Price Transmission and Market Integration of Cassava Root and Yam Tuber in Oyo State, Nigeria.

Eghieobomhe Wilson Igbaifua* Olawamiwa Reuben Adeniyi**
*(Agricultural Economics. Bowen University, Iwo, Osun State, Nigeria
Email: w.igbaifua@cgiar.org)
**(Agricultural Economics, Bowen University, Iwo, Osun State, Nigeria
Email: Olawamiwa.adeniyi@bowenuniversity.edu.ng)

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ABSTRACT

Prices serve as veritable guide to farmers' planning decision and other market actors in Nigeria. This study examined the trend in cassava root and yam tuber prices in rural and urban markets in Oyo State, Nigeria. Secondary data were used in this study. The data were sourced from Oyo State Agricultural Development Programme (OYSADEP). The average monthly retail price per kilogramme of cassava root and yam tuber covering the period, January 2011 to December 2015 (5 years) for 8 rural and urban markets each in Oyo State were used. Augmented Dicker Fuller (ADF) test, granger causality test and index of market concentration were used to analyze the data. The maximum and minimum prices of cassava root per kilogramme in the rural area were found to be N37.14 and N7.33 respectively. In the same vein, urban market prices obtained for cassava root per kilogramme were N39.34 and N7.09 as maximum and minimum prices. Furthermore, the maximum and minimum prices of yam tuber per kilogramme attained in rural markets were N230.14 and N38.04 respectively; whereas, N207.08/Kg and N38.57/Kg were the maximum and minimum urban market prices obtained between 2011 and 2015 for yam tuber. Cassava root and yam tuber prices were found to be integrated of the order one (1). Seven markets links rejected their respective null hypothesis of no granger causality at 5% significant level, two of the markets links demonstrated bi-directional granger causality while three market links exhibited uni-directional granger causality relationship at (P>0.05). Urban market in both commodities occupies the leadership position in the price formation and transmission in the markets examined. The index of market concentration indicated that the markets exhibited low short run market integration. It is recommended that Oyo State Government should pay more attention to the development of urban market infrastructures and rural-urban road network and activities of middlemen are discouraged in marketing of the commodities.

Keywords**: Price transmission, market integration, cassava root, yam tuber, granger causality, Nigeria**.

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1. INTRODUCTION

Prices are the most readily available and reliable information that guide farmers' planting decisions. A farmer's planting decisions depend on perceived benefits which in effect depends on anticipated prices of cultivated crops. This makes prices unique tool in the economic analysis of markets. Prices are so unique that they serve as market signals of the relative scarcity or surpluses of a given product. Prices also act as incentive to direct the allocation of economic resources and to a large extent determine the rate of economic growth and structure. Reference [8] reported the importance of spatial price transmission analysis of markets. He asserted that price and market information will not be disseminated between rural and urban markets as to know where food surplus and deficit exist. This suggests volatility in food prices, shortages, non – specialization of producers and loss of trade gain.

Several factors have been adduced to be responsible for the volatility in prices of agricultural commodities in Nigeria. This could be because of variances in bargaining power, seasonality of production, cyclical income fluctuation among sellers and consumers, inappropriate response by farmers to price signals and natural shocks (

[13],[27], [1]. According to [11], instability in commodity prices among markets is highly detrimental to the marketing system and the economy as it has caused inefficiency in the allocation of resources depending on the source of variability. ‘’Reference [2] therefore posited that the major determinants of quantity of goods supplied and demanded by consumers is the agricultural retail commodity price. Information on agricultural commodity price in developed and developing countries like Nigeria is necessary to both producers and consumers. This is because prices of agricultural commodities vary almost throughout the year and understanding the trend of such variations is essential for good planning by the farmers, processors, consumers and policy makers.

Market integration refers to the co-movement of prices and more generally put, to the smooth transmission of price signals and information across spatially separated markets. Spatial market price linkages are often interpreted as providing insights into the efficiency of markets infrastructures. This is likely in developing society, where infrastructures problems such as road networks, market development, transportation and others are important ones [14]. In separated markets, when there is significant price difference between homogenous goods, such that the differences exceeded the transfer cost, the arbitrage activities are promoted. This occurs when spatial markets are not integrated. On the other hand, two markets are said to be integrated when there is a significant long-run (say 10 years and above) relationship between prices of goods due to the smooth transmission of price signals and information across the two markets ([23], [3]).

Market integration could be perfect if price changes in one market are fully and simultaneously reflected in the alternative markets ([15]). It suggests it could that unless agricultural markets are integrated, producers and consumers will not realize the benefits from Liberalization. That is, the correct price signals will not be transmitted through the marketing channels, consequently, famers will not be able to specialize according to a long-term competitive advantage. In addition, the potential gains from trade will not be realized in full ([26]).

Cassava roots and yam tubers are important staple food crops in Nigeria and other sub-Saharan African countries. They are used for human food, animal feed, industrial raw materials, religious and traditional ceremonial events in sub-Saharan Africa ([10]). Root and tuber crops generate income, foreign exchange and create markets for Nigeria. Food crops such as cassava and yam contribute about 40% of household income in Nigeria ([21]).

Cassava roots and yam tubers are characterized by problems of bulkiness, seasonality, and high perishability. The persistence of these problems affects production, processing, marketing and consumption of these agricultural commodities. Due to the nature of cassava roots and yam tubers, proper handling is a serious challenge to majority of farmers in Nigeria. Poor infrastructural facilities like good road network, storage facilities, transportation, processing facilities constitute major constraints to cassava and yam production, consumption and even value addition in Nigeria [17]). Because of these problems associated with cassava and yam production and consumption, there are price variations among regions, rural and urban areas in the country.

Many researchers in Nigeria ([17], [13], [3] have linked price variations in agricultural commodities to several factors including variance in bargaining power among consumers, cyclical income fluctuations among sellers and consumers, seasonality of production, natural shocks such as flood, pests, diseases, and inappropriate response by farmers to price signals. Instability in agricultural commodity prices among markets could be detrimental to the marketing system and the economy. It could cause inefficiency in resources allocation among sellers and consumers

depending on the source of variability. It might also increase poverty level among low income earners in the society ([25]).

Based on the important of cassava and yam in the nutritional need and income generation of Nigerians, it is essential to understand the direction and magnitude of price transmission and market integration between the rural and urban markets in Oyo State. This will provide necessary input to policy makers in the state to formulate workable and acceptable policies for some components of the crop sub-sector and the agricultural sector. It will also promote the achievement of the food security drive and help in reducing the problem of poverty among citizenry in the state. Therefore, such information can help Oyo state government to decide when and which intervention policy on the price transmission and integration can be considered as efficient across different areas in the state.

Despite the importance of these two commodities, not much has been reported in the past works. For instance, ([22]) investigated the spatial integration and price transmission in selected cassava products (Lafun) markets in rural and urban markets of Oyo State, Nigeria. The result indicated the presence of the long-run equilibrium following exogenous shocks in the market. In addition, the result revealed unilateral granger causality that runs from the rural to the urban market. The impulse response analysis revealed that, the rural price was more responsive to shocks emanating from the urban market, the effect of which was computed as 95.6% using the forecast error variance decompositions. The work further revealed that, the effects of the rural prices' shocks on urban price were very negligible at 3.2% after 10 weeks. This implies that, the rural market was the dominant market for determining the price of lafun in the short run.

From the report, it is obvious that, issues related to cassava root and yam tuber price transmission and market integration studies had not been widely investigated in most parts of Nigeria. This study was therefore undertaken to specially provide current information on cassava root and yam tuber marketing in Oyo State, Nigeria. To achieve this broad objective, the following specific objectives were undertaken:

- To analyze the trend of the monthly price (N/kg) of cassava root and yam tuber in the rural and urban markets of Oyo State.
- To investigate the level of market integration of cassava root and yam tuber in the rural and urban markets in the State, and
- To determine the casual relationship between and among the rural and urban markets.

Research Hypothesis

The following null hypotheses were tested in this study:

Ho: There is no causal relationship between rural and urban prices of selected root and tuber crops

Ho: The price series is non-stationary

Ho: Price of cassava root or yam tuber in one market does not determine (granger cause) the price in the other market.

II. RESEARCH METHODOLOGY

The study was conducted in Oyo State, Nigeria. Oyo State is selected for the study due to high concentration of smallholder cassava and yam farmers in the State. Oyo State occupies an area of about 28,454 square kilometers and a population of 5,591,589 ([20]). Oyo state is in latitude 6°55' – 8°45'N and longitude 2.5°E – 3° 56'E in South western Nigeria. The mean annual rainfall ranges from 100mm to 1500mm. The agricultural sector of the state is dominated by food crops as well as cash crops. Such important staple food crops include Cassava, yam, maize and rice.

Source of Data

Data for the study were obtained from secondary sources. The data were sourced from the Oyo state Agricultural Development Project (OYSADEP). Monthly prices of cassava root and yam tuber in 8 rural and 8 urban markets across the state were collected from January 2011 to December 2015.

Analytical Techniques

Several statistical and econometric techniques were used to test for the relationship between rural and urban prices of cassava root and yam tuber in the study area. The tests applied include trend analysis, cointegration analysis, Augmented Dickey Fuller (ADF) test, Granger-causality procedural tests and Ravallion – Index of market concentration (IMC) model.

Test for Stationarity

The first step in carrying out a time series analysis is to check for stationarity of the variables (price series in this case) ([19]). A price series is said to be stationary if the means and variances remain constant over time. It is referred to as I (0), denoting integrated of order zero. On the other hand, a Non-stationary stochastic series have varying mean or time varying variance. The price series in this study were therefore tested for stationarity. The aim was to overcome the problems of spurious regression. A stationary series tends to constantly return to its mean value and fluctuations around this mean value have broad amplitudes, hence, the effect of shocks or white noise is only temporal.

A variable that is non-stationary is said to be integrated of order d, written I(d), if it must be differenced d times to be made stationary. In the same vain, a variable that must be differenced once to become stationary is said to be I (1) i.e. integrated of order 1. The Augmented Dickey Fuller (ADF) test model was adopted and used in this study to test for stationarity. This entails running a regression of the form:

$$\Delta P_{it} = \partial P_{t-1} + \beta_1 \Delta P_{t-1} + \ell_{it} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Δ= first difference operator, = 0, implies the existence of a unit root in P_{it} or that the price series is non-stationary,

i = commodity price series, i.e., cassava root or yam tuber,

t = time indicator,

e_{it} = the error term.

The null hypothesis that $\delta = 0$ implies existence of a unit root in P_{it} or that the time series is non-stationary. The critical values, which have tabulated, by [9], [12] and [18 are always negative and are called ADF statistic rather

than t-statistics. If the value of the ADF statistics is less than (i.e. more negative than) the critical values, it is considered that P_{it} is stationary i.e. P_{it} ~I (0).

When a series is found to be non-stationary, it is first-differenced (i.e. the series $\Delta P_{it} = P_{it-1}$ to make it stationary, then ADF test is repeated on the first-differenced series. If the null hypothesis of the ADF test can be rejected for the first-differenced series, it is concluded that P_{it} ~ I(1). The price series for all the markets included in this study were investigated for their order of integration.

Co-integration Test

The second steps consist of carrying out the Johansen tests using a linear deterministic trend to know the number of co-integrating vectors. The Johansen testing procedures have the advantage that they allow for the existence of more than one co integrating relationship (vector) and the speed of adjustment towards the long-term equilibrium is easily determined ([5]). The model is presented below as:

$$\Delta X_t = \mu_t + \sum \Gamma X_{t-1} + \Pi X_{t-k} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Where:

X_t is an (N x 1) vector containing the series of interest (cassava and yam spatial prices series),

Γ and Π = matrices of parameters,

K = number of lags, and should be adequately large enough both to capture the short-run dynamics of the underlying Vector Autoregressive (VAR) and to produce normally distributed white noise residuals,

ε_t = vector of white noise errors.

The Johansen test will give an insight into the number of estimation equations that can be fitted. The presence of at least one co -integrating relationship is necessary for the analysis of long run relationship of the prices to be plausible.

Causality Test

The third and final steps involve the Granger causality test which was carried out to determine the direction of causality. When two price series are cointegrated and stationary, one may proceed to carry out the Granger causality test. This is because one granger causal relationship must exist in a group of co-integrated series ([8]). When Granger causality run one way (uni-directional), the market which Granger-causes the other is tagged the exogenous market. Exogeneity can be weak or strong. "Reference [16] observed that weak exogeneity occurs when the marginal distribution of $P_{j\,(t-1)}$ and $P_{j\,(t-1)}$ was significant, while strong exogeneity occurs when there is no significant Granger-causality from the other variable. It could also be bi-directional which indicates that both series influence each other (e.g. M causes N and N also causes M). The Granger model used in this study can be represented thus:

$$\Delta P_{it} = \Sigma_n^m \alpha_1 \Delta \mathbf{Pi}_{(t-1)} + \sum \mathbf{aj}\ \Delta_{\mathbf{Pj(t-1)}} + \boldsymbol{\ell_1} \qquad (3)$$

Where m and n are the numbers of lags determined by a suitable information criterion i.e.Akaike, Schwarz or Hannan Quinn information criteria are generally applied ([7]). Rejection of the null hypothesis indicates that prices in market j Granger-cause prices in market i.

The hypotheses under the Granger causality can be stated as follow:

Ho: price of cassava root or yam tuber in one market does not determine (granger cause) the price in the other market

H1: price of cassava root or yam tuber in one market does determine the price in the other market (not granger cause)

Index of market concentration (IMC)

The index of market concentration was used to measure price relationship between integrated markets. Following [24]) approach, the actual rural price is given by the equation bellow.

$$P_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 (R_t - R_{t-1}) + \beta_3 R_t{}_{-1} + \varepsilon_t \quad (4)$$

Where: R_t= urban price (in Naira)

P_t = rural price (in Naira)

R_{t-1} = lagged price for urban market (in Naira)

$R_t - R_{t-1}$ = difference between urban price and its lag (in Naira)

E_t = error term

βo = constant term

β_1= coefficient of rural lagged price

β_2= coefficient of $R_t - R_{t-1}$

β_3 = coefficient of urban lagged price

From the estimation of equation (4) above, the Index of Market Concentration (IMC) is given by:

$$IMC = \frac{\beta 1}{\beta 3} \text{ where } 0 \leq IMC \leq \infty \quad (5$$

If:

IMC < 1 implies high short run market integration

IMC > 1 implies low short run market integration

IMC = ∞ implies no market integration

IMC = 1 high or short run market integration

III. RESULTS AND DISCUSSIONS

Price trends

As shown, Table 1 and figures 1 and 2 show the price trends of cassava root and yam tuber in rural and urban markets of Oyo State between 2011-2015. Specifically, Table 1 and figure 1 showed cassava root in rural and urban markets. The maximum price of cassava root in the rural area was found to be N37.14/kg which was recorded in April 2013. However, the minimum price in the rural area was recorded in February 2015 at the rate of N7.33/kg depicting fluctuation in prices across the season. Similarly, for urban cassava root, the maximum price was N39.34/kg in May 2013 whereas the minimum price obtained was N7.09/kg in April 2015.

In likewise manner, Table 1 and figure 2 showed rural and urban yam tuber markets. The maximum price of yam tuber in the rural area was N230.14/kg was obtained in 2015. The minimum price ever recorded in the study area for yam tuber was N38.04 in October 2011. Furthermore, the highest price ever recorded in yam tuber urban market was N207.08/kg which was obtained in March while the lowest price was recorded in August 2014 and was N38.57/kg respectively.

The results obtained for both crops showed that the prices of the root and tuber crops were not stable across seasons. Yam tuber was found to be cheapest during the harvest period which always began in third (July – September) and fourth (October – December) quarters of the year in the state. In the same vain, the highest price of yam tuber

was recorded in the first quarter (January – March) of the year which coincided with planting period of the year for both rural and urban yam markets. This period is regarded as hunger period or off season for yam. The peak price period for cassava root was in second quarter of the year. This could be attributed to hunger period of the year and could be responsible for why past researchers nicknamed cassava as a ‘’famine reserve crop’’([10]).

TABLE 1

PRICE TRENDS OF CASSAVA ROOT AND YAM TUBER IN RURAL AND URBAN MARKETS OF OYO STATE (2011-2015)

Parameters	Cassava root Price		Yam tuber Price	
	Rural Market	Urban Market	Rural Market	Urban Market
	₦/kg	₦/kg	₦/kg	₦/kg
Mean	16.59	17.62	66.94	65.85
Median	13.44	13.7	55.01	55.86
Maximum	37.14	39.34	230.14	207.08
Minimum	7.33	7.09	38.04	38.57
Standard deviation	8.14	8.88	39.06	32.25
Skewness	0.96	0.88	2.89	2.84
Kurtosis	2.84	2.62	10.97	11.64

Source: Oyo State Agricultural Development Programme (OYSADEP 2011-2015).

Table is computed by me and prices are expressed in nominal terms

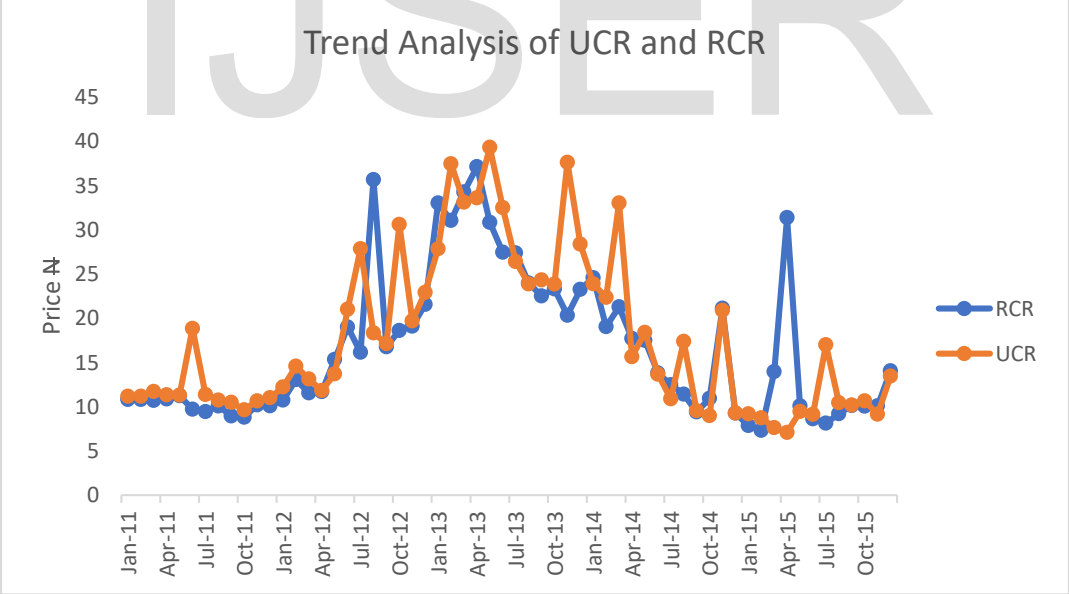

Figure 1: Urban cassava and rural root and rural root market

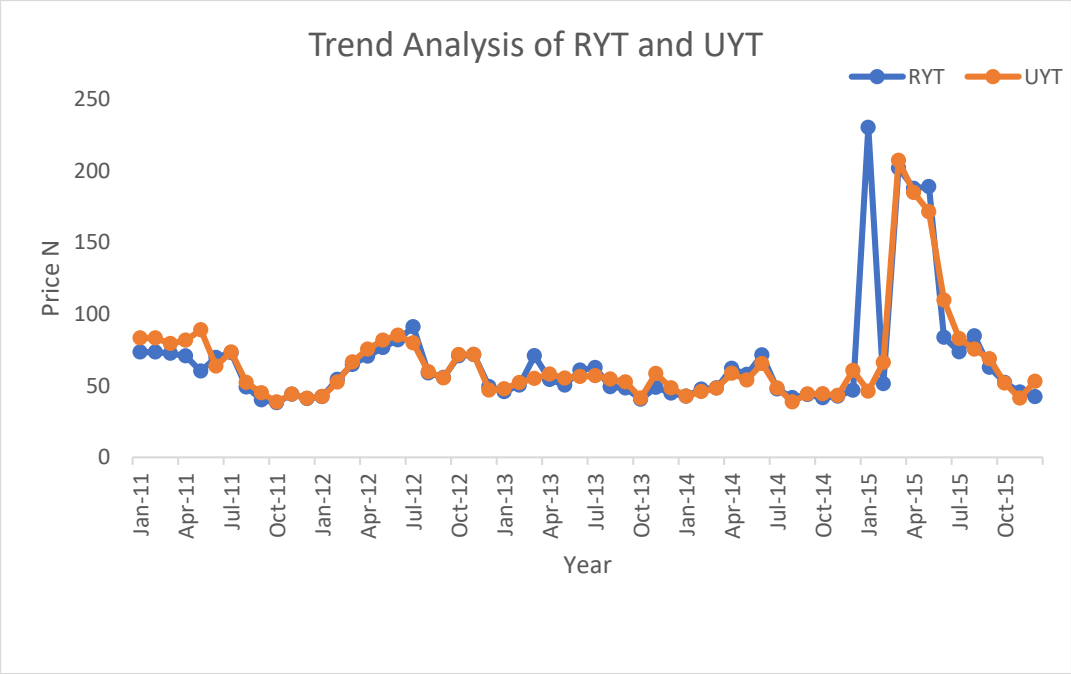

Figure 2: Rural yam and urban yam tuber market

Stationarity test of cassava root and yam tuber in Oyo State

The result in Table 2 shows the stationarity test for root and tuber crops using ADF procedure. The results indicate that all the variables are not stationary at their level form. The values of the ADF t-statistics were smaller in absolute term than the critical value at 5%. This shows that the null hypothesis of non-stationarity could be accepted at the probability of 5 percent of significance. Therefore, the null hypothesis of non-stationary was accepted for all the variables at their level form. The null hypothesis was however rejected at first difference for Rural and Urban cassava root, rural and urban yam tuber. This agrees with the findings of ([4], [8, [28]) that commodity prices are stationary at the order of first difference. This implies that the test of cointegration could be applied on selected root and tuber crops.

TABLE 2

RESULT OF STATIONARITY TEST FOR CASSAVA ROOT AND YAM TUBER IN OYO STATE

Unit Root Test

Market	Price level I (0)			First difference I (1)		
	ADF level form	PP	Remark	ADF	PP	Remark
Rural cassava root	0.0334	0.0561	Non-stationary	0.000***	0.000***	Stationary
Urban cassava root	0.326	0.1205	Non-stationary	0.000***	0.000***	Stationary
Rural/Yam tuber	0.0968	0.0001	Non-stationary	0.000***	0.000***	Stationary
Urban Yam tuber	0.0521	0.0349	Non-stationary	0.000***	0.000***	Stationary

*** Significant at 5 percent level

Co-integration test for cassava root and yam tuber in Oyo State

Co-integration tests was carried out on all the variables to determine the existence of long-run relationship between the different series data. Table 2 below presents the result of the co-integration test involving the use of Johansen maximum likelihood test to determine the number of co-integration relations. The maximum Eigen value revealed that the two market pairs investigated, co-integrated exist at 5 percent level of significance. Therefore, the null hypothesis of no co-integration was rejected at 5% significance level for both rural and urban markets for cassava root and yam tuber. This implies that both rural and urban cassava and yam tuber have their prices tied together in the long run.

TABLE 3

RESULTS OF JOHNSEN MAXIMUM LIKELIHOOD TEST FOR RURAL AND URBAN MARKETS OF CASSAVA AND YAM IN OYO STATE (2011-2015)

Market Pairs	Eigen value	Trace Statistics	Critical value 5%	Probability	Hypothesized No. of co-integrating equation
RCR	0.441	34.42	15.49	0	None*
UCR	0.045	2.65	3.84	0.104	At almost 1
RYT	0.661	72.66	15.49	0	None*
UYT	0.158	9.99	3.84	0.002	At almost 1

* Denotes rejection of the null hypothesis at 5% significant level

RCR = Rural cassava root RYT=Rural yam tuber

UCR = Urban cassava root UYT=Urban yam tuber

Granger causality test for cassava root and yam tuber prices in Oyo State

In general, twelve cassava root and yam tuber market links were investigated as depicted in Table 4. Five market links rejected their respective null hypothesis of no Granger causality while seven other market links either exhibited bi-directional Granger causality or a simultaneous feedback relationship or uni-directional Granger causality relationship. From the result of the analysis as shown in Table 4, three of the market links exhibited uni-directional Granger causality and four market links exhibited bi-directional Granger causality relationship. Urban yam tuber market has a strong exogeneity over urban cassava root market. Also, from the result of the analysis a few of the markets are spatially linked by trade. This implies low market integration between rural and urban market. The implication was that price changes in one market are not manifested to an identical price response in other market (Barrett, 1996). Furthermore, there is inadequate free flow of goods between markets and therefore existence of inefficient arbitrage in the markets.

TABLE 4

GRANGER CAUSALITY TEST FOR CASSAVA ROOT AND YAM TUBER PRICES IN OYO STATE (2011-2015)

Null Hypothesis	Observation	F-statistics	Probability
Rural yam tuber does not Granger cause rural cassava root	58	1.4472	0.2444
Rural cassava root does not Granger cause rural yam tuber		0.04706	0.9541
Urban cassava root does not Granger cause rural cassava root	58	4.867	0.0115*
Rural cassava root does not Granger cause urban cassava root		6.98758	0.0045*
Urban yam tuber does not Granger cause rural cassava root	58	7.79338	0.0011*
Rural cassava root does not Granger cause urban yam tuber		1.21297	0.3054
Urban cassava root does not Granger cause rural yam tuber	58	0.33972	0.7135
Rural yam tuber does not Granger cause urban cassava root		0.41114	0.665
urban yam tuber does not Granger cause rural yam tuber	58	14.7883	8.E-06*
Rural yam tuber does not Granger cause urban yam tuber		46.2976	2.E-12*
Urban yam tuber does not Granger cause urban cassava root	58	0.35588	0.7022
Urban cassava root does not Granger cause urban yam tuber		1.59413	0.2127

Source: Author's computation of secondary data collected from OYSADEP (2011-2015)

* 5% significant

The indices of Market Concentration (IMC)

The result of the analysis of indices of market connection/concentration (IMC) is presented in Table 5 below. For cassava root and yam tuber market pairs, the IMC were 2.04 and 1.98. The IMC for these market pairs were greater than unity implies low short run market integration. The results further indicate that price changes in the urban market do not cause simultaneous or immediate change in the prices in the rural market and vice versa.

TABLE 5

INDICES OF MARKET CONNECTION OF CASSAVA ROOT AND YAM TUBER PRICES IN OYO STATE

Market pairs	Crops	R^2	Adjusted R^2	F-statistics	DW	IMC classification
Rural and Urban	Cassava	0.66	0.641	34.50***	2.04	2.26 (low short run market integration
Rural and Urban	Yam	0.6	0.574	27.06***	1.98	5.45 (low short run market integration

Source: Author's computation of secondary data collected from OYSADEP (2011-2015)
DW=Durbin Watson statistics

IV. CONCLUSION AND RECOMMENDATIONS

The study assessed the price behaviour of cassava root and yam tuber in rural and urban markets of Oyo state. The trend analysis results showed that the prices of root and tuber crops were not stable across the seasons in Oyo state. Results also showed low short run market integration existed between rural and urban markets of cassava root and yam tuber with urban market being the leading markets. The existence of uni-directional and bi-directional granger

causality relationships was established for cassava and yam and inefficient arbitrage in the market. The stationary test indicated that the prices were not stationary at level from. However, it first difference, prices became stationary thereby leading to the rejection of the null hypothesis of no stationary in the prices of cassava root and yam tuber. It is therefore recommended that urban markets which have been shown in this study to be the lead market should be the target of Government of Oyo state in her developmental reforms. Also, there is need for Government to solve the problem of transportation networks, rural-urban feeder roads, curb activities of middle men and tours, market information which could be obtained by establishment of information centers and weekly review of market prices as a programme in State's owned radio station.

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