Original Research Article

COINTEGRATION AND MARKET INTEGRATION: AN APPLICATION TO HIDES AND '*POMO*' MARKETS IN NIGERIA

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ABSTRACT

Aim: To investigate long run and short run relationship between the prices of hides and '*pomo*' in Kano and Lagos markets in Nigeria, using cointegration techniques.
Study design: The study made use of purely secondary data the prices of hides for the past twenty one years (1988 – 2009) in Kano State and the prices of '*pomo*' for the same number of years in Lagos State to see whether their prices influence each other.
Place and duration of study: From the Federal Ministry of Agriculture and Natural Resources, Livestock and Veterinary Unit, Gwale, Kano and Federal Ministry of Commerce and Industry, Lagos, in July, 2011
Methodology: Data on prices of hides and '*pomo*' over a period of twenty one years (1988 – 2009) were used. Unit root test and Johansen cointegration test were carried to find out whether the markets in the two locations are cointegrated or fragmented.
Results: The result showed that there was no cointegration between the two markets. The result of similar trend in the prices of hides and '*pomo*' in the two markets may be attributed to other factors such as inflation and festivities.
Conclusion: There is no long run relationship in the price of hides and '*pomo*' in the two markets. Therefore, government should be committed to policies that can develop a well coordinated market information system to help marketers and consumers have access to prevailing market prices of agricultural products so that long run relationship exists among commodities in different markets.

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Keywords: Cointegration, market integration, hides, '*pomo*', Nigeria

1. INTRODUCTION

Hides and skins are the main export income generators from the livestock sector in Africa. In the year 2000, Africa's share of total world production was only 5% of bovine hides, 14% of goat and kidskins and 8% of sheep and lambskins (UNDP, 2005). Chemonics International Inc. (2009) discovered that hides and skins are obtainable in commercial quantities from abattoirs located all over the country, especially in the Northern states of Nigeria. Finished leathers on the other hand are obtainable from tanneries and also from traditional tanners, both of which are also located in the Northern part of the country. According to Ihuoma *et al*. (2001) a large proportion of hides and skins from slaughters that take place in registered abattoirs and slaughterhouses, are eaten by human beings as meat supplements and delicacies usually called *'pomo'* in Nigerian parlance. While the hides are flayed before reaching the *'pomo'* eaters, the skins particularly, those of goats are usually roasted together with the entire animal. This serves as special delicacies in many Nigerian homes and restaurants.

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'*Pomo'* is a hide that has undergone some processing such as roasting and boiling for human consumption as meat supplement and delicacy. Usually, it is cowhides that are used as '*pomo*' in Nigeria. The process of removing hairs from hides to become '*Pomo'* is traditionally done by roasting or by tenderizing the hides in hot water, followed by shaving

with razor blade. It is then boiled in water to soften the hides before it is used in soup or stew. It has low nutritional value but many Nigerians enjoy eating it as delicacy especially in the western part of the country.

Cointegration has been used to measure movement in prices from one location to another to infer the conduct of a firm (Ali and Rahman, 2009). It is an econometric method that has been applied successfully to integration questions in marketing and financial studies (Trotter, 1992). It is an econometric property of time series variables. If two or more series are themselves non- stationary, but a linear combination of them is stationary, then the series are said to be cointegrated (Granger, 1981). The integration test concerning the stationarity of any time series can be made using several techniques. Stationarity means that the stochastic properties of a time series (i.e the mean, the variance of the mean and the covariance of the mean with values of time series), are stationary and do not vary with time (Rahman, 2004). For price series with trends, one should test the individual series for integration and between the series for cointegration before modelling relationships between the series. Most economic time series are not stationary because, for example, the mean of the series changes with time, if only because of inflation or seasonality (Trotter, 1992).

Several works have been conducted on crops and livestock using cointegration techniques. Information on market integration of hides and '*pomo*' at different locations in Nigeria has been very scanty. This study therefore attempts to analyse the spatial price variations in hides and '*pomo*' markets in Nigeria. It is also hoped that information from this study will help the policy makers and researchers of hides and skins in understanding the price movement of hides and '*pomo*' in Nigeria. It will add to the existing knowledge on market integration of hides and '*pomo*' in Nigeria.

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2. CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

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Researches conducted in the late 70's and early 80's on time series data analysis (Dickey and Fuller, 1979; Dickey and Fuller, 1981; Evans and Savin, 1981; Granger, 1981; Granger and Weiss, 1983; Johansen, 1985; Phillips, 1985; Watson and Engle, 1985) had led to serious developments in the specification of time series data particularly the non stationary series. Macroeconomic time-series such as income and prices data are mainly non stationary data which need to be made stationary before cointegration test can be carried out. This is against statistical estimation theory that is based on asymptotic convergence theorems which assume that data series are stationary. However, cointegration procedure measures the degree of price integration in two markets A and B. Market integration is tested using the cointegration method, which demanded that the prices of the two markets, say P_{at} and P_{bt} must have the same order of integration and a linear combination exists between these two series, where P_{at} is price in market A time t and P_{bt} is price in market B time t.

In recent time, Akande and Akpokodje (2003) did a wonderful work in the application of cointegration to determine market integration in rice prices in selected areas in Nigeria. They observed that retail prices appear to be rising faster in Lagos than in any other centre. Indications are that prices of local rice rose more in Lagos than in Abuja and Enugu. Oyakhilomen *et al*. (2012) applied cointegration to examine the relationship between cocoa production in Nigeria and value of loan granted by Agricultural Credit Guarantee Scheme. It was found that there was no long run relationship between the output of cocoa and value of loans granted. However, Aminu, (2004), employed co-integration techniques in analyzing market integration in tomato and onion among various markets in Jigawa State. He discovered that those markets that were close together were more integrated than those far apart. Ali and Rahman (2009) applied it to determine the price of sorghum and maize in two wholesale markets (rural and urban) in Nigeria. They observed that the markets are integrated

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and that price signals and information are transmitted smoothly across the markets. Mukhtar and Javed (2008) applied cointegration to determining market integration in maize markets in Pakistan. It was found that the regional markets of maize have strong price linkages and thus are spatially integrated. Chirwa (1999) in his study tested whether the Law of One Price (LOP) holds for maize and rice spatial markets in Malawi using cointegration techniques in testing the spatial market integration hypotheses. The results suggest that markets for rice crop with complete price liberalization are more integrated than markets for maize in which the governments still imposes a price band for Agricultural Marketing and Development Corporation (ADMARC).

However, an important aspect of the cointegration analysis concerns the specification of processes of dynamic adjustment. Engle-Granger representation theorem (Engle and Granger, 1987) states that if two series are cointegrated, then they will be most efficiently represented by an error-correction specification, and furthermore, if the series are cointegrated, this dynamic specification will encompass any other dynamic specification, including the partial adjustment model.

3. METHODOLOGY

3.1. Data Collection

The study was conducted in Nigeria and the two markets selected were Kano market (where the largest market for the sales of hides in Nigeria is found) and Lagos market (where was expected to have the largest market for the sales of '*pomo*'). Secondary data on the prices of hides for the past twenty one years (1988 – 2009) were gathered from the Federal Ministry of Agriculture and Natural Resources, Livestock and Veterinary Unit, Gwale, Kano. The prices of '*pomo*' for the same years were also gathered from Federal Ministry of Commerce and Industry, Lagos, to find out if the price of '*pomo*' in Lagos is influenced by the prices of hides in Kano and assess if the two markets are fragmented or co-integrated.

3.2. Analytical Techniques

Cointegration tests were conducted after examining the univariate time series properties of the data to confirm that the price series in the two markets are stationary and integrated of the same order. The first step is the unit root test, that is, test for stationarity of the series. In testing the null hypothesis of non stationarity against the alternative, Augmented Dickey Fuller (ADF) tests were employed. The ADF tests the null hypothesis that a series (P_t) is non-stationary and must be differenced at least once before stationarity is achieved. The equation of ADF is given as follows:

$$\Delta P_t = \beta_0 + \beta_1 P_{t-1} + \gamma_t + \sum_{k=1}^{n} \delta_k \, \Delta P_{t-k} + e_t \quad \text{.....(1)}$$

Where $\Delta P_t = P_t - P_{t-1}$, $\Delta P_{t-k} = P_{t-k} - P_{t-k-1}$, k = 1, 2, 3, ...n, and $P_t, P_{t-1}, P_{t-k}, P_{t-k-1}$ are the respective prices at times t, t-1,t-k and t-k-1. While $\beta_0, \beta_1, \gamma_t$ and δ_k are parameters to be estimated, e_t = error term.

The alternative hypothesis is that the series is integrated of order 0, i.e. that no differencing of the series is needed to produce stationarity. Stationary series have a finite variance, transitory innovations from the mean, and a tendency for the series to return to its mean value. In contrast, the non-stationary series is one where the absolute value of the parameters is greater or equal to 1. Non stationary series have a variance which is

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asymptotically infinite; the series rarely cross the mean (in finite samples), and innovations to the series are permanent (Akande and Akpokodje, 2003). If P_t is found to be non-stationary then it should be determined whether P_t is stationary at first difference, if it is not stationary at first difference, it can also be determined at second difference until stationarity is achieved before we can test for cointegration.

3.3. Test for Cointegration

Having established that the two series are integrated of order 1, cointegration was carried out using Johansen cointegration test. Cointegration implies that there is a linear long-run relationship between price series in spatially separated markets, and is interpreted as a test that $r \neq 0$. This means there must be linear combination (r) of the series. The null hypothesis is that the two markets are not cointegrated.

H_0: $r = 0$

If $r \neq 0$, it means that the price series are cointegrated and a long-run equilibrium relationship exists between the prices. Cointegration tests for market integration is therefore tests of whether there is a statistically linear relationship between different data series (Asche *et al*., 1999). If the two markets are cointegrated, the Johansen trace statistic will be greater than the critical value at both 1% or 5% level of probability. Also, the maximum Eigen statistic will be greater than the critical value at both 1% or 5% level of probability and vice versa. The equation for cointegration in markets i and j is as below:

$$P_{it} = \alpha + \beta_1 P_{jt} + e_t \quad \text{.....(2)}$$

Where P_{it} is price in market i time t, P_{jt} is price in market j time t, α and β_1 are parameters to be estimated, e_t = error term.

If the two markets are cointegrated, we can therefore proceed to the next stage of error correction model (ECM). In addition to this, Granger causality test can as well be carried out to look at the direction of relationship and which market influences the other. However, if there is no cointegration, further analysis on *Granger Causality test* and *Error Correction Model* cannot be conducted.

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4. RESULTS AND DISCUSSION

4.1. Trends in the Prices of Hides in Kano and Lagos Markets (1988 – 2009)

The trends in the prices of hides and '*pomo*' in both Kano and Lagos markets were very similar. The average prices of hide was ₦500 and ₦550 per one whole piece (2.8kg) of hide between 1988 and 1999 in Kano and Lagos respectively. The average price of hide almost doubled between 1990 and 1993 in both locations. There was about 17% increase in the prices of hide in Kano between 1994 to 1996 (from ₦1200 to ₦1400 respectively) whereas the price was stable in Lagos at ₦1500. The price increased from ₦1500 to ₦1950 in Kano between 1997 and 2003 while it rose from ₦1700 to ₦2000 in Lagos. Between 2004 to 2009, there were similar trends in the price of hides in both locations, though the prices in Kano market were slightly lower than that of Lagos markets in all cases, which may be attributed to cost of transportation of hides from Kano to Lagos before processed to *'pomo'* . However, the continuous increase in the prices of hides in both locations over the years may be attributed to inflation and increase in the demand for hides by both the tanners and '*pomo*' marketers.

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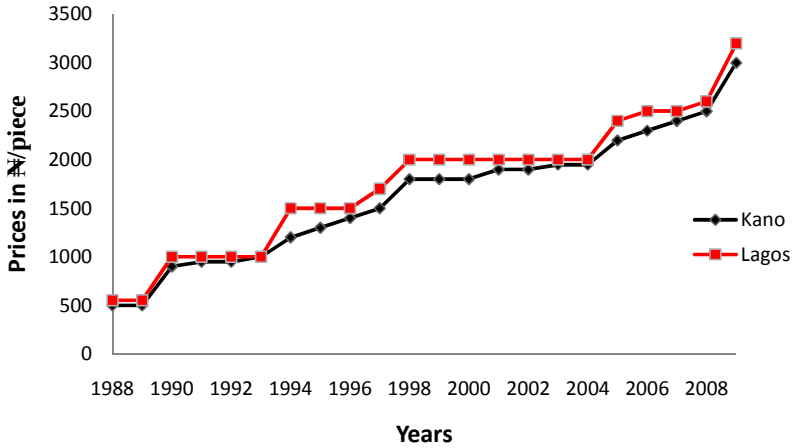

Figure 1: Trends in the average prices of hides and skins in Kano and Lagos (1988 - 2009)

4.2. Unit Root Test Result

The result of the unit root test for prices of hides and '*pomo*' in Kano and Lagos markets respectively is presented in Tables 1 and 2. This is a test for stationarity in the two markets. The stationarity test was carried out using Augmented Dickey –Fuller (ADF) test.

In both Kano and Lagos locations, various levels of the Augmented Dickey –Fuller (ADF) test were conducted as follows: no intercept, with intercept, with trend and intercept, with no difference and at first difference. At all these levels of tests, the ADF statistical test values were less than the critical value at 1% and 5% level of probability, indicating that the series were not stationary and need to be differenced. At first difference with intercept, intercept and trend, The ADF statistical values were less than the critical values in absolute terms at 1% level of probability but greater than the critical values in absolute terms at 5% level of probability in Kano. In Lagos, the ADF value was greater than the critical value at both 1% and 5% levels at first difference. Therefore, the null hypothesis of order 1 was accepted while the alternative was rejected. This implies that the series in both locations must be differenced once to achieve stationarity.

Table 1: Unit root test result of prices of hides in Kano markets

Location	Levels	No difference	1st Difference	ADF Value
KANO	**No intercept**			
	1% critical value	-3.8067		-0.0248
	5% critical value	-3.0199		
	10% critical value	- 2.6502		
	With intercept			
	1% critical value	-3.7856		-0.3742
	5% critical value	-3.0114		
	10% critical value	-2.6457		
	With trend and			

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	intercept			
	1% critical value	-4.4691		-2.1524
	5% critical value	-3.6454		
	10% critical value	-3.2602		
	With intercept			
	1% critical value		-3.8304	-3.0842
	5% critical value		-3.0294	
	10% critical value		-2.6552	
	With trend and intercept			
	1% critical value		-4.5000	-4.0776
	5% critical value		-3.6591	
	10% critical value		-3.2677	

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Table 2: Unit root test result of prices of '*pomo*' in Lagos market

Location	**Levels**	**No difference**	**1st Difference**	**ADF Value**
LAGOS	**No intercept**			
	1% critical value	-3.7856		-0.0820
	5% critical value	-3.0114		
	10% critical value	- 2.6502		
	With intercept			
	1% critical value	-4.4691		-2.5225
	5% critical value	-3.6454		
	10% critical value	-3.2602		
	With trend and intercept			
	1% critical value	-4.5000		-2.6877
	5% critical value	-3.6591		
	10% critical value	-3.2677		
	With intercept			
	1% critical value		-3.8304	-4.1938
	5% critical value		-3.0294	
	10% critical value		-2.6552	
	With trend and intercept			
	1% critical value		-4.5348	-3.8321
	5% critical value		-3.6746	
	10% critical value		-3.2762	

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4.3. Cointegration Test Result

The co-integration test was conducted using Johansen test (Johansen, 1991). The null hypothesis tested was that the two series are co-integrated of order 0, that is, the prices of

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hides and '*pomo*' in the two markets (Kano and Lagos respectively) are not co-integrated. The alternative hypothesis was that the series are co-integrated of order 1, that is, there is co-integration of the series in the two markets. The result of Johansen cointegration test is presented in Table 3

The result of the Johansen test showed that the Johansen trace statistic was less than the critical value at both 1% and 5% level of probability. Also, the maximum Eigen statistic was less than the critical value at both 1% and 5% level of probability. This implies that there is no co-integration in the prices of hides and '*pomo*' in the two markets. Hence, the prices of '*pomo*' in Lagos did not influence the prices of hides in Kano and vice versa.

Table 3: Johansen co-integration test result

Hypothesized No of cointegration(s)	**Eigen value**	**Trace statistics**	**5% critical value**	**1% critical value**
None	0.372215	9.459344	15.41	20.04
At most 1	0.007383	0.148204	3.76	6.55
Hypothesized No of cointegration(s)	Eigen value	Max-Eigen statistics	5% critical value	1% critical value
None	0.372215	9.311140	14.07	18.63
At most 1	0.007383	0.148204	3.76	6.65

Adjustment coefficients (standard error in parenthesis)

D(Kano)	0.649431(0.55780)
D(Lagos)	1.643387(0.74892)

However, the reason for no co-integration in the prices of hides in the two locations may be attributed to the fact that there is high competition between the '*pomo*' marketers and the tanners in Nigeria. Thus, the consumers of '*pomo*' in Lagos alone cannot influence the prices of hides in Kano. The reason for the prices in the two locations having similar trends may be due to exogenous factors like inflation and festive periods like Sallah and Christmas.

5. CONCLUSION AND RECOMMENDATIONS

` The study was able to conclude that the series in the two markets are non stationary and need to be differenced once before stationarity is achieved. Also, Johansen cointgration result revealed that the prices of hides and '*pomo*' in Kano and Lagos respectively were not cointegrated, eventhough, there was similar trend in prices in the two markets. This implies that there is no long run relationship between the prices of hides in Kano and that of '*pomo*' in Lagos. Based on the findings, the following recommendation is made:

There should be government's commitment to policies that can develop a well coordinated market information system to help marketers and consumers have access to prevailing market prices of agricultural products so that long run relationship will exist among commodities in different markets.

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COMPETING INTERESTS

The author has declared that no existing competing interests on this research work

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Comment [M15]: All the reference should be written in a form of guide line specifying journals, proceedings, articles etc so rearrange it well

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