Food Price Differences and Market Integration in Oyo State, Nigeria

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Abstract: The study tests the market integration of main staple agricultural commodities in Oyo State. Monthly prices in N/kg covering a period of 8 years (1994-2001) were obtained from Oyo State Agricultural Development Programme (OYSADP) and analyzed using Ravallion Model. The study also calculated the Indices of Market Concentration (IMC) to measure the degree of spatial market integration. The IMCs for cassava, yam, white maize and yellow maize were, 0.3074, 0.0814, 0.02712 and 0.1648, respectively. The IMCs imply high short-run market integration between the reference and rural markets. The market integration indices confirm that price changes in the urban markets (Bodija and Ilora) translated to changes in the price of cassava, yam, maize, yellow maize in rural markets (Akamata, Towobowow, Aniko, Irepole, Oje, Kajola, Akala and Aberu). It is concluded that agricultural commodity arbitrage is working. The degree of market integration can be enhanced by the provision of not only transport infrastructure but by provision of adequate formal marketing information and standardization of weights and measures in the system.

Keywords: Market integration, ravallion model, indices of market concentration

Introduction

Prices are the most readily available and reliable information that guide farmers’ planting decisions in Nigeria. A farmer’s planting decisions depend on anticipated profits which in fact depends on anticipated prices of planted crops. This has made prices an important tool in the economic analysis of markets.

Market integration refers to the co-movement of prices and more generally to the smooth transmission of price signals and information across spatially separated markets. In a developing economy like Nigeria, the dynamics of the exchange of information and its effects on the pricing processes are not well understood. This has made prices the most reliable information source in Nigeria’s agricultural marketing systems.

Most studies of agricultural product prices in Nigeria focused on vertical dynamic analysis (Olayemi, 1977; Oladiri, 1982; Mobolaji, 1977; Adekanye, 1988; Afolami, 1988; Adeyokunnu, 1973; Okumadeva, 1990; Ladiipo and Fabiyi, 1982). Of recent, a growing number of studies on agricultural market integration in Nigeria have focused on different aspects of agricultural marketing (Dittho, 1994; Mafirimasebi, 2000; Oladapo, 2004). This paper will extend the study of market integration in two aspects. Previous studies on market integration focused on single product. The study compares the market integration of different product markets and measures the degree of market integration by using the Index of Market Concentration (IMC). Studies of market integration can help policy makers design appropriate agricultural product supply across the state so as to avoid too much instability in the rural economy.

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Study Area

The study area is Oyo State which is one of the thirty six states in Nigeria. The State is located within latitude 3° and 5° North of the equator and between longitude 7° and 9° 3' East of the Greenwich Meridian.

Oyo State covers 35,743 square kilometers and has an estimated population 11.5 million as at 1996. The state consists of thirty three local government area (LGAs).

The State is characterized by equatorial climatic conditions. There are two distinct seasons namely wet and dry seasons. The wet season covers between November to March and is characterized by hot weather. The topography is about 0-5 m above sea level and the mean annual rainfall is within the range of 1000-1400 mm (MANR, 1999).

The soil resources of Oyo State may be divided into two broad groups. These are the poorly drained soils and the well-drained soils. The alluvial or poorly drained soils are found on the flood plains of Ofili, Opeki, Oma, Oba and Ilaa rivers. These soils are widely cultivated to grow yam, maize and sugar cane. They are most useful during the dry season when farming activities have stopped on higher grounds. They are three main types of well-drained soils. These soils support most of the farming activities in Oyo State. The crops grown include both annual and perennial crops such as yams, cassava, oranges, cocoa, tobacco, cashew, etc.

The vegetation consists of the savanna woodland and the forestlands. Savanna woodlands covers over half of the land area of Oyo State. It is often divided into the derived savanna and the gallery forests. The only forests found in the state are along river valleys and the called gallery forests.

Data Collection

The data for the study were sourced from the Oyo State Agricultural Development Programme (OYSADEP). It is one of the MSADP I projects approved by the World Bank for assistance in Nigeria. Average commodity market price data was collected through the Planning Monitoring and Evaluation (PME) unit of OYSADEP. For the price survey, four zonal extension offices with 20 block extension offices served as contact points for the collection of rural and urban market prices. Average monthly prices in Naira per kilogram (N/kg) for cassava, tuber, yam, yellow and white maize were collected for 8 years; 1994 to 2001 for both urban and rural markets. The urban markets in Oyo State include Bodija, Oje, Gboro, Iyana, Owode market, while the rural markets include Akete, Towobowolo, Anko, Irepodun, Oje, Obada, Ipa and Igbeti.

The integration of different product markets and measure the degree of integration by using the Index of Market Connection (IMC). Studies of market integration can help policy makers design appropriate agricultural product supply across the state so as to avoid too much instability in the rural economy.

Model Specification

The Ravallion Model seeks to determine whether a change in the price of a product in a local market is influenced by the change in the central market. Ravallion’s approach was used to develop a structural model of prices (Ravallion, 1986). Formation in N local markets by assuming that local prices \( P_1, \ldots, P_N \) are dominated by one central or reference market price \( R \). The static form of the model can be represented as follows:

\[
P_i = f(R, X_i), \text{ for } i = 1, \ldots, N
\]
\[
R = g(P_1, \ldots, P_N, X)
\]

Where \( X_i \) = vector of seasonal or other exogenous variables which might influence price formation in market \( i \) and central market.
The dynamic structure of Eq. (1) and (2) if expressed in a linear form are:

\[ P_t = a_0 P_{t-1} + b_0 R_t + b_1 R_{t-1} + C_X + \varepsilon_t \]  

(3)

Where:

\[ R_t = \alpha R_{12} + \beta_1 P_n + \beta_2 P_n + \ldots + \beta_{n0} P_{n-1} + \varepsilon_t \]

(\(\varepsilon_t\) and \(\varepsilon\) are suitable error processes)

Note the followings about the equations

- Only one lag of each endogenous variable has been included, but a general model with ‘n’ lags of local prices and ‘m’ lags of the central price is possible.
- Because of the nature of transport costs, the model was estimated with actual prices rather than their lags.

If Eq. (3) is rewritten in the form of error correction mechanism, that is using ‘\(\Delta\)’ for the difference operator.

\[ \Delta p_t = p_t - p_{t-1} \]

Thus

\[ \Delta p_t = (a_0)(P_n - 1 - R_t) + b_0 \Delta R_t + (b_t + b_{t-1}) R_{t-1} + C X_n + \varepsilon_t \]

(5)

Since there is likely to be less collinearity in Eq. (5) than the equivalent Eq. (3) this error correction form was estimated. Tests for market segmentation is given by

\[ b_0 - b_1 = 0 \]

On the other hand tests for long run integration is indicated by

\[ b_0 = 1, b_1 = a_0 = 0 \]

**Index of Market Connection Analysis**

Index of Market Connection (IMC) is used to measure price relationship between integrated markets and following formula was used to calculate IMC:

\[ P_t - \beta_0 \beta_1 P_{t-1} + \beta_1 (R_t - R_{t-1}) + \beta_1 R_{t-1} + \varepsilon_t \]

Where:

- \( R_t \) = Urban or reference price
- \( P_t \) = Rural price
- \( R_{t-1} \) = Lagged price for urban markets
- \( R_t - R_{t-1} \) = Difference between urban price and its lag
- \( \varepsilon_t \) = Error term or unexplained term
- \( \beta_0 \) = Constant term
- \( \beta_1 \) = Coefficient of rural lagged price
- \( \beta_2 \) = Coefficient of \( R_t - R_{t-1} \)
- \( \beta_3 \) = Coefficient of urban lagged price
- \( \text{IMC} = \frac{\beta_3}{\beta_1} \) where \( 0 \leq \text{IMC} \leq \infty \)
According to the model, IMC equals to the coefficient of lagged price in local markets divided by the coefficient of lagged in reference market interpretation of the IMC.

- $\text{IMC} < 1$ implies high short-run market integration
- $\text{IMC} > 1$ implies low short-run market integration
- $\text{IMC} = 0$ implies no market integration
- $\text{IMC} = 1$ high or low short run integration (theoretically)

The closer the value of the IMC to zero, the higher the degree of market integration and by extension the higher the marketing efficiency. In order to capture the IMC values better, the values were approximated to two decimal places.

**Results and Discussion**

Table 1 shows the regression results for the market pairs for four crops, cassava, yam, white maize and yellow maize.

The coefficient of multiple determination ($R^2$) shows the percentage of the rural price ($P_r$) that is explained by the lagged rural price ($P_{r-l}$), difference between urban price ($P_u$) and its lag ($P_{u-l}$). The regression equation explained 88.3, 86, 96.6 and 92.5% of all the variabilities in the rural prices of cassava, yam, white maize and yellow maize, respectively. The Durbin Watson test was conducted on the data to detect the existence of serial correlation. The result in Table 1 indicate the non-existence of serial correlation since the Durbin Watson values were either approximately equal to two for the crops covered by the study. The F-test indicates that the regression equation is significant at 10%.

**The Indices of Market Connection (IMC)**

The indices of market connection (IMC) is used to measure price relationship between integrated markets. For the cassava, yam, white maize and yellow maize market pairs the IMCs were 0.3074, 0.0814, 0.02712 and 0.1648, respectively (Table 2). The IMCs for these market pairs are all less than

**Table 1: Regression analysis results for Oyo state**

<table>
<thead>
<tr>
<th>Market pairs</th>
<th>Crops</th>
<th>Constants $B_0$</th>
<th>$B_1$</th>
<th>$B_2$</th>
<th>$B_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akanni, Towobowo, Anko-Bodija</td>
<td>Cassava (t-value)</td>
<td>-0.181</td>
<td>0.220**</td>
<td>0.447***</td>
<td>0.745***</td>
</tr>
<tr>
<td></td>
<td>Yarn (t-value)</td>
<td>(-0.686)</td>
<td>(2.380)</td>
<td>(5.772)</td>
<td>(7.677)</td>
</tr>
<tr>
<td>Irepoode, Obada, Ijape-Iloera</td>
<td>(t-value)</td>
<td>(1.135)</td>
<td>(0.643)</td>
<td>(14.524)</td>
<td>(8.039)</td>
</tr>
<tr>
<td>Akanran, Towobowo, Anko, Obada,</td>
<td>White maize (t-value)</td>
<td>0.391</td>
<td>2.460E-02</td>
<td>0.91E***</td>
<td>0.907***</td>
</tr>
<tr>
<td>Ijape-Bodija</td>
<td>Yellow maize (t-value)</td>
<td>0.958*</td>
<td>0.131</td>
<td>0.859***</td>
<td>0.795***</td>
</tr>
<tr>
<td>Obada, Ijape-Bodija</td>
<td></td>
<td>(1.655)</td>
<td>(1.244)</td>
<td>(10.568)</td>
<td>(7.9381)</td>
</tr>
</tbody>
</table>

**Diagnostic statistics**

<table>
<thead>
<tr>
<th>Market pairs</th>
<th>Crops</th>
<th>$R^2$</th>
<th>Adj. $R^2$</th>
<th>$F$</th>
<th>DW</th>
<th>IMC classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akanni, Towobowo,</td>
<td>Cassava (t-value)</td>
<td>0.883</td>
<td>0.879</td>
<td>228.806***</td>
<td>2.166</td>
<td>0.3074, high S/R</td>
</tr>
<tr>
<td>Anko-Bodija</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>market integration</td>
</tr>
<tr>
<td>Irepoode, Obada,</td>
<td>Yarn (t-value)</td>
<td>0.860</td>
<td>0.856</td>
<td>187.089***</td>
<td>1.940</td>
<td>8.145E-02, high S/R</td>
</tr>
<tr>
<td>Ijape-Iloera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>market integration</td>
</tr>
<tr>
<td>Akanni, Towobowo,</td>
<td>White maize (t-value)</td>
<td>0.966</td>
<td>0.965</td>
<td>854.667***</td>
<td>2.001</td>
<td>2.712E-02, high S/R</td>
</tr>
<tr>
<td>Anko, Obada, Ijape-Bodija</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>market integration</td>
</tr>
<tr>
<td>Akanni, Towobowo,</td>
<td>Yellow maize (t-value)</td>
<td>0.925</td>
<td>0.923</td>
<td>376.523***</td>
<td>1.990</td>
<td>0.1684, high S/R</td>
</tr>
<tr>
<td>Irepoode, Obada,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>market integration</td>
</tr>
</tbody>
</table>

*Source: Data Analysis 2004. Figures in parentheses are t-value calculated.*** - Coefficients significant at the rate of 1% <=, ** - Coefficients significant at the rate of 5% =, * - Coefficients significant at the rate of 10% <=, S/R-Short run*
unity and very close to zero thus indicating high degree of short run market integration. The IMC for white maize indicate a higher degree of market integration than yellow maize. This may be explained by the high demand for white maize for the preparation some local foods in the area.

These results confirm that price changes in the urban markets (Bodija and Ilora) immediately cause a price change in the rural markets (Akamran, Towobowo, Anko, Irepodun, Oje, Obada, Ipapo). The high degree of integration in these markets is explained by the short distances between the rural and urban markets and the channel of distribution of these staples. Bodija and Ilora serve as terminal markets for the nearby rural markets covered by the study.

These food crops reach the market from the farm in four principal ways; by means of direct sales to rural and urban consumers, direct sales to rural assemblers, direct sales to retailers and direct sales to terminal markets. Farmers transport these food crops to the terminal markets using pick-up trucks over relatively short distances up to 20 km and they sell directly to wholesalers. Farmers also sell small quantities to rural assemblers. These assemblers finally sell to urban based wholesalers who move from one village market to the other, to assemble these products.

Conclusions

Through this analysis of cassava, yam, yellow and white maize market integration, it is concluded that the grains and the tuber markets in Oyo State are highly integrated. Thus, price signals are transmitted from food deficit urban markets to food surplus rural areas. The study did not indicate a fully integrated market ($B_s=0$) and complete market segmentation did not exist ($B_s>0$). Using the Indices of Market Connection as a proxy for marketing efficiency, we infer that the grain and tuber markets in Oyo State are highly efficient in the short run, thus the market pairs are not characterized by much market imperfections. This is due to the short distances between the reference and the rural markets as well as the direct interaction of urban wholesalers with the farmers facilitated information flow between reference and rural markets.

Despite the progress in market performance, some inefficiency remain. However these inefficiencies and absence of the necessary storage infrastructures, storage, market information, standardized weights and measure and other market support services still impair further free flow of goods and services.

References