	12	100	6.39

Source: field Survey, 2004

The results show that there were great variability in prices among markets. The mean price spreads for maize exceeded zero. The highest price differential was recorded in Peta with the value of ₦741.69 per 100kg and the lowest of ₦6.39 per 100kg in Baga road market.

The reasons for the high price difference between the base market and the other supplying markets is due to the fact that most of these markets are produce (supply) markets and prices of produce in most of the markets are farm-gate prices or sometimes slightly above farm-gate prices. Sometimes the produce are bought directly from the farmers where the level of arbitrage is low. Besides, in some of the markets, especially the supplying markets, the supply sometimes is higher than demand, thus lowering the prices of the commodities in those markets.

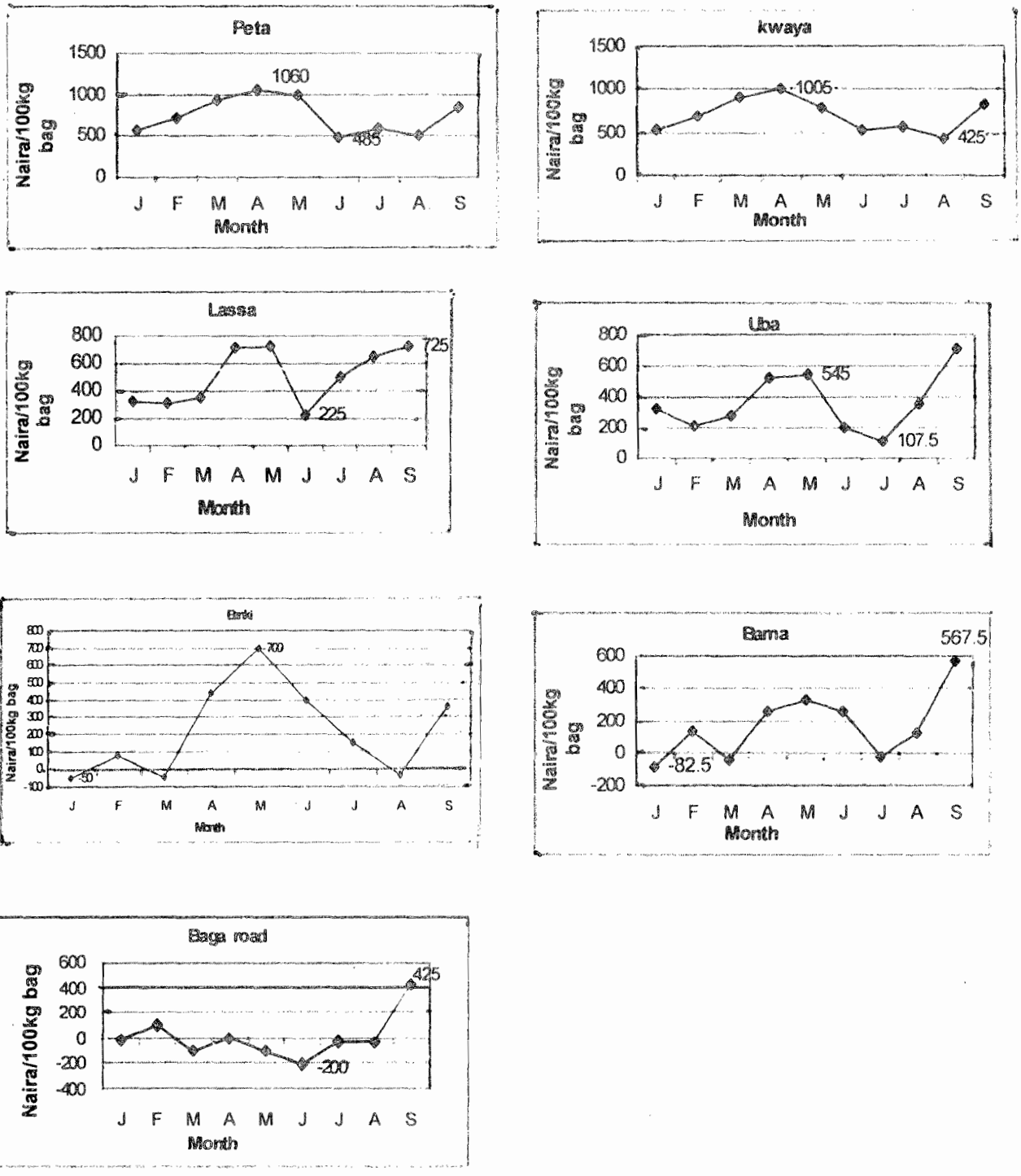

Figure 1: Maize Price differential for each of the supplying markets in relation to Maiduguri Monday marketJanuary –September 2004 (₦/100kg bag)

Price differential levels in the production areas (rural areas) were higher than those close to the urban centres as shown in table 1 figures 1, while the price differentials for the semi-urban and urban centres were close to zero and sometime even negative. This is as a result of the fact that the semi-urban and urban markets are rather consumer markets and not supplying markets. The distance between markets also affects the price differentials as all the markets that had higher price differential are from the southern parts of the state, with distance of about 271 kilometres, 239 kilometres, 252 kilometres and 215 kilometres for Peta, Kwaya, Lassa and Uba respectively. The high price differential may also be attributed to the fact that maize is one of the major crops produced in those areas and as such the supply is higher than demand, resulting in excess supply and low price.

MARKET INTEGRATION

Horizotal market integration

The inter-market relationship between prices in two markets was used to determine the price association between markets using correlation matrix. The results are shown in tables 2 and 3 for wholesale prices.

Table 2: Correlation matrix for wholesale prices of maize in selected markets of Borno State, Nigeria: January- September 2004

Market	Monday	Peta	Kwaya	Lassa	Uba	Banki	Bama
Peta	0.8816	-					
Kwaya	0.9112	0.9785	-				
Lassa	0.8319	0.8049	0.8288	-			
Uba	0.9138	0.9133	0.9178	0.8294	-		
Banki	0.8514	08696	0.8584	0.7214	0.8726	-	
Bama	0.9094	0.8712	0.8937	0.7473	0.9388	0.7175	- -
Baga Road	0.9220	0.8750	0.9001	0.7783	0.9140	0.7830	0.9046

Source: Field survey, 2004.

Table 3: Percentage distribution of values of correlation coefficient for wholesale prices of maize in selected markets of Borno State, Nigeria: January-September 2004

Values of r	Frequency	Percentage
0.7- 0.79	4	14
0.8 –0.89	12	43
0.9- over	12	43
Total	28	100

Source: Field survey, 2004.

Table 3 shows that the percentage distribution of correlation coefficients for wholesale price of maize was 43% with r-values of 0.9 and above, indicating high degree of price association, while 43% were between 0.8-0.89, implying moderate degree of price association. Only 14% were between 0.7-0.79, meaning low degree of price association. The higher coefficients shown by wholesale price of maize is an indication of flow of the commodities from surplus region to deficit region, while the low r values mean low level of arbitrage between the markets.

Vertical market integration

To investigate the degree and extent of integration within a market (vertical integration), retail-wholesale price relationships were estimated. The results are presented in tables 4 and 5 for the selected market

Table 4: Regression estimates of retail –wholesale price relationship of maize in eight markets in Borno State, Nigeria: January-September 2004 (n =36)

Market	Constant	Coefficient	r^2	T-Ratio	F-Ratio
Monday	3.17198	0.02465 (0.00085)	0.9614	29.11*	84.27*
Peta	28.2265	0.00972 (0.00202)	0.4041	4.80*	23.06*
Kwaya	24.3852	0.01303 (0.00217)	0.5145	6.00*	36.03*
Lassa	22.5331	0.01010 (0.00185)	0.4665	5.45*	29.72*
Uba	20.1779	0.01214 (0.00180)	0.5716	6.73*	45.36*
Banki	24.2223	0.01825 (0.00187)	0.7364	9.25*	94.99*
Bama	6.68706	0.02298 (0.00141)	0.8860	16.26*	264.30*
Baga Road	-7.60017	0.02755 (0.00097)	0.9595	28.40*	806.48*

Source: Field survey, 2004.
* Significant at 1%
Figures in parentheses denote standard errors

The regression coefficients in the eight markets showed that the various degrees of integration with Monday and Baga road markets were r^2s of 0.9 and above, implying high degree of price association within the markets. The regression coefficients were significantly different from zero, implying that the wholesale price of maize had an effect on the retail price. In the case of Peta, Kwaya, Lassa and Uba markets, the regression coefficients were rather low, which indicates that the wholesale and the retail prices were not integrated. This is due to the fact that retailers not only get their supplies from wholesalers but also from farmers or rural assemblers who take their maize direct to the market and sell them at farm-gate prices.

Under the assumption that retail price is a function of wholesale price, the extent of integration of the different markets was determined by their elasticities (Table 5).

Table 5: Elasticities of retail-wholesale prices of maize in eight markets of Borno State, Nigeria: January-September 2004

Market	Elasticities
Peta	0.436
Kwaya	0.557
Lassa	0.535
Uba	0.622
Banki	0.670
Bama	0.912
Baga Road	1.091
Monday	0.964
Average	0.723

Source: Field survey, 2004.

Table 5 shows the elasticities of retail-wholesale prices of maize in the study area. Maize prices were inelastic in all the markets except Baga road market. The elasticities below one ($E_P<1$) indicate that a proportionate change in wholesale price of the crop will result in less than a proportionate change in the retail price. The implication is that, on the average, one percentage increase in the wholesale price will bring about 0.72% increase in maize retail prices. This means that not all the increases in the wholesale price of maize are passed on to the consumers. Thus, maize retailers are able to pass on to consumers a greater percentage of price (0.723%).

CONCLUSION AND RECOMMENDATIONS

This paper has explored several related aspects of spatial price efficiency in Borno state of Nigeria. The negative effect of road on price efficiency is not surprising. The greater the distance between the markets, the more costly it is to undertake a trade. Exploring opportunities with closer markets results in high positive price differentials between the markets. The prices of maize vary in space due to transportation cost, handling charges and other imperfections in the marketing system. Government, therefore, should improve the road network and encourage corporate media organization to expand the communication network so that market information can be passed to the farmers and other market participants in good time.

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