



## ASSESSMENT OF PRICE TRANSMISSION MECHANISMS OF CASSAVA IN RURAL AND URBAN MARKETS OF BENUE STATE, NIGERIA

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### ABSTRACT

The study assessed price transmission mechanisms of cassava in rural and urban markets of Benue State, Nigeria. Average monthly prices (₦/kg) of cassava spanning from January, 2008 to December, 2018 were collected and analyzed using ADF test, Johansen co-integration test, Error Correction Model (ECM) and Index of Market Concentration (IMC). The result of ADF test showed that the price series were stationary at levels with the co-integration test revealing the presence of co-integration between rural and urban market prices in the study area; and the ECM revealed that the speed of price transmission between rural and urban markets was weak and that adjustment towards the long run equilibrium in the short run was slow. The results of the Index of Market Concentration (IMC) was less than one ( $IMC < 1$ ) and statistically significant at  $P \leq 0.01$  probability level which implies the existence of high short-run market integration between rural and urban markets in the study area. It was recommended that, there was the need for efficient transmission of price information among the various market actors in the urban and rural markets through the establishment of market information centers to facilitate adequate communication and information flow.

**Keywords:** Cassava, Co-integration, Market, Price, Stationarity.

### INTRODUCTION

Cassava (*Manihot esculenta*) is one of the important sources of carbohydrate and primary product for food especially in the form of gari, *tapioca* and *fufu* for human consumption in Nigeria. It is a perennial vegetative propagated shrub and is one of the most important food crops grown in Africa (Oyegbami *et al.*, 2010). As a crop whose by-products have a wide array of uses, cassava is the most important food-crop for Nigeria by production quantity next to yam, which is the most important food crop by value. Nigeria is the world's largest producer of cassava with other top producers being Indonesia, Thailand, the Democratic republic of Congo and Angola (Food and Agricultural Organization Statistics [FAOSTAT], 2012). Cassava prices are highly unstable between seasons in different part of Nigeria. Consumers pay different amounts for the same product in different markets separated by few kilometers. Price instability of agricultural commodity would be considered a normal phenomenon, if it does not significantly differ from one market to another. On the contrary, if products prices are significantly different among markets it will distort resources flow, which might have adverse effect on the food security goal of the nation (Akpan *et al.*, 2014).

Nigeria is a vast country with clear distinct regions, rural and urban areas. Prices of agricultural commodities in each of this region, rural and urban areas differ depending on the availability of infrastructures among others (Akpan *et al.*, 2014). Spatial price linkages are often interpreted as providing insight into the efficiency of infrastructures of markets. This is especially true in developing economy or society, where infrastructure issues such as roads, market links and development, transportation, communication among others may be especially pertinent.



Market integration is a central issue in many contemporary debates concerning market liberalization (Adenegan and Anifat, 2014). It is perceived as a pre-condition for effective market reform in developing countries: "Without spatial integration of markets, price signals will not be transmitted from urban food deficit to rural food surplus areas, prices will be more volatile, agricultural producers will fail to specialize according to the long term comparative advantage and gains from trade will not be realized" (Adenegan and Anifat, 2014). In separated markets, when there is significant price difference between homogenous goods, such that the differences exceeded the transfer cost; the arbitrage activities will be activated. The arbitrageur purchases commodities from lower-price markets and resell in higher-price markets. This is a situation where spatial markets are not integrated but on the other hand, two markets are integrated when there is a significant long-run relationship between prices of homogenous goods due to the smooth transmission of price signals and information across the two markets (Akpan *et al.*, 2014). Market integration could be perfect if price changes in one market are fully and instantaneously reflected in the alternative markets.

In recent years, the empirical research on agricultural price transmission has gathered considerable attention. Interest in this topic unquestionably increased after the so-called food crisis of 2007-2008 in which international agricultural markets were shocked by increased volatility, which is a rapid rise and fall of the "price bubbles" as well as a possible change in the long-term downward trend of agricultural prices (Guilia and Roberto, 2012). The boom and subsequent decrease in food prices that took place around 2008 raised numerous questions about the impact of such variations on populations' welfare and on the economic sector which directly concerns the agricultural sector. In this matter, if governments are to take adequate measures to ensure food security, they need to have good knowledge of the functioning of their markets. This implies, among others, knowing the state of price transmission along the marketing chain within the country and between international and domestic markets (Sadiq *et al.*, 2017).

Hence, understanding the direction and magnitude of cassava price transmission between rural and urban markets in Benue State will provide indispensable input to policy makers to formulate workable policies for the agricultural sector in the state. It will also promote the achievement of the food self-sufficiency goal and help in minimization of the poverty menace among the citizens in the state and the nation at large. Therefore, such information can help government at all tiers to decide the extent to which price transmission can be considered as efficient across different geo-political zones in their domains (Akpan *et al.*, 2014).

In the light of the aforementioned, this study therefore sought to provide answers to the following research questions: What was the trend of cassava price series in the markets? What was the long run and short run influences of cassava prices in the markets? What was the market integration of cassava price series in the rural and urban markets of Benue State? The aim of the study was to analyze the price transmission mechanisms of cassava in rural and urban markets of Benue State, Nigeria. The specific objectives were to: (i) examine the trend of cassava price series in the rural and urban markets; (ii) determine the long run and short run influences of cassava prices in the rural and urban markets; and (iii) analyze the market integration of cassava price series in the rural and urban markets of Benue State, Nigeria.

## **MATERIALS AND METHODS**

### **The Study Area**

The study was conducted in Benue State, Nigeria. The State was carved out of old Plateau State on 3rd February, 1976. The State is located in the middle belt of Nigeria,



approximately between latitudes 6°30'N and 8°10'N of the equator and longitudes 6°35'E and 8°10'E of the Greenwich meridian. The State is bounded by Nasarawa State in the North, Taraba State in the East, Cross-River State in the South, Enugu State in the Southwest, Ebonyi State in the South Central, Kogi State at the West and at the Southeast by Cameroun with a population of 4,253,641 in 2006, which is projected to be about 6,069,945 in 2020 at 3.05% growth rate (National Bureau of Statistics [NBS], 2016). The State is made up of 23 Local Government Areas and is divided into three agricultural zones A, B and C. The dominant ethnic groups are Tiv and Idoma.

**Methods of Data Collection**

Secondary data were used for the study. Time series data for average monthly price series of cassava (₦/kg) spanning from January 2008 to December 2018 was collected from the National Bureau of Statistics and the Benue State Agricultural Development Programme.

**Analytical Techniques**

The study applied series of statistical and econometric techniques to analyze the data collected in line with the stated objectives. The test include: Augmented Dickey Fuller (ADF) test, Johansen Co-integration test, Error Correction Model (ECM) and Index of Market Concentration (IMC). These were described and specified as follows:

1. Augmented Dickey Fuller (ADF) unit root test: As first step in the analysis involving time-series data, the investigation of the presence of unit root in the data is very important for the reason that it helps to ensure that the variables used for the analysis do not result in spurious regression. The ADF unit root test was carried out on the data in order to test for the stationarity of each time series data set. The ADF model is specified as.

$$\Delta P_t = \beta_0 + \beta_t P_{t-1} + \sum C_j \Delta P_{t-1} + \varepsilon_t \quad \dots (1)$$

where;

$\Delta$  = first difference operator and  $\varepsilon_t$  = stochastic error term that follows the classical assumptions. The decision rule is that, if the value of the ADF statistic is less than the critical value at a specified significance level then the series ( $P_t$ ) is said to be non-stationary and vice versa.

2. Johansen co-integration test: The next logical step was to test for co-integration using Johansen co-integration techniques (Trace and Eigen-value Test). It was used to test the hypothesis.  $H_0$ : The time series variables are not co integrated ( $r = 0$ ). If two (2) series are individually stationary at same order, the theories of Johansen and Juselius (1990) and Juselius (2006) can be used to estimate the long run co-integrating vector from a Vector Auto Regression (VAR) model of the form specified in equation 2:

$$\Delta p_t = \alpha + \sum_{i=1}^{k-1} \tau_i \Delta P_{t-1} + \pi P_{t-1} + \mu_t \quad \dots (2)$$

where;

$P_t$  = (n x 1) vector containing the price series at time (t),

$\Delta$  = first difference operator,

$\Gamma_i$  and  $\Pi$  = (m x n) matrix of parameters on the  $i^{th}$ ,

$k^{th}$  lag of  $p_t, \tau_i = (\sum_{i=1}^k A) - I_g,$

$\pi_i = (\sum_{i=1}^k A_i) - I_g,$  and

$I_g$  = identity matrix of dimension g,  $\alpha$  is constant term,  $\mu_t$  is (n x 1) white noise vector. Throughout, p is restricted to be (at most) integrated of order one, denoted by  $I(1)$ , where  $I(j)$  variable requires  $j^{th}$  differencing to make it stationary.

3. Index of Market Concentration (IMC): The index of market concentration was used to measure the price relationship between integrated markets as expressed mathematically in equation 3.

$$P_t = \beta_0 \beta_1 P_{t-1} + \beta_2 (R_t - R_{t-1}) + \beta_3 R_{t-1} + \varepsilon_t \quad \dots (3)$$





where;

$R_t$  = urban,  $P_t$  = rural price,

$R_{t-1}$  = lagged price for urban markets,

$R_t - R_{t-1}$  = difference between urban price and its lag,

$\epsilon_t$  = error term or unexplained term,

$\beta_0$  = constant price,

$\beta_1$  = coefficient of rural lagged price,

$\beta_2$  = coefficient of  $R_t - R_{t-1}$ , and

$\beta_3$  = coefficient of urban lagged price.

The index of market concentration was obtained with equation 4.

$$IMC = \beta_1 / \beta_3 \quad \dots (4)$$

where;

$0 \leq IMC \leq \infty$ ;  $IMC < 1$  implies high short-run market integration;  $IMC > 1$  implies low short-run market integration,  $IMC = \infty$  implies no market integration; and  $IMC = 1$  implies high or short-run market integration.

## RESULTS AND DISCUSSION

### Trend of Cassava Market Price Series in Benue State

The trend of cassava market price series in Benue State presented in Figure 1 shows that there was price instability in the State during the study periods. In the urban markets of Otukpo and Aliade, the price of cassava was unstable between 2008 – 2010 in Aliade market, which was followed by a sharp decline in 2011 while there was a rise in price for Otukpo market in 2009 and this was followed by consistent decrease from 2010 – 2017. The instability and rise in price could be due to rapid urbanization and increase demand of the commodity for various uses in the study area. Considering the rural markets in Adoka and Taraku, an irregular price movement was observed in Taraku market over the period of study, which may be due to the forces of demand and supply as well as the activities of middlemen in the market. For Adoka market, there was a sharp decrease in price in 2010, followed by an increase in 2011 after which the trend keeps increasing at an exponential rate over the period of study reaching its peak of ₦194.37/kg in 2017. The implication of price increase in the rural market is reduction in the quantity demanded for cassava in the rural market and a corresponding price increase in the urban market. The price fluctuations however, could negatively affect policy formulation and planning in the study area. Furthermore, the price fluctuations and corresponding increase in the rural and urban markets suggested a possible co-movement of prices of cassava in the study area. These findings corroborates with the assertion made by Akpan *et al.* (2015) that there were possible co-movement of prices for cowpea and maize in the rural and urban markets of Akwa Ibom State, Nigeria due to the price fluctuations and exponential growth rate observed during the period of study.

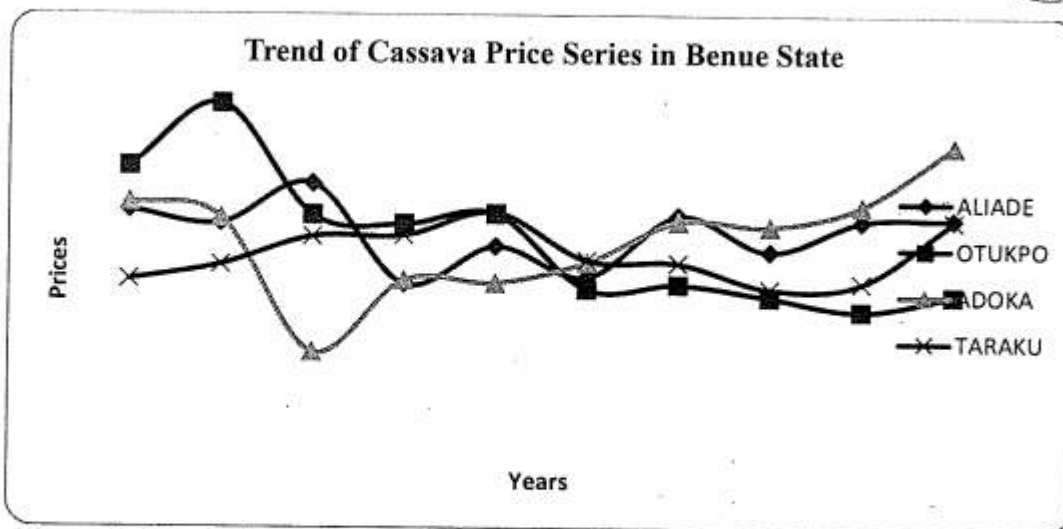


Figure 1: Trend of cassava market price series in Benue State

**Determination of Time Series Properties for Cassava Markets in the Study Area**

Table 1 presents the ADF unit root test of stationarity for cassava market price series in the study area as a prerequisite step in the analysis involving the use of time series data. The results from the ADF test shows that all the market price series in the rural and urban markets were stationary at levels with order of integration 0, I (0). All the markets under study (rural and urban) were all significant at the 0.01 probability level (P < 0.01). This therefore confirms the stationarity of the market price series at levels, thereby leading to the rejection of the null hypothesis of non stationarity of the cassava market price series at levels in the study area. The result corroborates that of Adenegan and Adeoye (2011) who reported similar result in Oyo State, that tomato price series in the rural and urban markets of Oyo State were stationary at their levels.

**Table 1: Results of Unit Root Test for Cassava Price Series in the Study Area**

Market price series	Level	Order of integration
Otukpo	-7.419*** (0.000)	I(0)
Aliade	-4.435*** (0.000)	I(0)
Adoka	-3.881*** (0.002)	I(0)
Taraku	-4.312*** (0.000)	I(0)

Note: \*\*\*and\*\*implies significant at the 1% and 5% level of significance, respectively; Figures in parentheses are probability values.

Source: Data analysis, 2020

**Johansen Co-integration Test for Cassava Markets**

Table 2 shows the co-integration results for cassava market price series in the study area. The result shows that there were at least four co-integrating equations in the rural and urban markets as indicated by 8.33 and 10.71 for both trace and max statistics in the rural and



urban markets respectively, which is greater than the critical value of 3.76 at 5% level of significance.

The null hypothesis of no co-integration among the cassava market price series was therefore rejected; implying a long run relationship among cassava market price series in the rural and urban markets. This result corroborates the co-integration test result of Akpan *et al.* (2014) which revealed the presence of co-integration between the rural and urban prices of maize and beans, thereby implying a long run relationship among the rural and urban market prices.

**Table 2:** Results of Johansen Co-Integration Rank Test for Cassava Markets

Markets	Trace statistics	Critical value (5%)	Max Statistics	Critical value (5%)
<b>Urban market</b>				
r = 0	133.59	68.52	54.11	33.46
r = 1	79.48	47.21	29.88	27.07
r = 2	49.61	29.68	25.29	20.97
r = 3	24.33	15.41	16.00	14.07
r = 4	8.33*	3.76	8.33**	3.76
<b>Rural market</b>				
r = 0	150.60	68.52	67.04	33.46
r = 1	83.57	47.21	37.48	27.07
r = 2	46.09	29.68	19.81	20.97
r = 3	26.28	15.41	15.57	14.07
r = 4	10.71*	3.76	10.71**	3.76

Note: \* and \*\* indicates the number of co-integrating equation at 5% level of significance for Trace and Max statistics, respectively.

Source: Data analysis, 2020

**Vector Error Correction Model (VECM) for Cassava Markets**

The ECM results presented in Table 3 revealed that the short run market integration as measured by the magnitude of market inter-dependence and the speed of price transmission between the urban markets was weak. The result shows that among the urban markets considered only the estimated short run coefficient of Otukpo market was statistically significant at 1% level of significance. This suggests that the transmission of price changes from one market to another during the period was weak. Price changes in Otukpo market was transmitted to other markets at a rate of 3.6% within the period; this shows that adjustment towards the long run equilibrium in the short run was very slow. Similar pattern was also observed in the rural markets where only Taraku market transmitted price changes to other markets at a rate 36%. Therefore based on the results, it can be deduced that cassava markets in the study area were not well integrated in the short run. Mkpado *et al.* (2013) reported that it took time for spatial price adjustment to take place between rural and urban markets, implying a weak price transmission and as such the markets were not well integrated.



**Table 3:** Estimates of Vector Error Correction Model (VECM) for Cassava Markets

Co-int. Eqns	Rural markets		Urban markets	
	Adoka	Taraku	Otukpo	Aliade
Co-integration (equation 1)	-0.1333 (0.0938) [-1.42]	0.3610 (0.1764) [2.10]**	0.0366 (0.0058) [6.27]***	-0.0060 (0.0076) [-0.78]
Co-integration (equation 2)	-0.1489 (0.0924) [-1.61]	-0.3594 (0.0885) [-4.06]***	0.0513 (0.0977) [0.52]	-0.1504 (0.0949) [-1.58]

Note: \*\*\*and\*\*implies significant at 1% and 5% significance level, respectively. Figures in bracket are standard errors and t-values, respectively.

Source: Data analysis, 2020

### Index of Market Concentration for Cassava Markets

The IMC results presented in Table 4 revealed that there was high short run market integration between the rural and urban markets for cassava in the study area as indicated by the IMC value of 0.7761 which is less than one. This is a strong indication that price changes in the rural markets do cause immediate changes in the price of cassava in the urban markets in the study area. This finding is in line with Akpan *et al.* (2014) who conducted a study on monthly price analysis of cassava derivatives in the rural and urban markets of Akwa Ibom State and reported that there was high short-run market integration between rural and urban prices of cassava products in the study area.

**Table 4:** Results of Index of Market Concentration (IMC) for Cassava

Variables	$\beta_1$	$\beta_2$	$\beta_3$	IMC
Markets	0.0104 (0.37)	0.6350 (6.99)***	0.0134 (1.75)	0.7761

Note: \*\*\* and \*\* implies significant at 1% and 5% level of significance, respectively. Figures in parenthesis are t-values.

Source: Data analysis, 2020

### CONCLUSION AND RECOMMENDATIONS

The study analyzed the price transmission mechanisms of cassava in the rural and urban markets of Benue State, Nigeria and concludes that there was price instability over the period of study due to irregular trends of cassava prices in the rural and urban markets. Also, there was long run relationship among the variables with high short run market integration between the rural and urban markets and a weak speed of adjustment between the integrated markets. The study therefore, recommended the need for efficient transmission of price information among the various market actors in the urban and rural markets through the establishment of market information centers to facilitate adequate communication and flow of information.

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