Original Research Article

Market Integration and Price Movement of white and brown cowpea in Urban and Rural Markets of Gombe State, Nigeria. A Granger - Causality Approach.

ABSTRACT

The study investigated the price movement and market integration of rural and urban price of brown and white cowpea in Gombe State, Nigeria .Monthly market prices (measured in Naira per kilogram) of brown and white cowpea in the rural and urban markets from January 2004 to December 2014. The data was obtained from the Gombe State Agricultural Development Programme (GSADP). The descriptive statistics shows that the average price of rural brown cowpea was ₦109.88k,rural price of white was ₦95.71k, urban price of brown was ₦ 123.18k while urban price of white was ₦ 110. Unit root test indicated that the prices were stationary at level 1(0) and first difference 1(1). The Johansen co- integration analysis was used to test for the relationship between markets price and the results indicated that the rural and urban markets price were co- integrated. Pair-wise granger causality test indicated a bi-directional movement between the urban price of brown and urban price of white and a uni-directional movement between rural price of white cowpea and rural price of brown cowpea. There is need for the State government to establish market information centers and information centre of the GSADP should facilitate efficient communication and flow of information concerning prices of agricultural products using the mass media and social media.

Keywords: Stationarity, Granger-causality, Market integration, Vector error correction model, Price movement,

1.0 INTRODUCTION

Agricultural Production plays an important role in economic development of Nigeria. Apart from contributing to the largest share of the Gross Domestic Product (GDP), agriculture is the largest non-oil foreign exchange earner, the largest employer of labour and a key contributor to wealth creation and poverty alteration in Nigeria (Adamu et al,)[1].

The pivotal role of marketing in enhancing rural economy of the world cannot be overemphasized. One of the major functions of Agricultural marketing is to bring items of trade from surplus to deficit areas. Cowpea *(VignaUnguiculata)*is one of the agricultural produce in Gombe State, Cowpea marketing entails all the activities involved in moving cowpea from the point of production to where it is needed by the final consumer. It involves series of transaction costs which are reflected in the size of the marketing margin. These margins vary among brands, types, location and over time (Akpan et al)[3].

Cowpea is considered more tolerated to drought than soybeans and better adapted to sandy soils. fjMany cowpea cultivars have a vining growth habit, but modern plant breeding has also led to more upright, bush-type cultivars, (Abah et al)[2].

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Cowpea is an important source of plant protein in the developing world and most especially in West Africa; cowpea is rich in protein and constitutes a staple food for people in rural and urban areas (Baributsa et al)[6].

The need for the marketing system of cowpea to be well structured and efficiently organized cannot be overemphasized. It enhances the place of economic development by encouraging specialization, generation of foreign exchange earnings, development of an exchange economy, provision of income and employment opportunity for marketing (Olukosi et al)[7].

Instability in commodity prices among markets could be detrimental to the marketing system and the economy as a whole. It could cause inefficiency in resources allocation among sellers and consumers depending on the source of variability. It could also increase poverty level among low income earners in the society (Polaski,)[8] (Akpan et al)[3].

Pries of cowpea is highly unstable between seasons and consumers pay different amount for the same product in different markets separated by a few kilometers (Akpan et al)[3].

In order to ensure maximum returns, farmers must market their production decisions considering the most favourable place, time and form in which their products could be marketed (Ayinde and Idris)[13]. Prices of cowpea vary from month to month, variety and even day to day. Prices also differ between various grades of cowpea and also differ between alternative markets. Farmers usually sell their surpluses to rural assemblers, who in turn sell to urban wholesalers directly or through commission agents, therefore Sustainability of agricultural activities is hinged on effective price system. In the recent past, the markets for agricultural commodities in Nigeria have shown a pattern of long-term price fall and short-term price instability (IMF, 2010)[11](Akpan et al)[3].

During harvesting periods, prices of farm product are generally low due to surpluses : In the off-season, prices rose due to reduced production and seasonal change (Akpan, 2002[] Akintunde et al)[12]. Hence, agricultural commodity price is one of the major determinants of quantity of commodities supplied by farmers and demanded by consumers. Price instability among agricultural commodities is a regular phenomenon in markets across Nigeria and could be detrimental to the Marketing system and the economy as a whole. From the literatures reviewed, it can be seen that price movement and market integration studies on white and brown cowpea has not been widely investigated in the study area. Therefore to achieve this the following specific objectives were achieved.

i. To examine the degree of market integration of white and brown cowpea in the rural and urban markets in the study area.
ii. To examine the Granger –Causality between the urban and rural price of white and brown cowpea .
iii. To examine the speed of adjustment to equilibrium of white and brown cowpea in the rural and urban markets in the study area.

Materials and methods

Gombe State is located between latitude 9 ^{0}30’ and 12 ^{0}30’ N and longitude 8^{0}45’ and 11 ^{0} 45’ E of the Greenwich meridian. It lies within the North east region of Nigeria and occupies a total area of about 20,265 square kilometres. The State had, as at 1998 an estimated population of 1,820,415 inhabitants (NPC, 2006).The projected population is about 2,275,518 people in 2016. It is a confluence of economic activities by its position as a meeting point for business people from the surrounding State. The State share boundary with Yobe and Borno to the north east,

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Taraba and Adamawa to the south and Bauchi to the west .This advantage has made the state vibrant in all respects. It has agriculture as the mainstay of its economy with the production of varieties of cash crops with large percentage of the populace engaged in farming and agro allied activities. The soil is very fertile for crops like cowpea, maize, sorghum, millet, groundnut among others that are cultivated in the study area. The State has eleven (11) Local Government Areas grouped into three senatorial zones. Gombe north comprising of Gombe,Kwami,Dukku,Nafada and Funakaye and Gombe central comprising Yamaltu/Deba and Akko Local Government areas while Gombe south comprises of Billiri, Balanga,Kaltungo and Shongom Local Government areas respectively (www.gombe state.gov.ng,)[17].

Data Collection

The data for this study was sourced from Gombe State Agricultural Development Programme (GSADP). Secondary data on monthly prices of brown and white cowpea in rural and urban market spanning from 2009- 2014 was collated.

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Empirical Models

Testing for Unit Root.

A variable is said to have a unit root if it is non-stationary (Vavra and Goodwin,)[15]. A time series that has a unit root is known as a random walk. Vavra and Goodwin)[15] defined a random walk as a process where the current value plus an error term defined as a white noise.

A variable is said to contain a unit root or is 1 (1) if it b non-stationary. The use of data characterized by unit roots may lead to serious error in statistical inference. According to Vavra and Goodwin[15].

$$y_t = \beta y_{t-1} + E_t \quad \text{---------- (1)}$$

If equation (1) equals one, the model is said to be characterized by unit root (the equation becomes the random walk model), and the serious is non-stationary (Vavra and Goodwin)[15].For a series to be stationary, must be less than unity in absolute value.

Hence, stationary requires that $-1 < \beta < 1$.

The reason for unit root is to determine whether the series is consistent with 1(1) (integrated order of one) process with a stochastic trend. (Welson and Plosser, 1982 and Jasehus, 1993). The commonly used test for the presence of unit root are the t-test proposed by Dickey-Fuller (1979) & the alternative test proposed by Philips &Perron)[9].

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Co-integration Test

Co-integration test is concerned with estimating long-run economic relationships among non-stationary and integrated variables. Variables are said to be integrated when they share common unit root and the sequence of stochastic shock is common for both. Co-integration is a powerful concept that allows capturing the equilibrium relationship even between non-stationary series (if such equilibrium relationship exists) within a stationary model (Vavra and Goodwin,)[15]. If the series indicates that the series are co-integrated, then one can test for transmission of price.

Model Specification

Augmented Dickey Fuller Test (ADF)

$\Delta Pit = \beta + \beta i\ T + \text{ɖi}\ Pt\text{-}1 + \sum_{j=1}^{k} b1\ \ \Delta Pt\text{-}1\ \ + Et$ ----------(2)

Where;

Δ = the difference operator

T= time trend

β =drift parameter

βi ,ɖi and bi =coefficients

Et = error term. (Dickey and Fuller, 1979)

Johansen co- Integration Model

$\Delta Pt = \alpha + \sum_{t-1}^{k-1} \Gamma \Delta P t\text{-}1\ \ + \Gamma \Delta Pt\text{-}1\ + \prod P + Ut$ ----------(3)

Where;

Pt = n * 1 vector containing the cowpea price series at time (t)

Δ = the first difference operator

Γi and ∏ = n*n matrix of parameters on ith and kth lag of Pt

(Johasen and Juselius,1990)

Decision Criteria:

* Reject at the 5% level.

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* Reject the null hypothesis if the value of the trace and Max statistic greater than 5% critical value, otherwise ,fail to reject the null hypothesis.

Vector error correction model(VECM)

The vector error correction model(VECM) restricts the long –run behavior of the endogenous variable to converge to their co-integrating relationship while allowing for a short run adjustment. it is a restricted VAR designed for use with nonstationary series that are known to be integrated. The Vector Error Correction Model (VECM) is an extension of co-integration method and this is what is used for this study to analysis price movement because it separates short and long-run market dynamics (Conforti,)[4].

$\Delta y_t = \beta_0 + \sum_{t=1}^{n} \beta\, \Delta y_{t-1} + \sum_{i=1}^{n} \delta \Delta x_{t-1} + \psi Z_{t-1} + u_t$

Z = ECT and is the OLS Residual from the long-run co-integration equation.

ψ = speed of adjustment.(it measures the speed at which y returns to equilibrium after a change in X.

Cointegrating equation: $Z_{t-1} = ECT_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1}$

Granger Causality Test

After undertaking co- integration analysis of the long run linkages of the various market pairs , and having identified the market pairs that are linked, an analysis of statistical causation will be conducted .The causality test uses an error correction model (ECM) of the following form;

The Granger Model

$Rpt = \alpha + \sum_{i=1}^{m} \alpha Upt\text{-}1 + \sum_{j=1}^{u} \beta j\ RPt\text{-}j + Et$ ----------(4)

Where:

Rpt = rural market price

$\boldsymbol{Upt}$-1= urban market price

U= number of observations

m= number of lags

Et=error term

α and β =parameter to be estimated. (Baulch,1997)

Results and Discussions

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Table 1: Descriptive Statistics of white and brown cowpea in the study area (2009-2014).

	Ruralpb	Rural pw	Urbanpb	Urbanpw
Mean	109.8750	95.70833	123.1806	110.0000
Median	100.0000	90.00000	110.0000	100.0000
Maximum	210.0000	200.0000	250.0000	250.0000
Minimum	62.00000	30.00000	64.00000	64.00000
Std. Dev.	35.98393	32.03011	44.52830	36.54941
Skewness	1.659353	1.205355	1.802193	2.382366
Kurtosis	5.418819	5.882478	5.891071	9.540859
Jarque-Bera	50.59349	42.36061	64.04968	196.4566
Probability	0.000000	0.000000	0.000000	0.000000
Sum	7911.000	6891.000	8869.000	7920.000
Sum Sq. Dev.	91933.88	72840.87	140776.7	94846.00
Observations	72	72	72	72

Source: Gombe State Agricultural Development Programme (GSADP), 2018, table is computed by Authors and price expressed in nominal terms. Unit of measurement (₦/kg).

The mean price of 1 kg of brown cowpea in the rural market was ₦109.86k with a minimum price of ₦62 and maximum price of ₦210. The mean price of 1 kg of white cowpea was ₦95.71k with a minimum price of ₦30 and a maximum price of ₦200/kg. The mean urban price of brown cowpea per kg was ₦123.18k with a minimum price of ₦64 and a maximum price of ₦250/kg while the mean urban price of white cowpea was ₦110/kg with a minimum price of ₦64 and a maximum price of ₦250/kg. The prices of both white and brown cowpea were positively skewed to the right. The result of the kurtosis shows that the prices were leptokurtic meaning that the kurtosis are greater than 3 and are flat tailed. The standard deviation in the rural pw and urbanpw followed similar pattern (32.03011 and 36.54941) which indicates that the change in both prices assumed similar pattern , the same goes for ruralpb and urbanpb (35.98393 and 44.52830).

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Table 1a:Augmented Dickey- Fuller Unit root test result of price series (2009 -2014)

Market price series	price level 1(0)	Lag	First Diff (1)	Lag
Rural PB	7.9630 ***	(0)	9.5130***	(1)
Rural PW	4.9477 ***	(0)	11.7228 ***	(0)
Urban PB	3.6052 ***	(0)	8.2934 ***	(0)
Urban PW	5.3491 ***	(0)	13.0761 ***	(0)

Source: Authors extract.
Significant at 1%

H_o: Price series has a unit root
H_A: Price series has no unit root

The result in the table shows the stationary test for urban and rural prices of brown and white cowpea. The results indicate that the variables were stationary both at levels 1(0) and at first difference 1(1) this is done in other to avoid a spurious regression and errors as a result of the data generating process. Therefore, the null-hypothesis was rejected in favour of the alternative. Thus,the price series were stationary both at levels 1(0) and first difference 1(1) are requirements for the Johansen co-integration analysis. The result is in agreement with the findings of Mafimisibi et al., 2014, Akintunde et al[12].

VAR Lag Order Selection Criteria
Endogenous variables: RURALPB RURALPW URBANPB URBANPW
Exogenous variables: C

Sample: 2009M01 2014M12
Included observations: 66

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1160.626	NA	2.50e+10	35.29170	35.42440	35.34414
1	-1100.122	111.8400	6.49e+09*	33.94310*	34.60664*	34.20530*
2	-1091.469	14.94687	8.15e+09	34.16573	35.36008	34.63767
3	-1076.120	24.65206	8.43e+09	34.18544	35.91062	34.86714
4	-1068.167	11.80770	1.10e+10	34.42932	36.68532	35.32077
5	-1047.699	27.91191*	1.01e+10	34.29390	37.08073	35.39511
6	-1034.065	16.93901	1.16e+10	34.36560	37.68326	35.67657

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

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HQ: Hannan-Quinn information criterion

From the VAR Lag Order Selection criteria table above the Akaike Information Criterion(AIC), Final prediction error(FPE),Schwarz information criterion(SC), and Hannan-Quinn information criterion(HQ) all selected a lag length of one(1) while sequential modified LR test statistic selected lag length of five(5).So we go with a lag length of one (1).

Test for co-integration between urban and rural market price of cowpea (white and brown).

Table 2: Johansen Co-integration result (2009-2014)

Market pair	Trace Statistic	Critical Value (5%)	Max Eigen value	Critical value	Hypothesized No of CE (S)
Rural- Urban PB	32.57	15.49	21.03	14.26	At most 1
Rural PB- Rural PW	34.44	15.49	20.62	14.26	At most 1
Rural PW- Urban PW	34.44	15.50	23.45	14.26	At most 1
Urban PB- Urban PW	35.91	15.50	23.22	14.26	At most 1

Source :Authors Extract.

* Significant (P < 0.05)

The co-integration test carried out on all the price series to determine the existence of long-run relationship between the price series using Johansen co-integration test gave the result presented in Table (2). Both the trace statistics and maximum Eigen value indicated two co-integrating vectors for brown and white cowpea market price at 5% level of significance.

The null hypothesis of co-integration, r = 0 is rejected This is because the trace statistic for the null hypothesis of r = 0 were greater than the critical value of 5%. This implies that rural – urban market price for these commodities are co-integrate and there is significant existence of long-run market relationship. It also indicates that a perfect price transmission of formation exist in both urban and rural markets of cowpea. When there is perfect transmission of price in a network of markets, producers, marketers and consumer, will realize the appropriate gains from trade because correct price signals will be transmitted down the marketing chain. This is in line with the findings of (Ojiako et al[14] and Izekor et al[16].

Table2a : Cointegraing Equation

1 Cointegrating Equation(s)	Log likelihood	-768.3542

Normalized cointegrating coefficients (standard error in parentheses)

RURALPB	URBANPB
1.000000	0.007707
	(0.41555)

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Table2b : Cointegrating Equation

1 Cointegrating Equation(s)	Log likelihood	-760.7569

Normalized cointegrating coefficients (standard error in parentheses)

RURALPB	RURALPW
1.000000	-0.322020
	(0.59799)

Table2c : Cointegrating Equation

1 cointegrating Equation(s)	Log likelihood	-614.6303

Normalized cointegrating coefficients (standard error in parentheses)

RURALPW	URBANPW
1.000000	-0.724583
	(0.07677)

Table 2d : Cointegrating Equation

1cointegrating Equation(s)	Log likelihood	-621.1777

Normalized cointegrating coefficients (standard error in parentheses)

URBANPB	URBANPW
1.000000	-1.222191
	(0.07616)

Source: From Authors extract.

From the above co-integrating equations(Table 2a -2d),the signs of the coefficient is reversed in the long-run, and this shows that in the long-run falling price of urban price of brown cowpea are associated with the rising price of rural price of brown cowpea vice- versa, in table 2b, the coefficient is reversed in the long-run and this shows that in the long-run the rising price of urban price of white cowpea is associated with the rising price of rural price of brown cowpea vice-versa. Table 2c in the long-run shows that the rising price of urban white cowpea is associated with the rising price of urban price of brown cowpea vice versa, table 2d ,in the long run shows that the rising price of urban price of white cowpea is associated with the rising price of urban price of brown cowpea and vice versa**.**

VECM RESULT

Speed of Adjustment coefficients

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The speed of adjustment coefficient given as – 0.935 and -0.866 for the rural price of brown cowpea and urban price of white cowpea. The negative sign indicates a move back towards equilibrium. The results indicate that if there is a positive direction for long-rum equilibrium the markets tends to respond with a decrease if both rural and urban prices of brown cowpea and white cowpea prices. The rural price of Brown cowpea tends to respond faster relative to urban price of white cowpea. The adjustment coefficient was statistically significant at 5% suggesting that the urban price of white cowpea is weakly exogenous. This suggests that movement in urban price of white cowpea is less affected by the price of rural price of Brown cowpea. This means that the long-run equilibrium after exogenous shocks is restored.

The speed of adjustment coefficient is given as – 0.5514 and 0.4407 for rural price of white and urbanprice of brown cowpea. The results indicate that if there is a positive deviation from long-run equilibrium the markets tend to respond with decreases in both rural and urban price of cowpea. The rural price of white cowpea tends to respond faster compared to urban price of brown cowpea , and at long run it will converge at equilibrium while the that of urban price of brown cowpea will not converge at long-run.

The adjustment coefficient was statistically significant at 5% suggesting that the urban price of brown cowpea is weakly exogenous.

Estimated VECM with RURALpb as target variable:

$$\Delta Ruralpb = 0.935060 ect_{t-1} + 0.097148 \Delta Ruralpb_{t-1} + 0.112009 \Delta Urbanpb_{t-1} + 0.086067$$

Cointegrating equation(long-run)

$$ect_{t-1} = 1.000000 Urbanpbt\text{-}1 - 0.519536 Urbanpn_{t-1} - 46.29201$$

Estimating VECM with URBANpw as target variable

$$\Delta Urbanpw = - 0.0866278 ect_{t-1} - 0.025234 \Delta urbanpw_{t-1} - 0.083578 \Delta urbanpb_{t-1} + 0.295933$$

Cointegrating equation (long-run)

$$ect_{t-1} = 1.000000 Urbanpw_{t-1} - 0.696457 \Delta Urbanpb_{t-1} - 24.30492$$

Estimating VECM with Ruralpw as target variable

$$\Delta Ruaralpw = -0.55147 ect_{t-1} + 0.101959 \Delta Ruralpw_{t-1} - 0.390509 \Delta urbanpw_{t-1} + 0\text{-}187129$$

Cointegrating equation (long-run)

$$ect_{t-1} = 1.000000 Ruralpw_{t-1} - 0.836287 \Delta urbanpw_{t-1} - 3.6580507$$

Estimating VECM with URBANpb as target variable

$$\Delta Urbanpb = 0.440712 ect_{t-1} - 0.197389 \Delta urbanpb_{t-1} + 0.374656 \Delta Ruralpb_{t-1} + 0.237327$$

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Cointegrating equation (long-run)

$ect_{t-1} = 1.000000Urbanpw_{t-1} - 1.924795\Delta Ruralpb_{t-1} + 89.10264$

Table3 : Granger- causality for urban and rural prices of white and brown Cowpea(2009-2014).

Direction of causality	No of lag	F-statistic	Decision
Urbanpb → Urbanpw	1	4.94277(0.0295)	Rejected
Urbanpw → Urbanpb	1	11.6964(0.0011)	Rejected
Ruralpb→ Urbanpw	1	1.23686(0.2700)	Accepted
Urbanpw → Ruralpb	1	11.2936(0.0013)	Rejected
Urbanpb→ Ruralpw	1	1.83690(0.1798)	Accepted
Ruralpw → Urbanpb	1	3.55414(0.0637)	Accepedt
Ruralpb→ Ruralpw	1	1.14766(0.2878)	Accepted
Ruralpw → Ruralpb	1	04.17977(0.0448)	Rejected
Ruralpw→ Urbanpw	1	0.19863(0.6572)	Accepted
Urbanpw → Rural pw	2	0.01206(0.9129)	Accepted

Source : Author's Extract

Value in parenthesis= probability level.

From table 3 above the pair wise Granger causality test shows that the rural and urban price of brown and white cowpea does not granger cause each other except for urban price of brown(urbanpb) that that granger cause urban price of white(urbanpw) and also urban price white granger cause urban price of brown cowpea,urban price of white cowpea(urbanpw) granger cause rural price of brown(ruralpb), rural price of white(ruralpw) also granger cause rural price of brown cowpea(ruralpb). There are two uni-directional movement of price and one bi-directional movement.

Summary and Recommendation

The study used statistical and econometric method to analyze the movement of price and market integration of white and brown cowpea in the rural and urban markets of Gombe State, Nigeria .The result for the unit root test between the rural and urban prices of white and brown cowpea shows that the prices were stationary at level 1(0) and at first difference 1(1). T he Johansen co-integration test revealed that the urban and rural markets were integrated at long-run, and VECM result revealed that the prices will converge at long run to equilibrium except for urban price of

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brown cowpea. The Granger –Causality test revealed that two markets exhibited uni- directional movement of price and one bi- directional movement of price.

Therefore, based on the discoveries of this study, it is recommended that the Gombe State government should help in putting marketing infrastructures in place especially in rural areas, also effort should be made to reduce excessive charges by revenue collectors on the road from rural to urban centers. The State agricultural development programme should intensify effort to create a proper information sharing centers through the use mass media (radio, television etc) and even social media to facilitate efficient flow of information to cowpea farmers and consumers both within and outside the State.

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