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Research article

SPATIAL PRICE TRANSMISSION IN SELECTED TIMBER MARKETS IN EKITI STATE NIGERIA: AN ERROR CORRECTION MECHANISM APPROACH

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ABSTRACT

Spatial price transmission and market integration study is important in explaining market performance and the degree of integration. This study therefore examined spatial price transmission in selected timber markets in Ekiti State of Nigeria for the period from January 2003 to December 2012 using error correction approach. Monthly price series of selected timber species from selected timber markets in the state were used. The selected timber species were *Milicia excelsa* (Iroko), *Triplochiton scleroxylon*(Obeche), *Mansonia altissima*(Mansonia) and *Terminalia superba*. The study examined the trend in timber prices in Ekiti State. The respective maximum and minimum prices of timber species in rural market in the state were found to be ₦1,240/unit and₦490/unit for Milicia excelsa;₦850/unit and ₦220/unit for *Triplochiton scleroxylon*; N950/unit and N270 for *Terminalia superba* as well as ₦1,930/unit and₦780/unit for Mansonia altissima. For the urban timber market, the respective maximum and minimum prices were ₦1,350/unit and₦520/unit for Milicia excelsa;₦950/unit and ₦270/unit for *Triplochiton scleroxylon*; N1,030/unit and N330 for *Terminalia superba* as well as ₦2,130/unit and₦820/unit for *Mansonia altissima*. Timber species prices were subjected to stationarity test and were found to be stationary after first differencing, which implies that timber prices were integrated of order one, I(1). Co-integration analysis showed that timber markets in Ekiti State were co-integrated. The error correction model results revealed that 21-32 % disequilibrium is removed or corrected in each period. That is, one month in the timber markets in the state. Six of the market links rejected their respective null hypothesis of no granger causality(p>0.05), four of which exhibited bi-directional granger causality or simultaneous feedback relationship while the remaining two market links exhibited unidirectional granger causality at 5% level of significance. Rural timber market was discovered to be the leading market in the state.

Keywords: Stationary, error correction mechanism, granger causality, co-integration, timber, market

INTRODUCTION

Price transmission studies are ostensibly an empirical exercise testing the predictions of economic theory and providing important insights as to how changes in one market are transmitted to another, thus reflecting the extent of market integration, as well as the extent to which markets function efficiently (Dittoh, 1994; Villafuete, 2011; Ghafoor, 2012).According to Ghafoor and Aslam (2012), price transmission is important because of two major reasons. Firstly, the price transmission conveys unbiased information on prices to agricultural producers; it is a precondition for a good allocation of resources. Secondly, because many policy reforms are implemented via price channel, so the lack of integration along the marketing chain hinders the reforms from reaching the rest stakeholders of the chain, particularly in agricultural producers. Incomplete price transmission creates biased incentives for producers, which in turn leads to reduce the agricultural productivity. A key premise of several arguments in economics is that markets allow for price signals to be transmitted both spatially and vertically (Lohano and Mari, 2006; Choi *et a*l, 2008). An obvious example is the assessment of the relative merits of alternative trade and/or policy environments: potential losses for a country or a group of economic agents and benefits crucially depend, among other things, upon markets receiving price signals, which, in turn, depends upon a number of markets' features, including their very existence (Conforti, 2004; Balcombe and Morrison, 2002). Spatial market integration has been widely used to indicate overall market performance (Faminow and Benson 1990). Market integration of agricultural products has retained importance in developing countries due to its potential application to policy making. Based on the information of the degree of market integration, government can formulate policies of providing infrastructure and information regulatory services to avoid market exploitation. The extent to which a price shock at one point affects a price at another point can broadly indicate whether efficient arbitrage exists in the space that includes the two points. It is also dependent on the magnitude of the price difference between these locations (Goodwin and Piggott 2001; Stephens *et al*, 2011) At two extremes, one may assume that a full transmission of price shocks can indicate the presence of a frictionless and well functioning market (Mushtaq *et al*, 2006), while at the other extreme a total absence of transmission may make the very existence of a market questionable. Therefore, the degree of price transmission can provide at least a broad assessment of the extent to which markets are functioning in a predictable way, and price signals are passing-through consistently between different markets (Mushtaq, 2007; Hussain, 2010). If two spatially separated price series are co-integrated, there is a tendency for them to co-move in the long run according to a linear relationship (Zahid *et al*, 2007). In the short-run, the prices may drift apart, as shocks in one market may not be instantaneously transmitted to other markets or due to delays in transport.

Markets are said to be perfectly spatially integrated if price changes in one market are fully reflected in alternative markets (Goodwin and Schroeder 1991). Prices are the signals that direct and coordinate not only the production and consumption decisions but also the marketing decisions over time, form, and space (Kohls and Uhl 2001). In spatially separated markets, when the price difference between different markets exceeds transportation and transactions costs, the arbitrage activities involve the purchase of commodities from lower-price regional markets and the subsequent resale in higher-price regional markets. Competition among arbitragers will ensure that a unique equilibrium is achieved where local prices in regional markets differ by no more than transportation and transaction costs (Goodwin and Schroeder 1991). Prices in spatially integrated markets are determined simultaneously in various locations, and information of any change in price in one market is transmitted to other markets (Gonzalez-Rivera and Helfand 2001). Moreover, the improved information between regional markets contributes significantly to spatial price convergence, so explicit trade between each pair of markets may not be necessary in order for regional price adjustments to take place (Serra et al. 2006). The analysis of spatial market integration, thus, provides indication of competitiveness, the effectiveness of arbitrage, and the efficiency of pricing (Sexton *et al* 1991).

Markets that are not integrated may convey inaccurate price signal that may result in distortion in producers' marketing decisions and inefficient product movement (Goodwin and Schroeder 1991), and traders may exploit the market and may benefit at the cost of producers and consumers. In more integrated markets, farmers specialize in production activities in which they are comparatively proficient, consumers pay lower prices for purchased goods, and society is better able to reap increasing returns from technological innovations and economies of scale (Vollrath 2003).

Timber (also known as sawn wood) is a major forest product in Nigeria and it serves as a raw material for wood based industries (Langbour and Gerarrad, 2007). Timber trade in southern Nigeria is highly commercial with over 500 sawmills (Okunomo and Achoja, 2010). Timber marketing like every other marketing enterprise 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 Isitor, 1990). It is therefore, the sum total of all business activities involved in the movement of commodities from point of production until the commodities are received by the ultimate consumer. It denotes all the activities that enable forest goods and services to flow from the producer to the ultimate consumer which shape the management processes because it undoubtedly benefits the stake holders who depend on forest enterprises for survival. The efficiency of the marketing process as a link between the producer and the consumer is a major determinant of economic incentives of forestry subsector. This invariably, has effects on the consumption pattern of the products which is mostly felt in timber marketing. In a competitive economy, efficient marketing of timber will not only give sellers higher prices but also give consumers lower ones achieved through bargaining power. Owing to the economic importance of timber marketing as source of income, employment generation as well as foreign earning generation to Nigeria, there is the need to examine the functioning and performance of timber markets in the study area. Though several studies have been carried out on price transmission and market integration on various agricultural commodities, little or nothing has been done on price transmission on timber markets. In addition, most of previous studies on price transmission and market integration do not fully capture the use of co-integration test with a description of dynamic features and patterns of causality among price series as well as the Error Correction Mechanism (ECM), which according to Granger Interpretation Theorem, forms the basis of the long term relationship between co-integrated variables. This study therefore attempted to address these gaps.

The objective of this paper was therefore to analyze spatial market integration between rural and urban timber markets of Ekiti State, Nigeria with specific focus on examining the trend of price transmission in the markets, comparing the market integration between rural and urban timber markets, estimating the speed of price transmission between rural and urban timber markets and identifying the leading market between rural and urban timber using monthly retail price series of selected timber species. First the unit root test was applied to check for the stationarity in the price series, and then evaluate the degree of spatial integration among the selected markets for timber species using the Error Correction Model. The results for the timber species are then compared to investigate how far these markets diverge from perfect spatial integration.

METHODOLOGY

Data used in this study are monthly retail prices in naira (₦) per unit of timber for the period from January 2003 to December 2013. The data was obtained from Associations of Timber Sellers, Ekiti State Chapter, Forestry Research Institute of Nigeria, National Bureau of Statistics and International Tropical Timber Organization. Monthly retail prices of timber species were collected in both rural and urban regions of Ekiti State, Nigeria. The species selected was the *2.5cmx30cmx360cm* dimension, often known as *1x12* dimensions. The selected timber species for the study were *Milicia excelsa* (Iroko), *Mansonia altissima*(Mansonia), *Triplochiton scleroxylon*(Obeche) and *Terminalia superba*(Afara).

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Analytical Method

The analytical tools that were used included descriptive statistics, co-integration, Error Correction Model (ECM) and Granger causality test .These techniques offer a framework for the assessment of price transmission and market integration. The descriptive statistics was used to measure the mean price of the selected timber species in selected timber market of Ekiti State while co-integration analysis was used to measure the market integration. The concept of co integration (Granger, 1981) and the methods for estimating a co integrated relation or system (Engle and Granger, 1987; Johansen, 1988, 1991, 1995) provide a framework for estimating and testing for long run equilibrium relationships between non stationary integrated variables. Granger causality test was used to evaluate the leading market in the state.

Conceptual and Empirical Framework

Traditional time series econometric techniques were based on the assumption of stationarity. However, a recent advancement in time series econometric techniques indicates that the most time series are non-stationary. If the time series is non-stationary, then the application of the usual statistical tools to analyze data is inappropriate. Most economic time series are trended over time and regression among trended series may produce significant results with high R^2 but may be meaningless or spurious (Granger and Newbold, 1974). Many economists have ignored the possibility of spurious regression (the analysis of non-stationary time series) and used standard statistical techniques which are developed for stationary processes.

To overcome the problem of spurious regression, the concept of co-integration was introduced (Granger, 1988; and Engle and Granger, 1987). Econometric techniques based on co-integration take into account long run information so that results can wander extensively, but when paired with another series or a set of series then the pairs tend to move together over time and the difference between them are constant (i.e. stationary).

Stationary and non-Stationary

A series is said to be stationary if its mean and variance remain constant over the time and the value of the covariance between the two time periods depends only on the distance or lag between the two time periods and not the actual time at which the covariance is computed or in other words remain constant over time (Gujrati, 2005). On the other hand a series is said to be non-stationary if it fails to satisfy any part of above definition i.e., its mean, variance or covariance change over time. A stationary series has a tendency continuously to return to its mean value and to fluctuate around it in a more or less constant range, while a non-stationary series has a changing mean at different points in time and its variance varies with the sampling size.

To demonstrate the conditions for stationarity, consider the following first order autoregressive model.

$$X_t = \varphi\beta X_{t-1} + \mu_t \qquad (1)$$

Where: t =1…... T

Here μt is assumed to be strictly white noise i.e. IID $(0, \sigma^2)$. If $\varphi < 1$, the series X_t is stationary and if $\varphi = 1$, the series is non-stationary and is known as random walk. X_t can be made stationary after differencing once but it is not necessary that it become stationary after first difference. The number of times series needs to be differenced in order to achieve stationarity depends upon the number of unit roots it contains. If a series becomes stationary after differencing d times, then it contains d unit roots and it is said to be integrated of order d, denoted by I(d) in (1) where $\varphi = 1$, X_t has a unit root and thus $Xt \approx I(1)$.

Therefore the first step in dealing with time series data is to test for the presence of a unit root in the individual time series of each model. There are a number of methods to test the unit root hypothesis but the early and pioneering work on testing for a unit root in time series was done by Dickey and Fuller (Dickey and Fuller 1979; Fuller 1976). The number of lags in the Dickey–Fuller (ADF) equation are chosen to ensure that serial correlation is absent, using the Breush-Godfrey statistics (Greene, 2000). The DF-test requires us to estimate the following by OLS:

$$\Delta X_t = \alpha + \beta_3 t\ (\varphi_3 - 1)\ X_{t-1} + \mu_t \qquad (2)$$

Equation (2) indicates that the series X_t now has both stochastic and deterministic trends and can be used as a DF-equation for testing the unit root hypothesis i.e., Ho: $(\varphi_3-1) = 0$.

The Concept of Co-integration

The basic idea of co-integration is to identify the long run relationship between variables, then divergence from the long run equilibrium path is bounded, and the variables are co-integrated. For co-integration, two conditions must be satisfied. First, the series for at least two of the individual variables are integrated of the same order and Second, a linear combination of the variables exist which is integrated to an order lower than the individual variables. Simply, the concept of co-integration is that even though level variables are individually I(1), that is, dominated by the long-run components but the linear combinations of these I(1) variables can be I(0). In this case, the long-run components of these series cancel each other out to produce a stationary series, and such variables are then said to be co-integrated. Consider the co-integration regression

$$Y_t = \alpha + \beta X_t + \mu_t \qquad (3)$$

If the series Yt and Xt are both I (1) and the error term μt is I (0) then the series are co-integrated of order I (1, 0). In (3), β measures the equilibrium relationship between the series Y_t and X_t, and μt is the deviation from long run equilibrium path.

The econometric interpretation for co-integration is that if in the long run two or more series Yt and X_t are linked together to form an equilibrium relationship, then even though Y_t and X_t themselves are trended (i.e. non-stationary), they will nevertheless move tighter closely over time and the difference between them is constant i.e. stationary. So the concept of co-integration implies the presence of a long run equilibrium to which an economic system moves over times, and μ_t may thus be interpreted as the equilibrium error i.e. the extent to which the relationship deviates from equilibrium.

In the literature, there are two major approaches to test co integration. These include Residual-based ADF-approach proposed by Engle and Granger (Engle and Granger, 1987) and Johansen‟s Full Information Maximum Likelihood (JFIML) approach (Johansen, 1988, and Johansen and Juselius, 1990). In the Engle and Granger approach, first step is to test co integration and then in the second step residuals are used in an error correction model to get information on speed of adjustment in the long run. The major weaknesses of this approach include its low power and finite sample biasness. This approach cannot be used in a situation where there are more than two variables (Dolado *et al.*, 1991 and Charemza and Deadman, 1992). So Johansen's approach is preferred over Engle and Granger's approach.

Granger Causality and Error Correction Mechanism

Error Correction Mechanism explains dynamics of short run adjustment towards long run equilibrium. When variables are cointegrated, there is general and systematic tendency for the series to return to their equilibrium value. It means that short run discrepancies may be constantly occurring but cannot grow indefinitely which shows that adjustment dynamics is intrinsically embodied in the cointegration theory. The theorem of Granger representation states that if a set of variables is cointegrated, it implies that residuals of cointegrating regression is of order I(0), thus there exists an ECM describing that relationship. This theorem explains that cointegration and ECM can be used as a unified theoretical and empirical framework analyzing both short run and long run behaviour. The ECM specification is based on idea that adjustments are made to get closer to long run equilibrium relationship. Hence, link between cointegrated series and ECMs is intuitive; an error correction behaviour induces cointegrated stationary relationship and vice versa (McKay *et al.,* 1998).

When two price series are stationary of the same order and co-integrated, causality test can be carried out on the series. This is due to the fact that at least one granger –causal relationship must exist in a group of co-integrated series, according to Chirwa (2000). Hence, an Error Correction Mechanism (ECM) could be used to test for causality as well as the speed of price transmission among integrated markets. To test for Granger causality between price pairs, equations (4) and (5) below could be used.

$$Pi_t = a + \alpha t + \sum_{i=1}^{m} \beta i Pit - m + \sum_{j=1}^{n} \gamma Pjt - n + e_t \quad (4)$$

$$Pj_t = a + \alpha t + \sum_{i=1}^{m} \beta i * Pit - m + \sum_{j=1}^{n} \gamma * Pjt - n + z_t \quad (5)$$

Both equations will then be tested for $\beta_{i,}$ $\gamma_{j,}$ $\beta^*_{i \text{ and }}$ γ^*_j to ascertain whether they are significantly different from zero for any *i* or *j*. Acceptance of the null (no causality) implies that past values of the series on the right hand side are not adding information on the actual values of the series on the left hand side, in addition to what is provided by its own past values. If this happens in both equations, then neither of the two series is Granger-causing the other, while if the null can be rejected in one of them, the price appearing on the left hand side will be Granger-causing the other. This test is significant in the sense that it can be used as a confirmation of the test for the long run equilibrium between two price series as well as to understand which of the two prices acts as a source of information for the other. In addition, it enables us gain qualitative elements to understand the results, in terms of the causality direction.

The speed of price transmission between markets and their equilibrium will be determined by an ECM expression as given below:

$$\Delta P_{it} = \alpha_0 + \alpha_1 \Delta P_{jt} + \alpha_2 U_{t-1} + e_t \quad (6)$$

Where e_t is a white noise error term and U_{t-1} is the lagged value of the error term from the co-integration regression of one price series on another price series and a time trend. The error term U_{t-1} can be used to tie the short run behavior of P_{it} to its long run value. The ECM is used to correct for disequilibrium.

Definition of Variables

Mansonia-R = Rural Price of *Mansonia altissima* in Ekiti State
Mansonia-U = Urban price of *Mansonia altissima* in Ekiti State
Iroko-R = Rural Price of *Milicia excelsa* in Ekiti State
Iroko-U = Urban price of *Milicia excelsa* in Ekiti State
Obeche-R = Rural Price of *Triplochiton scleroxylon* in Ekiti State
Obeche-U = Urban Price of *Triplochiton scleroxylon* in Ekiti State
Terminalia-R = Rural price of *Terminalia superba* in Ekiti State
Terminalia-U = Urban price of *Terminalia superba* in Ekiti State

RESULTS AND DISCUSSION

Price Trend Analysis

Figure1 shows the trend in rural and urban prices of *Milicia excelsa*(Iroko) timber species in Ekiti State of Nigeria. The maximum rural price for *Milicia excelsa* was found to be ₦1, 240/unit which was obtained in September 2012, while the minimum price was obtained in January through March 2003 at ₦490/unit. For the urban price of Iroko in Ekiti State, maximum was ₦1, 350/unit and was obtained in September, 2012 while the minimum was ₦520/unit which was obtained in January and February 2003.

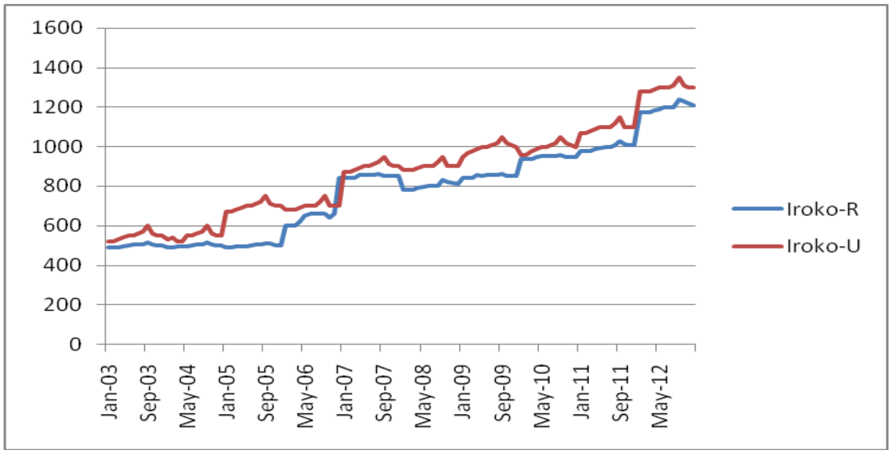

Figure1: Average monthly price of Milicia excelsa(Iroko) in Ekiti State

Similarly in Figure2, the maximum rural price of *Triplochiton scleroxylon(*Obeche) in the State was found to be ₦850/unit obtained in September 2012 while the minimum of ₦220/unit was obtained in January and February 2003. Urban maximum price of N950/unit was obtained in September 2012 while the minimum price of N270 was obtained in January and February 2003.

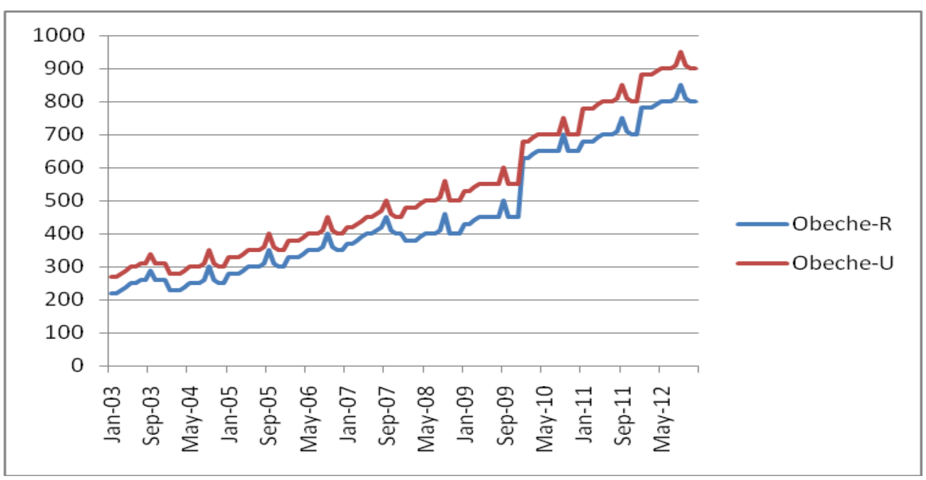

Figure2: Average monthly price of Triplochiton scleroxylon (Obeche) in Ekiti State

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Likewise, Figure3 shows the rural and urban price trend of *Terminalia superba*(Afara) in Ekiti State. The highest rural price for which the species was sold within the period of study (2003-2012) was ₦950/unit and this was obtained in September 2012 while ₦270 was the lowest rural price a unit of the species was sold and this was obtained from January through March 2003. For urban, the maximum price was ₦1, 030/unit obtained in September and October 2012 and the minimum was ₦330/unit obtained from January to March 2003.

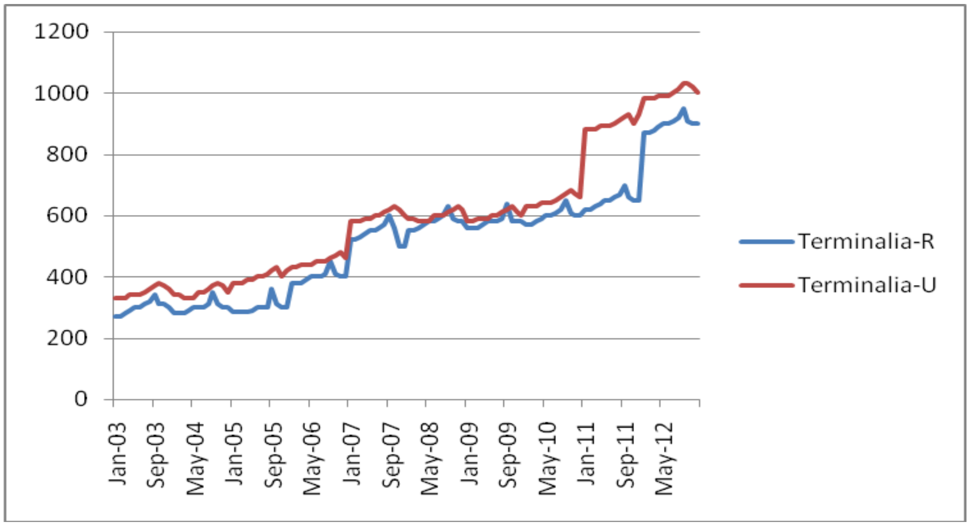

Figure3: Average monthly price of Terminalia superba(Afara) in Ekiti State

In Figure4, the maximum rural price of *Mansonia altissima(*Mansonia) in the State was found to be ₦1,930/unit obtained in September 2012 while the minimum of ₦780/unit was obtained from January to March 2003. Urban maximum price of N2, 130/unit was obtained in September 2012 while the minimum price of N820 was obtained in January and February 2003.

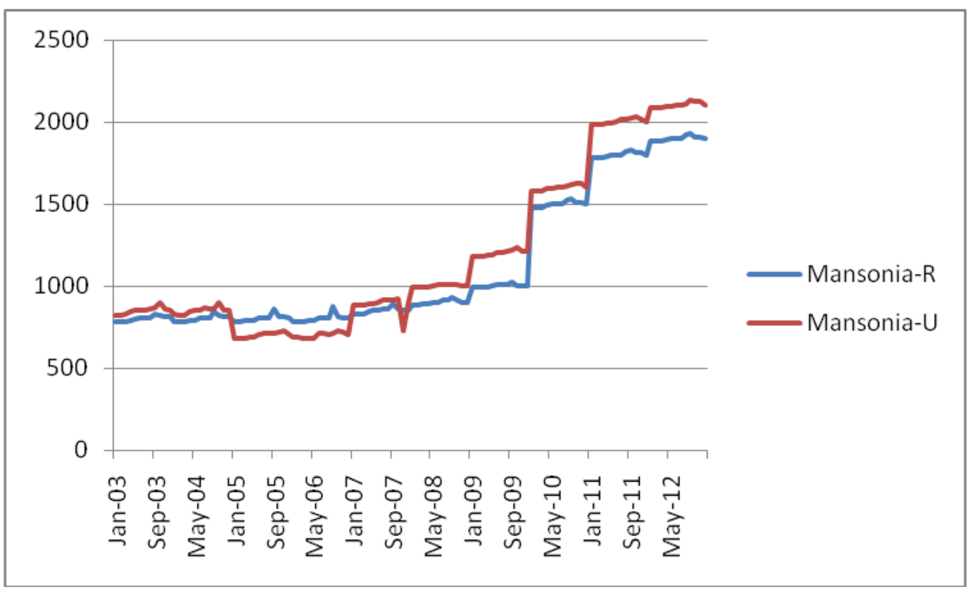

Figure4: Average monthly price of Mansonia altissima(Mansonia) in Ekiti State

It was observed from the study that prices of timber species were relatively stable from January through March. But they began to rise from April and were at their peak around September before they began to decline around October. This could be attributed to the fact that the periods within which prices began to rise and reached their highest points fall within the raining season when logging activities become more tedious and difficult to accomplish. This is because bushes are overgrown during this period, making the accessibility of the forests more difficult for the lumbers or loggers, thereby attracting additional cost to employ labour to clear the bushes for easy access to the forests. In addition, the forests are waterlogged during this period, making it an onerous task for loggers to convey logs of wood from the forest to sawmill where they are processed into marketable timber or planks. All these contribute to the relatively higher prices of timber species being noticed during this period.

Stationarity test of timber price series

Augmented Dickey Fuller (ADF) unit root test was used to determine whether each time series is stationary or not. The null hypothesis is that the variable observed has a unit root, against the alternative that it does not. Table1 depicts the results of test of the series (in logarithms) for unit roots using ADF Test (Dickey and Fuller 1979, Fuller 1976).The results of all the tests indicate that all price series are non-stationary at their level form but stationary at their first difference. Here, the order of integration is one and the variables are said to be integrated of the first order. That is I (1). This therefore corroborates earlier studies by Okoh(1999), Mafimisebi(2002), Adeoti and Owoyemi(2006) and Ghafoor *et al*(2009) that commodity prices are integrated of order one and are usually stationary after first differencing(Hussain,2010; Mehmood,2010).The results therefore allow to proceed for co-integration tests for examining long-run equilibrium relationship.

Table1: Stationarity test of timber price series

Price Series	**Augmented Dickey-Fuller Test (Level Form)**	**Remark (Level Form)**	**Augmented Dickey-Fuller Statistics (At First Difference)**	**Remark At First Difference**
IROKO-R	0.093589	Non Stationary	-10.86756	Stationary
IROKO-U	-0.333017	Non stationary	-11.57881	Stationary
MANSONIA-R	-0.567736	Non Stationary	-10.688123	Stationary
MANSONIA-U	0.356366	Non Stationary	-11.94748	Stationary
OBECHE-R	0.462625	Non Stationary	-10.396552	Stationary
OBECHE-U	1.022944	Non Stationary	-11.883486	Stationary
TERMINALIA-R	-0.180492	Non Stationary	-11.306936	Stationary
TERMINALIA-U	0.419851	Non Stationary	-11.89930	Stationary

Critical values are -3.486064 and -3.486551 at 1% level of significance for price at their level and first difference series respectively

Co-integration Analysis

Co-integration analysis is concerned with the existence of a stable relation among prices in different localities. It refers to co-movements of prices, and, more generally, to the smooth transmission of price signals and information across spatially separated markets. Prices move from time to time, and their margins are subject to various shocks. When a long-run linear relation exists among different series, these series are said to be co-integrated (Engle and Granger (1987). Hence, the Engle and Granger test of co-integration was applied to analyze long-run market integration between rural and urban timber markets in Ekiti State, Nigeria. The test result is presented in Table 2. The result indicates that the four timber market pairs compared were co-integrated. The market pairs were IROKO-R and IROKO-U, MANSONIA-R and MANSONIA-U, OBECHE-R and OBECHE-U as well as TERMINALIA-R and TERMINALIA-U. This shows that rural and urban timber markets in Ekiti State are co integrated and by extension that the number of co-integrated variables gives the number of stationary linear combinations of the price series. It is therefore consistent with Jezghani *et al* (2013) identification of one linear combination of prices (as it is a bivariate case) that exhibits stability over the time.

Table2: Engle-Granger Co-integration Test Result

Market Pair	Augmented Dickey-Fuller Coefficient of regression residual	t-value
IROKO-R __IROKO-U	-0.1910	-3.5378*
MANSONIA-R _ MANSONIA-U	-0.1049	-3.8110*
OBECHE-R _ OBECHE-U	-0.1001	-4.0905*
TERMINALIA-R _ TERMINALIA-U	-0.1545	-4.1367*

**Indicates that the coefficients are significant at 5% level of significance. The critical value at 5% is -2.8863. Therefore the null hypothesis of no co-integration is rejected.*

The estimated long-run equilibrium relationships between co-integrated variables are as given in equations 7 to 10 below. The figures in parentheses are t-values. It can be observed from the equations that the long-run equilibrium relationship between Ekiti rural and urban timber markets is about perfect. This is evident from equations (7) to (10) where the coefficients of the co-integrating equations range from about 0.83 to 0.95. This implies that about 83% of the price change in Ekiti rural timber market for *Mansonia altissima*(Mansonia) is transmitted to urban timber market for Mansonia while about 95% of the price change in rural price of *Milicia excelsa*(Iroko) is transmitted to the urban price of Iroko in Ekiti State in the long-run.

IROKO-U = 1.254 + 0.945 **IROKO-R** (7)

(8.895)

MANSONIA-U = 3.620 +0.829 **MANSONIA-R** (8)

(4.391)

OBECHE-U = 4.012 + 0.919 **OBECHE-R** (9)

(8.157)

TERMINALIA-U = 3.893 + 0.835 **TERMINALIA-R** (10)

(3.989)

Error Correction Model

Since co-integration only considers the long-run property of a model and does not deal with the short-run dynamics explicitly, a Vector Error Correction Model (ECM) was specified for this purpose. This ECM is perhaps the most useful tool as it provides a stylized picture of the relationship between two prices. The closeness of the error correction coefficient to -1 can be used to assess the extent to which policies, transaction costs, delay in transportation and other distortions delay full adjustment to the long run equilibrium. When we therefore express market integration through co-integration there could be disequilibrium in the short-run. That is price adjustment across markets may not happen instantaneously. This is because it often takes traders to notice the change and respond to it. Therefore may take some time for spatial price adjustments to happen. The error correction model takes into account the adjustment of short-run and long-run disequilibrium in markets and time to remove disequilibrium in each period.

Table3 shows that 21-32 % disequilibrium is removed in each period. That is, one month in the timber markets in Ekiti State of Nigeria. The value of co-efficient demonstrates that 21 percent equilibrium is adjusted between Ekiti State rural and urban markets for *Milicia excelsa*(Iroko) timber species after one month, while 32 percent disequilibrium is removed between rural and urban timber markets for *Mansonia altissima*(Mansonia) after one month. Twenty six (26) percent disequilibrium is removed between rural and urban timber markets for *Triplochiton scleroxylon* (Obeche) species after a period of one month. Between Ekiti State rural and urban markets for *Terminalia superba*(Afara), 27 percent equilibrium is adjusted after one month. On average, selected timber markets in the study area will take 3-5 months to move towards equilibrium.

Table3: Result for Error Correction Models (ECMs) and Price Transmission for Selected Timber Markets

D(IROKO-U)	**Coefficient**	**D(MANS-U)**	**Coefficient**	**D(OBECHE-U)**	**Coefficient**	**D(TERM-U)**	**Coefficient**
ECM	-0.21*	**ECM**	-0.32*	**ECM**	-0.26*	**ECM**	-0.27*
	(-3.32)		(-4.15)		(-3.41)		(-3.08)
C	1.17	**C**	0.17	**C**	1.21	**C**	1.12
	(0.21)		(0.11)		(0.70)		(0.02)
D(IROKO-U)(-1)	0.16*	**D(MANS-U)(-1)**	0.22*	**D(OBECHE-U)(-1)**	0.12	**D(OBECHE-U)(-1)**	0.16
	(2.53)		(3.44)		(1.24)		(0.53)
D(IROKO-U)(-2)	0.16	**D(MANS-U)(-2)**	0.27*	**D(OBECHE-U)(-2)**	-0.17*	**D(OBECHE-U)(-2)**	0.08
	(1.71)		(2.63)		(-2.37)		(0.87)
D(IROKO-R)(-1)	-0.07	**D(MANS-R)(-1)**	-0.19*	**D(OBECHE-R)(-1)**	-0.12*	**D(OBECHE-R)(-1)**	-0.42*
	(-0.76)		(-2.77)		(-2.64)		(-2.55)
D(IROKO-R)(-2)	-0.18*	**D(MANS-R)(-2)**	-0.09	**D(OBECHE-R)(-2)**	-0.06	**D(OBECHE-R)(-2)**	-0.36*
	(-2.66)		(-0.72)		(-0.35)		(-3.43)

Eight (8) timber market links were investigated for evidence of Granger-causality. Six (6) of these timber market links rejected their respective null hypotheses of no Granger causality. From Table4, four market links showed bi-directional Granger-causality or simultaneous feed-back relationship while the remaining two market links showed unidirectional Granger-causality. Ekiti state rural and urban market prices for *Mansonia alitissima* and *Triplochiton scleroxylon* exhibit bi-directional Granger-causality. This implies that they demonstrate equal strength since they Granger-caused each other at 5% level of significance. Two of the market prices exhibit unidirectional Granger-causality where both rural market of *Milicia excelsa* and *Terminalia superba* granger-caused their respective urban market at 5% level of significance. It was also observed that rural market prices of Ekiti State timber species are completely exogenous to the system.

Table4: Granger Causality Test

Hypothesis(H_0): No causality	**F-Statistics**	**Probability**
IROKO-R → IROKO-U	7.95282	0.0006*
IROKO-U → IROKO-R	0.32188	0.7254

MANS-R → MANS-U MANS-U → MANS-R	8.52931 6.97318	0.0005* 0.0016*
OBECHE-R → OBECHE-U OBECHE-U → OBECHE-R	4.23327 3.41709	0.0169* 0.0362*
TERM-R → TERM-U TERM-U → TERM-R	4.33427 1.15062	0.0149* 0.3201

*Note: Variables are in log level. The Granger causality is tested using up to second lag.*significant at 5% level*

CONCLUSION

It was discovered from the study that prices of timber species in Ekiti State were stationary after first differencing which implies that markets were integrated of first order. It was also found that there was market integration between rural and urban timber markets in Ekiti State timber markets and that it took between 3 to 5 months for price transmission to be complete between markets that were co-integrated. More so, it was discovered that the transmission of price from one market (reference market) to another market (peripheral market) is faster when the markets are perfectly integrated and slower in weakly integrated markets. Therefore the contemporaneous movement over time of prices in different markets becomes an important indicator of market efficiency or market performance. The study therefore concludes that market price linkages and the interrelationship among spatial markets are important in economic analysis.

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