PRICE TRANSMISSION AND MARKET INTEGRATION OF SAWNWOOD OF Poga oleosa (Pierre) IN DELTA STATE, NIGERIA

Ohwo1, O. A. and Adeyemi2, A. A.

ABSTRACT

Marketing of forest products such as sawn-wood plays an important role in determining the prices received by the forestry sector and those paid by the forest stakeholders. Forest product marketing system in Nigeria appears to be inefficient and poorly integrated. The study examined market integration of sawn-wood of Poga oleosa in Delta State of Nigeria with a view to evaluating the performance of the markets. The study investigated the trend in prices of selected dimensions {2”×2”×16 (0.013m³), 2”×3”×16 (0.019m³) and 2”×4”×16 (0.025m³)} of P. oleosa sawn-wood in Delta State, Nigeria. Secondary data on monthly retail prices of the Poga oleosa and dimensions spanning 2004 to 2013 were sourced from sale records of sawn-wood sellers in the urban and rural markets of the state. The data were analyzed using Ravallion model, Augmented Dicker Fuller (ADF) test, Engle-Granger Co-integration test and Error Correction Mechanisms. The maximum and minimum prices for P. oleosa in urban market were ₦520, ₦435, ₦610 and ₦135, ₦225, ₦330 while prices in the rural market were ₦350, ₦465, ₦570 and ₦140, ₦240, ₦330 respectively. Sawn-wood prices for all dimensions considered were all integrated of order one I (1). The Index of Market Concentration (IMC) indicates that the markets exhibit high short-run market integration for 2”×2”×16 (0.013m³) and 2”×4”×16 (0.025m³) while 2”×3”×16 (0.019m³) exhibited low short-run market integration. The urban and rural markets were co-integrated in the long-run and the error correction model result indicated that there is high degree of price transmission. This shows that there is high efficiency of price information flow in sawn-wood markets in Delta State. We recommends that forest stakeholders should be provided with more price information to stimulate their interest in forestry investment, which will lead to sustainable forestry development in Delta State since the sawn-wood market is performing efficiently.

Keywords: Market integration, price transmission, sawn-wood, species, Delta State.

INTRODUCTION

Forest management objectives over the years have centred on increasing forestry production. This is with a view to maintaining the integrity of the forest estate to continually supply goods and services as well as improvement in the welfare of rural dwellers. Understanding the price of a commodity from price theory point of view helps in understanding the working of a free enterprise economy, providing the analytical tools for assessing the economic policies of a country, spelling out the standards and norms of a welfare state, comparing the actual economic condition with the ideal and reveals how far off the ideal state is with the economic conditions, analyzing efficiency with which productive resources are employed and the efficiency of allocation of the output of productive efforts, maximizing economic welfare from available resources and stimulating production through appropriate pricing of resources and output (Jhinghan, 1973). The advantages of price theory can only be achieved through efficient pricing, which invariably depends on the structure of the market (Arowosoge et al., 2011). The objectives of marketing and pricing policies have been to ensure stability and remunerative incomes for forest investors. Marketing plays a central role in the developmental process of the forestry sector and the market serves as the link between the producers and the consumers. Prices are the most readily available and reliable information that guide investors decisions in forestry. An investor’s decisions depend on anticipated profits, which depend on anticipated prices of forest goods. This has made prices important tools in the economic analysis of markets (Momoh et al., 2007).

The nature of marketing system is profoundly influenced by the economic and physical characteristics of the commodities handled, their value, processing required to make the commodity fit for use by end users and the condition of production and consumption (Jones, 1972). Synchronous movement over time among prices in different markets is an important indicator of market efficiency. Markets play a fundamental role in managing risk associated with demand and supply shocks in that well-integrated markets facilitate adjustment in net export flows across space, thereby reducing price variability faced by consumers and producers (Donovan et al., 2005). The ubiquitous nature of wood has made it a valuable material in every stage of human development such as building construction, marine and sea applications, railway, domestic appliances and musical instruments (ITTO, 2005). Sawn-wood is a major forest product in Nigeria and it serves as a raw material for wood-based industries (Langbour and Gerarrad, 2007). It is locally marketed in designated plank markets and sawmills across the country. The marketing of sawn-wood involves the exchange between a buyer and a seller at a given price. The price is such that the seller meets the total cost as well as profit margin (Olukosi and Isitior, 1990).
It shapes the management processes because it undoubtedly benefits the stakeholders, who depend on forest enterprises for survival (Olukosi and Isior, 1990). In Nigeria, sawn-wood is used for various purposes across the country and its prices are fundamental pre-requisite for socio-economic development of the country (Toledo, 2006). This has important implications for economic growth and development, since it favourably affects the terms of trade. Prime marketable product of most forests today is wood, providing some 3.5 billion cubic metres of timber equivalent a year globally (ITTO, 2006). Out of the semi-processed and processed wood categories, sawn-wood has the highest production and demand, and it is the most widely distributed in Nigeria for construction purposes (FAO, 1999).

Timber trade in southern Nigeria is highly commercial with over 500 sawmills (Okunomo and Achoja, 2010). Presently, the rate of exploitation of forest resources in Nigeria is approaching a critical level, and this is due to the fact that a large proportion of the population depends heavily on the forest products for survival (Oni et al., 2013). According to Langbour and Gerarrad (2007), despite the fact that sawn-wood is a major forest product in Nigeria, it is produced from different species. Most of species of sawn-wood differ in mechanical properties, which informed their grading and demand. Even with the grading, most species of sawn-wood are variedly priced. This price variation encourages the purchase of sawn-wood from region of lower prices, thereby increasing demand and in order to meet with these demands greater pressure is exerted on the forest estate, thus, affecting forest development in the region. It has been reported that existing forests are being depleted at the rate of 5.2 million hectares per annum globally (FAO, 2010), and that deforestation in Nigeria is not only due to the pursuit of economic development alone, but also as a result of lack of sound environmental policies, which are supposed to address poorly-defined property rights and under-pricing of forest products. The total wood consumed in Nigeria is estimated at over 200,000 m³ per annum (Arowosoge et al., 2011). FAO (2000) had predicted that if the present demand trends and utilization of sawn-wood continue, the tropical rainforest could completely disappear by the year 2020. To prevent this, there is need for sustainable use of forest resources to ensure that there is adequate supply of sawn-wood continuously with a minimal depletion of timber resources, and this can only be achieved with appropriate information on sawn-wood marketing situation existing in the state.

The ability of a marketing system to efficiently perform its function of contributing positively to the development of forestry sector depends on the ease with which price changes and responses are transmitted spatially and temporally between markets for a homogeneous commodity such as sawn-wood. Owing to unavailability of data on transactions cost or low quality of such data in the state, synchronous price movement overtime was used as a proxy for assessing marketing efficiency. Prices are the most readily available and reliable information that guide investment decisions in forestry. Despite the biological nature of the forest estate and the long-term effect of deforestation, the price transmission of sawn-wood has not been examined in the state, and as such there is no insight into the market performance. Although, Awe et al. (2013) assessed spatial price transmission in selected timber markets in Ekiti State, their study did not cover Delta State. Kalu et al. (2009), Arowosoge et al. (2011), Izekor and Izekor (2011), Ogunwusi (2012) as well as Aiyeloya et al. (2013) have conducted independent studies on the price transmission and sawn-wood marketing in various parts of the country, none of these studies included data from the study area, and as such any inference made may be inoperative in Delta State. In the same vein, several studies have been conducted on price transmission and market integration on various agricultural commodities in different states, yet little has been done on market integration of species of sawn-wood. For instance, Popoola and Rahji (2001) worked only on Terminalia ivorensis, but study including several other important species of sawn-wood in the state has not been reported. Hence, this study was carried out with a view to evaluating market performance by measuring market integration of selected dimensions of Poga oleosa sawn-wood in Delta State.

MATERIALS AND METHODS

The study area
The study was carried out in Delta State, located in the South-south geopolitical zone of Nigeria. It lies approximately between longitude 5°00’ and 6°45’E and latitude 5°00’ and 6°30’N with a total land area of 16,842 km² and a population of 4,098,291 (FRN, 2006). It is bounded in the north by Edo State, east by Anambra State, south-east by Bayelsa State, and on the southern flank is the Bight of Benin, which covers about 160 km of the state's coastline. The state is divided into three senatorial districts namely: Delta North, Delta South and Delta central and has twenty-five (25) Local Government Areas (LGAs).

Data collection
Data for this study were obtained from secondary sources. Monthly retail prices covering January, 2004 to December, 2013 of the selected dimensions [2"x2"x16 (0.013m³) 2"x3"x16 (0.019m³) and 2"x4"x16 (0.025m³)] of Poga oleosa were obtained from sales receipt of sawn-wood sellers in rural and urban sawn-wood markets in Delta State.
Data analysis

This study made use of analytical tools namely Augmented Dickey Fuller (ADF) Test, Ravallion Model, Engle-Granger Co-integration Test and Error Correction Mechanism.

Unit root test using augmented Dickey Fuller

The standard classical estimation methods are based on the assumption that the mean and variances of the stochastic series are constant and time invariant. However, applications of unit roots have shown that a large number of economic series are non-stationary, that is, their means and variances change over time. This happens because time series data reflect a process that involves trend, cycle and seasonality. By removing these deterministic and/or stochastic patterns, the remaining data become stationary. The unit root tests determine the stationarity characteristics of the data.

\[ \Delta Y_t = \alpha + \rho Y_{t-1} + \delta_i \Delta Y_{t-1} + \mu_t \cdots \cdots \cdots \cdots \cdot 1 \]

Where:
- \( \Delta \) = first difference operator
- \( Y_t \) = sawn-wood price series being investigated
- \( t \) = time variable

The null hypothesis is: \( H_0: \rho = 0 \), meaning that a unit root exits in \( y \), that is, \( y \) is non-stationary. If a variable is stationary, that is, it does not have unit roots, it is said to be integrated of order zero or I (0). When the non-stationarity problem is present in series data, the original data is differenced and retested. If a variable is not stationary in its level form, but stationary in its first differenced form, it is said to be integrated of order one or I (1). More generally, the series \( Y_t \) will be integrated of order \( d \), that is, \( Y_t \sim I(d) \), if it is stationary after differencing \( d \) times, so \( Y_t \) contains \( d \) unit roots (Dickey and Fuller, 1979). Through this process, the order of the integrated process for each data series was established. If ADF value is more negative than the critical value, then the variable is significant (Hande et al., 2009).

Ravallion IMC model

The model seeks to determine whether a change in the price of the product in a local (rural) market is influenced by the change in price in the central (urban) market. Index of Market Concentration (IMC) is used to measure price relationship between integrated markets. IMC illustrates the contribution of the market type 1 (urban) and the market type 2 (rural) past prices on current type 1 (urban) market prices. It can be used to evaluate the level of price relationship between integrated markets. IMC is used to measure the difference in price in the central (urban) market. Index of Market Concentration (IMC) is used to measure the degree to which the price change in the market type 2 (rural) is transmitted to the type 1 (urban) market. This parameter measures “Long-Run Market Integration” (LRMI) and its value is expected to be equal or close to 1. The difference between these two indicators is that \( d_2 \) shows the percentage of the price change in the type 2 (rural) market is transmitted to the type 1 (urban) market price, whereas IMC indicates the relative percentages of the current type 1 (urban) price that are originating from type 1 (urban) market and type 2 (rural) market past prices.

\[ P_t = f(R_t, X_t) \text{ for } t = 1 \ldots n \]

Based on Timmer (1974), the Ravallion model can be expanded as follows:

\[ P_t = d_1 + \delta_1 R_{t-1} + \epsilon_t \]

\[ P_t = (1 + d_2) Y_t + \epsilon_t \]

\[ (d_1 - d_2) R_{t-1} + \epsilon_t \]

\[ (1 + d_0) \]

\[ (d_1 - d_2) \]

\[ (1 + d_0) \]

In general model, ‘\( n \)’ lags of market type 1 price and ‘\( m \)’ lags of the market type 2 price is possible. But with the introduction of “one lag” to this model and excluding \( X \) variables, one can derive “Index of Market Concentration” (IMC), which is the ratio of the Rural Market Coefficient \((1 + d_0)\) to the urban Market Coefficient \((d_1 - d_2)\) (Timmer, 1974):

\[ IMC = \frac{(1 + d_0)}{(d_1 - d_2)} \]

\[ \cdot \frac{...}{...} \]
Index of Market Connection is interpreted as follows:
IMC \leq 1 \text{ implies high short-run market integration}
IMC > 1 \text{ implies low short-run market integration}
IMC = \infty \text{ implies no market integration}
IMC = 1 \text{ implies high or low short-run integration (theoretically)}

The closer the value of the IMC to zero is, the higher the degree of market integration and thus, the higher the marketing efficiency. In order to capture the IMC values better, the values should be approximated to two decimal places (Popoola and Rahji, 2001).

Engle and Granger’s Two-step Procedure

Engle and Granger (1987) test of co-integration (or common stochastic trends) start by estimating the co-integrating regression (the first step),

\[ x_{1,t} = \beta_1 + \beta_2 x_{2,t} + \ldots + \beta_p x_{p,t} + u_t \]

Where:
- \( p \) = number of variables in the equation.

In this regression, we assumed that all variables were I(1) and might co-integrate to form a stationary relationship, and thus a stationary residual term

\[ \Delta u_{0,t} = x_{1,t} - \beta_1 x_{1,t} - \beta_2 x_{2,t} - \ldots - \beta_p x_{p,t} \]

In the tabulated critical values, \( p = n \). This equation (6) represents the assumed economically meaningful (or understandable) steady state or equilibrium relationship among the variables. If the variables are co-integrating, they will share a common trend and form a stationary relationship in the long-run.

The second step, in Engle and Granger’s two-step procedure, is to test for a unit root in the residual process of the co-integrating regression above. For this purpose set up an ADF test like,

\[ \Delta u_{0,t} = \alpha + \mu_{0,t-1} + \sum_{i=1}^{k} \gamma_i \Delta u_{0,t-1} + v_t \]

Under the null of no co-integration, the estimated residual is I(1) because \( x_{1,t} \) is I(1), and all parameters are zero in the long-run. Finding the lag length so the residual process becomes white noise is extremely important. The empirical distribution is not identical to the Dickey Fuller, though the tests are similar. The reason is that the unit root test is now applied to a derived variable, the estimated residual from a regression. Thus, new critical values must be tabulated through simulation. The maintained hypothesis is no co-integration. Thus, finding a significant \( \pi \) implies co-integration. The alternative hypothesis is that the equation is a co-integrating equation, meaning that the integrated variable \( x_{1,t} \) co-integrates at least with one of the variables on the right hand side. The decision rule is to reject the null hypothesis of no co-integration when the t-statistics is greater in absolute value than the critical values at the chosen probability levels.

Error Correction Model (ECM)

Advantage of the error correction model is that it incorporates variables both in their levels and first differences. This helps to capture the short-run disequilibrium situations as well as the long-run equilibrium adjustments between prices. Even if one demonstrates market integration through co-integration, there could be disequilibrium in the short-run i.e. price adjustment across markets may not happen instantaneously. It may take some time for the spatial price adjustments. ECM can incorporate such short-run and long-run changes in the price movements.

An ECM formula, which describes both the short-run and the long-run behaviour of prices is expressed as:

\[ \Delta R_{\mu} = \gamma_1 + \gamma_2 \Delta U_{\mu} - \pi V_{\mu-1} + v_{\mu} \]

Where:
- \( \gamma_2 \) = impact multiplier (short-run effect) that measures the immediate impact that a change in \( U_{\mu} \) will have on a change in \( R_{\mu} \).
- \( \pi \) = feedback effect or the adjustment effect that shows how much of the disequilibrium is being corrected, that is the extent to which any disequilibrium in the previous period affects any adjustment in the \( R_{\mu} \) period.
- \( V_{\mu-1} = R_{\mu-1}^1 - \beta_1 - \beta_2 U_{\mu-1} \), and therefore from this equation we also have being the long-run response. High absolute value of ECM indicates rapid price movement among variables.

RESULTS AND DISCUSSIONS

Price trend analysis

Monthly retail price trends (2004 to 2013) of *Pogia oleosa* sawn-wood and the dimensions under consideration are presented in figures 1, 2 and 3. Prices ranged from N435 in January 2004 to a peak of N320 in January 2013 for the 2”×2”×16 (0.013 m³) dimension in the urban market, while in rural sawn-wood market, prices ranged from N140 in January 2004 to a peak N850 in 2013. For 2”×3”×16 (0.019 m³) sawn-wood dimension, urban market prices ranged from N225 in January 2004 to a peak of N435 in January 2013 while the rural market prices ranged from N240 in January 2004 to N465 in January 2013. The 2”×4”×16 (0.025 m³) dimension of *Pogia oleosa* sawn-
wood also showed an increasing price trend. Prices of sawn-wood increased from ₦330 in January 2004 to ₦610 in January 2013 and ₦330 in January 2004 to ₦570 in January 2013 for urban and rural sawn-wood markets respectively.

Figure 1: Mean monthly retail price trend of *Poga oleosa* 2″×2″×16 (0.013 m³)

**Stationarity test for sawn-wood price series in delta state**

The result of ADF for rural and urban sawn-wood prices is presented in Table 1. The result showed that unit root exists in all the dimensions {D1 (2″×2″×16 (0.013 m³), D2 (2″×3″×16 (0.019 m³) and D3 (2″×4″×16 (0.025 m³)) of *Poga oleosa* considered at level 1 (0) since the ADF t-statistics were smaller in absolute term than the critical values. At first difference, all variables were stationary at 1% and 5% level of significance. This corroborates the findings of Chirwa (2000), Yusuf *et al*., (2006) and Adeoye *et al*., (2011) that commodity prices could be stationary at first difference.

**Ravallion index of market concentration (IMC) analysis**

The regression and index of market concentration of sawn-wood prices for *Poga oleosa* and the respective dimensions is presented in tables 2. The result showed that 2″×2″×16 (0.013 m³) and 2″×4″×16 (0.025 m³) dimensions showed high short-run market integration. Dimension 2″×3″×16 (0.019 m³) showed low short-run market integration with IMC value of 2.62. The degree of market integration is measured by how close the IMC values are to zero. The closer to zero the value is, the higher the degree of market integration and thus market efficiency. From the result, price information of sawn-wood with dimensions 2″×2″×16 (0.013 m³) and 2″×4″×16 (0.025 m³) will be transmitted instantaneously within a month across markets. Using the Index of Market Concentration as a proxy for marketing efficiency, 2″×2″×16 (0.013 m³) and 2″×4″×16 (0.025 m³) dimensions of *P. oleosa* in the market pairs shows there is presence of market efficiencies indicating low variation in price across space and time. The low short-run market integration recorded for 2″×3″×16 (0.019 m³) implies that price changes in both markets cannot be transmitted within a month, hence inefficiencies observed.

**Engle-Granger co-integration analysis**

Co-integration test was carried out since all variables were integrated of the same order 1 (1). The results of co-integration test of urban and rural sawn-wood prices in Delta State are presented in Table 3. The result showed that all dimensions of *P. oleosa* sawn-wood considered co-integrated. The criterion for selection is that the trace statistic value must be greater in absolute term than the critical value at 0.05 level of significant. From the result in Table 3, the null hypothesis of no co-integration, i.e., H₀, was rejected. This is because calculated
Figure 2: Mean monthly retail price trend of *Poga oleosa* 2’’×3’’×16 (0.019 m$^3$)

Figure 3: Mean monthly retail price trend of *Poga oleosa* 2’’×4’’×16 (0.025 m$^3$)
Table 1: Result for unit root testing for sawn-wood price

<table>
<thead>
<tr>
<th>Variables (Market pairs)</th>
<th>ADF (At level)</th>
<th>P. values</th>
<th>Remark</th>
<th>ADF (1st Difference)</th>
<th>P. values</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>R P. spp D1</td>
<td>0.3602</td>
<td>0.98803</td>
<td>ns</td>
<td>-3.9533*</td>
<td>0.0024</td>
<td>sig.</td>
</tr>
<tr>
<td>U P. spp D1</td>
<td>2.2024</td>
<td>0.9999</td>
<td>ns</td>
<td>-4.9355*</td>
<td>0.0001</td>
<td>sig.</td>
</tr>
<tr>
<td>R P. spp D2</td>
<td>0.7983</td>
<td>0.9936</td>
<td>ns</td>
<td>-4.3545*</td>
<td>0.0006</td>
<td>sig.</td>
</tr>
<tr>
<td>U P. spp D2</td>
<td>0.2278</td>
<td>0.9732</td>
<td>ns</td>
<td>-4.2407*</td>
<td>0.0009</td>
<td>sig.</td>
</tr>
<tr>
<td>R P. spp D3</td>
<td>0.2226</td>
<td>0.9729</td>
<td>ns</td>
<td>-4.2368*</td>
<td>0.0009</td>
<td>sig.</td>
</tr>
<tr>
<td>U P. spp D3</td>
<td>0.7435</td>
<td>0.9926</td>
<td>ns</td>
<td>-11.2668*</td>
<td>0.0000</td>
<td>sig.</td>
</tr>
</tbody>
</table>

Source: compiled from result of stationarity test
** and *denote significance at 1% and 5% probability level. MacKinnon critical values of ADF statistics are -3.593 (1%) & -2.889 (5%). H_0: there is no unit root. If ADF value is greater in absolute value than the critical value the H_0 is rejected.

Table 2: Regression result for market pair (Rural and Urban) of sawn-wood and dimensions

<table>
<thead>
<tr>
<th>Species</th>
<th>Dimension</th>
<th>Constant</th>
<th>Rural (P_{t-1})</th>
<th>Urban (R_{t-1})</th>
<th>R - R_{t-1}</th>
<th>IMC</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. oleosa</td>
<td>2&quot;x2&quot;x16 (0.013 m³)</td>
<td>-0.0166</td>
<td>-0.0950</td>
<td>1.0511</td>
<td>0.9338</td>
<td>0.38</td>
<td>High SRMI</td>
</tr>
<tr>
<td>P. oleosa</td>
<td>2&quot;x3&quot;x16 (0.019 m³)</td>
<td>-0.4106</td>
<td>-0.4234</td>
<td>-0.1618</td>
<td>-0.6661</td>
<td>2.62</td>
<td>Low SRMI</td>
</tr>
<tr>
<td>P. oleosa</td>
<td>2&quot;x4&quot;x16 (0.025 m³)</td>
<td>-0.0703</td>
<td>-0.6112</td>
<td>-1.6007</td>
<td>-2.3722</td>
<td>0.38</td>
<td>High SRMI</td>
</tr>
</tbody>
</table>

Source: compiled from result of Ravallion IMC test

Table 3: Result for Engle and Granger co-integration test of urban and rural sawn-wood prices in Delta State

<table>
<thead>
<tr>
<th>Species</th>
<th>Dimension</th>
<th>t-statistics</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. oleosa</td>
<td>2&quot;x2&quot;x16 (0.013 m³)</td>
<td>-10.9910*</td>
<td>0.0000</td>
</tr>
<tr>
<td>P. oleosa</td>
<td>2&quot;x3&quot;x16 (0.019 m³)</td>
<td>-6.8862*</td>
<td>0.0000</td>
</tr>
<tr>
<td>P. oleosa</td>
<td>2&quot;x4&quot;x16 (0.025 m³)</td>
<td>-7.5960*</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Source: compiled from result of Co-integration Test
H_0: No co-integration. H_1: co-integration. Critical values at 5% level of significance is -2.889(Engle Granger critical value). When t-stat in absolute term is < critical value, reject H_0; * denotes rejection of H_0.

trace statistics for the null of H_0 are greater in absolute values than the critical values. P. oleosa 2"x3"x16 (0.019 m³) dimension showed the lowest trace statistics of 6.8862 with the 2"x2"x16 (0.013 m³) dimension of P. oleosa having the highest trace statistics value of 10.9910. From the result, there exists strong and stable price linkage in all dimensions of sawn-wood rural and urban market considered since prices co-move over time. The co-integrating relationship indicates that price in the rural market can be used to predict urban market prices and vice versa. There is price transmission between the markets, it indicate that forest stakeholders, that is sawn-wood traders in the urban and rural market in Delta State as well as consumers will realize the appropriate profit from trade because correct price signals will be transmitted through the marketing chain.

Error correction mechanism analysis
The Error Correction Mechanism (ECM) result, as presented in Table 4, showed the rate at which price changes are transferred from rural to urban sawn-wood markets. The Error Correction Model is the rate of price transmission at which price restores to equilibrium in the short-run. The ECM coefficient shows the speed at which short-run fluctuations get corrected within the lag periods. The speed, which sawn-wood prices in the markets return to their equilibrium, depends on the proximity of ECM coefficient to one. The ECM values must be negative and statistically different from zero. The stronger the negative values the shorter period it takes for prices in states to reach their equilibrium position, the shorter the time to complete price adjustment, the better integrated is the market and vice versa (Goleitti et al., 1995). Large values of ECM are indications of how swiftly market prices are transferred from the urban market to rural market within a particular time frame (monthly). Low values imply low inefficiencies in terms of price information flow between markets. The result showed that the entire ECM coefficient for P. oleosa and dimensions in the state were significant at 5%. The rural-urban pair value was -1.0755 for P. oleosa sawn-wood with 2"x3"x16 (0.019 m³). The different rates of sawn-wood price transfer from the result have implication on the performance of the markets. Market pair rural-urban for P. oleosa of sawn-wood with 2"x3"x16 (0.019 m³) dimension have the highest ECM value of -1.0755 with the lowest ECM value of -0.3509 recorded for 2"x2"x16 (0.013 m³) dimension. The high value signifies that there will be over a 100% instantaneous adjustment of sawn-wood prices for rural and urban prices across market within a given time frame (one month). Large values of ECM are indications of how swiftly market prices are transferred from rural to urban sawn-wood market in Delta State on a monthly basis, hence high market efficiencies. Traders operating between these markets could easily form correct expectation about price changes.
and this would help them in taking proper decisions on the dimension and time of purchase of sawn-wood therefore minimizing the problem of price uncertainty.

Table 4: Result of error correction mechanism for sawn-wood prices

<table>
<thead>
<tr>
<th>Market pair</th>
<th>ECM coefficient</th>
<th>Standard error</th>
<th>Probability</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural – Urban</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. spp D1</td>
<td>-0.3509</td>
<td>0.1042</td>
<td>0.0010</td>
<td>0.9554</td>
</tr>
<tr>
<td>P. spp D2</td>
<td>-1.0755</td>
<td>0.2165</td>
<td>0.0000</td>
<td>0.9181</td>
</tr>
<tr>
<td>P. spp D3</td>
<td>-0.8663</td>
<td>0.1326</td>
<td>0.0000</td>
<td>0.9725</td>
</tr>
</tbody>
</table>

α = 0.05

CONCLUSION AND RECOMMENDATION

Market integration was examined by estimating price linkages between rural and urban sawn-wood markets in Delta State. The unit root test results indicate that price series were not stationary at level and were stationary at first difference at 5 % level of significance. The Index of Market Concentration result indicates high short-run market integration in the rural and urban markets except for the 2”×3”×16 (0.019 m³) dimension of P. oleosa that showed low short-run market integration. The Engle-Granger co-integration result indicates long-run relationship among variables at 5% level of significance. There is a strong and stable price linkage between urban and rural sawn-wood markets in Delta State. Presence of price transmission in the markets enables marketers to specialize according to comparative advantage. The Error Correction Model was employed on the co-integrated variables to determine the price transmission between the dependent (urban) market and the rural market. The result indicates that the rates of price transfer were generally high. This may be related to the efficiency of information flow. It is recommended that reforestation and afforestation programmes should be embarked on in the state in order to prevent extinction of the mostly demanded species of sawn-wood in the area. Government should encourage individuals to establish private plantations to solve the problem of wood scarcity by providing them with soft loans and/or incentives and forest stakeholders should be provided with more price information to stimulate their interest in Forestry investment, which will lead to Sustainable Forestry Development in Delta State since the sawn-wood market is functioning efficiently.

REFERENCES


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