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CO-INTEGRATION RELATIONSHIPS AMONG MAJOR GUM ARABIC MARKETS IN KANO STATE, NIGERIA

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Abstract
The study examined price co-movements of various grades of gum arabic in the major gum arabic markets in Kano State. Purposive sampling technique was employed to select five major markets in five local government areas and price time series data were collected weekly for fifty-two weeks from the various markets under study. The price information of the different grades of gum arabic were decomposed and subsequently subjected to cointegration procedure. The results revealed various levels and directions of price co-movements among the markets. The study concludes that gum arabic prices varied and co-moved between market pairs at different periods of the year. The study recommended that since most of the markets were co-integrated, establishment of a central market in the study area will further improve better pricing mechanism, collective bargaining and control. Buffer stock storage facilities could be provided by cooperative association in collaboration with the government and private sector.

Keywords: Cointegration, Gum Arabic, Markets, Kano State, Nigeria

Introduction

Nigeria is among the most naturally endowed countries in the world with a population projection of 189 million people by October, 2015; a yearly increment of about five million people, a land mass of 923,768 square kilometres and vast agricultural and mineral resources. Agriculture has been the most important economic sector in terms of its contributions to the Gross Domestic Product (NPC, 2011). The sector contributes over 41.8% of the country's GDP, employs about 65% of the total population and provides employment to about 80% of the rural population (Chintai, 2009). Nigeria has a comparative advantage of exportable agricultural commodities such as gum arabic, cocoa and dry ginger. In order to diversify the Nigerian economy, expand the

productive base and widen the market for agricultural commodities to absorb increases in production, there is the compelling need to promote the export of these agricultural and agro-industrial products. Ever since the early 1950s, when gum arabic commercial production and trade began on small scale, Nigeria has remained the second largest producer after Sudan (Aghughu and Ojiekpon, 2009),

Gum arabic is the dried exudates obtained from stems and branches of *Acacia senegal (L)* Wildenow or closely related species (Adekanye, 1988). Chemically, it is a slightly acidic complex compound made up of glycoprotein, polysaccharides and their calcium, magnesium and potassium salts. There are about 1100 species distributed over tropical areas of Africa, India Australia and America. Gums from *Acacia senegal* and *Acacia seyal* are the most commercially exploited species internationally. Nigeria's Gum Arabic is classified into three grades: Grades 1 *(Acacia senegal)* Grade 2 *(Acacia seyal)* and Grade 3 *(Combretum)* and other species (Adekanye, 1988).

Gum arabic and the *Acacia* tree from which the gum is tapped are an integral part of life in the sahelian countries of Africa. Whether as nomadic collectors, sedentary small scale producers, rural merchants or exporters from the cities, several hundreds of thousands of people depend directly or indirectly on the production and marketing of gum arabic for providing at least part of their subsistence. Production of gum arabic in Nigeria is largely from the wild (Oyedokun and Oluwa, 2001). It covers about 250,000 square kilometres in the entire sahelian region spreading across twelve states namely; Adamawa, Borno, Bauchi, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, Plateau, Taraba and Zamfara (Mokwunye and Aghughu, 2010). The gum tree plantations are essentially natural with less than 4,000 hectares of land dedicated to plantations that are communally owned and controlled by community authorities (MNS, 2009).

The commercial value of gum arabic can be traced back to the year 2000 BC, when the Egyptians used it in foods, adhesive and paint industries. In Nigeria, marketing of gum arabic is domestically liberalized, from farm gate to export, and is in the hands of private traders or merchants. The sale of the gum in the markets is in *mudus* measures or 50kg bags (Yakasai, 1998). Gum arabic is mostly marketed in the unprocessed form with little or no value addition. The local price varying from season to season with higher price recorded off season and lower prices at on season (Yakasai, 1998). Therefore, the objective of this study is to examine the price cointegration of gum arabic markets in the study area.

Methodology

Study Area

Kano state is one of the thirty-six (36) States of the Nigerian Federation and has forty-four (44) Local government areas (Yaro, 1999). It lies between latitude 11^0 30' 0" $N8^0$ 30' 0" E (Abdullahi, 2002). It is bordered by Katsina State to the North-west, Jigawa State to the north-east, and Bauchi and Kaduna States to the south. Kano State, with capital as Kano city, has a population of 9,383,682 inhabitants. Majority of the inhabitants are Hausa-Fulani and Muslim by faith. Other minority tribes include; Kanuri, Nupe, Yoruba, Igbo, Tiv, Igbira. (Trade Fair, 2010). The inhabitants are mostly traders, civil-servant farmers and artisans.

Sampling Procedure

Purposive sampling technique was employed to select five major markets in five local government areas, based on the propensity of marketing of gum-arabic in the locations. Price time series data were collected weekly for fifty-two weeks from the markets under study. The price information of the different grades of gum arabic were decomposed and subsequently subjected to cointegration analysis procedure.

Analytical Tools

The following analytical tools were employed in order to achieve the various objectives of the study:

(1) Multiplicative model for time series decomposition
(2). Co-integration procedure

Multiplicative Model for Time series Decomposition

Goetz and Weber, (1986) stated that the basic idea behind decomposing a price series is that there are four components composing a price; namely trend, cyclical, seasonal, random or disturbance components. Intuitively, the trend reflects the general economic factors such as inflation and increased demand due to population increases. The cyclical pattern can be weather induced or as result of slow supply responses due to long gestation periods (tree crops or animal production). The seasonal pattern is a result of the need for the relatively costly storage to match a discontinuous supply to a continuous demand for the product. Finally, the random component is government policy or an error term (Trotter, 1992). This study mainly focused on the seasonal component and the most common method is to assume that the four components are linked multiplicatively, though it can be additively, but the former method was employed for this study.

$P_t = (T_t)\ X\ (C_t)\ X\ (S_t)\ X\ (R_t)$ ……. (i)

Where:
P_t= Price component at time t
T_t = Trend component at time t
C_t = Cyclical component at time t
S = Seasonal component at time t
R_t = Random component at time t
t = one observation per day, week or month

Seasonality is defined as a systematic movement that repeats itself every 12 months. The most common reason for seasonal price movements is the seasonal fluctuation of supply. Demand fluctuation can also cause seasonal price changes. To estimate the seasonal index of time series, one first has to calculate the centred moving average (CMA) or (MSA) moving seasonal average (Aminu, 2009):

$$MSA_t = \frac{P_{t-2} + P_{t-1} + P_t + P_{t+1} + P_{t+2}}{5} \quad \text{…… (ii)}$$

The technique of using the centred moving average (for any given number of periods *n*) involved substituting the observed value in the time series with the average of that value and a given number of observations taken immediately before and after it. Consequently, the CMA_n eliminates random variations and systematic movements of duration equal to *n*. If one computes a CMA_{52} (for n = 52) with weekly data, one completely eliminates seasonal price movements. In other words, centered moving average represents the trend and cyclical components of the original price series and eliminates seasonality and randomness. Trotter (1992) observed that Moving Average technique means that we *lose values* at the beginning and at the end of the series, a half season in each case. Therefore, the Seasonal Index (SI) can be calculated as a division of the original price by CMA_{48} multiplied by 100

$$SI = \frac{P}{CMA} X 100 \quad \text{.................................. (iii)}$$

Where:

SI........................ Seasonal index
P......................... Price
CMA.................... Centred Moving Average

The mean monthly seasonal Index is estimated by averaging the four weekly seasonal indexes that constitute a month for a period of 12 months (January, 1- December, 30). Moreover, the mean monthly values were subjected to student-t test analysis.

Co-integration

Regional prices move over time because of various shocks. If in the long run, they exhibit a linear relationship, then, we say that they are co-integrated (Aminu, 2009). Co-integration procedure provides more information than correlation procedure. It allows the identification of both the degree of integration and its direction in financial and marketing studies (Francesco and Eleni, 1995). Aminu (2009), further stressed that, to use co-integration technique, several steps are needed to be carried out on the price series under examination. First, the Augmented Dickey Fuller test; then, the Engle Granger Two-Step procedure. If the Augmented Dickey Fuller test proved that the two price series are integrated and cointegrated, then price changes in one market implies that there is some market integration and it helps to explain its direction).

Let P_{ti} denotes the Price of the commodity under consideration at time t and location i. In order to study the interdependence of prices in the study area between any pair of markets *i* and *j*, extermination has been suggested (Arene, 1998).

Since the price series are generally non-stationary, this relationship has interest only if the error term μt is stationary, implying that price changes in market *i* do not drift far apart in the long run from market *j*. When μt is stationary, the two series are said to be co-integrated. However, standard statistical tests do not allow conducting explicit tests of the significance of parameters.

Engle and Granger (1987) proposed a two-step procedure for evaluating the properties of a pair of non-stationary economic time-series. In the first step, each price series is tested for the order of

econometric integration, that is, for the number of times the series needs to be differenced before transforming it into a stationary series. The test is the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979):

$k = n$
$\Delta P_{it} = \alpha_{\circ} + \alpha 1 P_{it-1} + \Sigma \alpha K + \Delta P_{it} + E_{it}$ …….. (v)
$k = l$

Where:
Δ refers to the difference operator, that is $X_t = X_t - X_{t-1}$.
For each variable X, the null hypothesis is that the series P_{i-1} is integrated of order 1 and alternative is that the series is of order 0. If *t* statistics for the coefficient is greater in absolute value than a critical value given by the ADF critical value, then the null hypothesis is rejected and the alternative hypothesis of stationary is accepted. If the null hypothesis is not rejected, then one must test whether the series is of order of integration higher than just 1, possibly of order 2. In this case the same regression equation (1) is applied to the second differences $\Delta 2P_{i,t} = \Delta(P_{i-t})$. In the second step, the residual $U_{i,t}$ of the OLS regression (1) between the two series is again tested for stationarity, with the ADF test. If the first step results in two non-stationary series, both integrated of order 1 and the second step results in a stationary error term, then the two series are said to be co-integrated of 1.1. The presence of co- integration is indicative of interdependence between the two series. In order words, co-integration is indicative of non-segmentation between the two series. Market segmentation refers to a case where markets *i* and *j* do not exhibit co-integration either in the direction *i* to *j* or *j* to *i*. In testing for co-integration, it makes sense to consider only those pair of markets that are close. If markets *i* and *j* are very far away from each other, the lack of co-integration may be due to the transportation costs. It is more interesting to focus on those markets that in spite of being separated by less than a critical distance; do not exhibit co-integration (Francesco and Eleni, 1995). A critical distance as defined by Francesco and Eleni (1995) is for example the maximum distance that could be covered by one-day trip of a truck with the commodity under consideration. Under these assumptions, segmented markets can be defined as those markets that are not co-integrated with each other and that are separated by less than a critical distance.

Results and Discussion
Table 1 shows the result of co-integration for gum arabic (Grade I) in various markets. From the results, three market pairs were found to be cointegrated ($p<0.05$). The market pairs and directions were; Dakata - Tokarawa**,** Tokarawa - Dakata, Dakata - Kurmi while all other market pairs and directions were not co-integrated. However, Dakata was selected to be a major reference market for the study due to its high intensity of gum arabic marketing. The findings implies that markets very close horizontally (Kurmi, Dorayi, Dawamau) and separated by less than a critical distance were not co-integrated with the major reference market located at Dakata in Nassarawa local government area. A critical distance as defined by Francesco and Eleni (1995) is the maximum distance that could be covered by one day trip of a truck loaded with the commodity under consideration. Furthermore, the incidences of commodity speculation among the various markets probably facilitated non-cointegration.

Table 2 displays the results of co-integration of order (1.1) for gum arabic (Grade II) in the markets. The result shows that all the (8) market pairs were variously co-integrated ($p<0.05$ and $p<0.1$) taking *Dakata* as a reference market. It can be deduced from the empirical findings, that, the level of co-integration in Grade II price among the markets was higher than in Grade I prices. This might be connected with higher demand of Grade I than Grade II and thus lower incidence of speculative activities with regards to Grade II.

Table 3 shows the result of co-integration test of order (1.1) for gum arabic (Grade III) in the study area. It is important to note that due to high intensity of marketing activities in *Dakata* market, it was selected as a reference market. The result reveals that *Dakata-Tokarawa* were co-integrated from every direction of the commodity transfer ($p<0.05$) while *Dakata-Kurmi* market pair was not co-integrated from any direction of commodity transfer but there was only a direction of co-integration between *Dakata* and *Tokarawa*. Moreover, gum arabic transfer from all directions between *Dakata* and *Dawanau* exhibited co-integration ($p<0.05$). The result implies that prices of markets closely located co-moved together and thus no evidence of speculative activities was observed since the demand for Grade III was not high but just normal.

Conclusion and Recommendations

The results revealed various levels and directions of price co-movements among the markets. The study concludes that gum arabic prices varied and co-moved between market pairs at different periods of the year. Therefore, were evidence of cointegration among the various gum arabic markets in the study area

Based on the findings of the study, the following recommendations are proffered:

- Since most of the markets were co-integrated with one another, establishment of a central market in the study area to enhance collective bargaining and control. This will further improve market access to buyers and provide ease of availability of the product among others.

- Buffer stock storage facilities can be provided by cooperative association in collaboration with the government and private sector so as to spread the availability of the product throughout the year.

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Table 1: Markets co integration of order 1(1) for Grade I

Market Pair	**F- Statistic**	**Probabilty**	**Decision**
Dakata* – Tokarawa	0.02588	0.00872**	Cointegrated
Tokarawa– Dakata	5.21415	0.02729**	Cointegrated
Dakata *– Kurmi	5.80497	0.02023**	Cointegrated
Kurmi – Dakata	2.10998	0.15348 NC	Not cointegrated
Dakata*– Dorayi	2.10952	0.15366 NC	Not cointegrated
Dorayi – Dakata	1.74226	0.19368 NC	Not cointegrated
Dakata *– Dawanau	5.80497	0.15004 NC	Not cointegrated
Dawanau—Dakata	5.74226	0.19368 NC	Not cointegrated

* Reference market ** Significant at 5% level of significant NC -Not cointegrated

Table 2: Markets co integration of order 1(1) for Grade II

Market Pair	F- Statistic	Probabilty	Decision
Dakata* – Tokarawa	0.72761	0.00489**	Co integrated
Tokarawa— Dakata	0.9461	0.00460**	Co integrated
Dakata* – Kurmi	3.05132	0.08765***	Co integrated
Kurmi – Dakata	3.69981	0.06090**	Co integrated
Dakata *– Dorayi	3.03111	0.08159***	Co integrated
Dorayi – Dakata	3.05570	0.08721***	Cointegrated
Dakata *– Dawanau	0.89347	0.06052***	Cointegrated
Dawanau—Dakata	3.04609	0.08036***	Cointegrated

* Reference market ** Significant at 5% level ***Significant 10% level

Table 3: Markets co integration of order 1(1) for Grade III

Market Pair	F- Statistic	Probabilty	Decision
Dakata* – Tokarawa	4.28400	0.0024**	Cointegrated
Tokarawa—Dakata	0.48708	0.00618**	Cointegrated
Dakata – Kurmi	2.071447	0.15715 NC	Not Cointegrated
Kurmi – Dakata	1,61578	0.21036 NC	Not Cointegrated
Dakata*—Dorayi	0.48708	0.00618**	Cointegrated
Dorayi – Dakata	1.61578	0.21036 NC	Not Cointegrated
Dakata *– Dawanau	4.09168	0.02398**	Cointegrated
Dawanau—Dakata	4.00306	0.02567**	Cointegrated

* Reference market ** Significant at 5% level NC - Not cointegrated