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Seasonal Festive periods and Meat Price Transmission and Market Integration in Akwa Ibom State, Southern Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author SBA designed the study, developed the analytical and mathematical framework, and wrote the problem statement and interpreted results. Author EJU fine-tuned the analysis and reviewed the first draft extensively. IVP managed the literature reviewed. Author UJU was involved in editing and proof reading of the initial manuscript. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

The study analyzed the dynamics of meat (pork, goat meat, beef, exotic chicken, local chicken and snail meat) price transmission and market integration in Akwa Ibom state, Nigeria. Average monthly prices (measured in naira per kilogram) of meats in rural and urban markets were used in the analysis. The data covered the period from January 2005 to September 2013, and was obtained from the quarterly publications of the Akwa Ibom State Agricultural Development Programme (AKADEP). The trend analysis showed that, prices of sampled meats in the rural and urban markets have positive significant relationships with time. The descriptive analysis revealed that, the standard deviation and coefficient of variation of rural price of each meat was similar to its urban counterpart and this was substantiated further by the respective pair linear graph of each meat. This result suggested possible co-movement of meat prices in rural and urban market in the study

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area. The Pearson correlation coefficient of each of the respective pair of rural and urban price of meats revealed significant linear symmetric relationships. The bivariate Granger causality test revealed bi-directional relationships between the rural and urban price of all sampled meats in the State. The co-integration test revealed the presence of co-integration relationship between the rural and urban meats used in the analysis. The coefficients of market integration in the rural meat price equations converge to unity or law of one price which connotes high degree of market integration in the long run. The results of the error correction model (ECM) confirm the existence of the short run market integration between the rural and urban prices of meats in the study area. The rural prices of meats adjusted faster to the stable state in the long run than their respective urban prices. The index of market connection (IMC) supported the existence of the short run market integration between meat prices in rural and urban markets. Based on the findings, it is recommended that, the Akwa Ibom State government should continue to provide marketing infrastructures and reduce sources of externality cost in order to improve further the symmetric nature of information flow among meats markets in the state. Also, individuals, trade unions, NGOs' and government should established market information units and awareness programmes on mass media to facilitate efficient communication or flows of meat market information in the state.

Keywords: Rural; urban; meat; price; integration; agricultural; Akwa Ibom; Nigeria.

1. INTRODUCTION

Meat is generally defined as the skeletal muscle from animals, including the connective tissue and fat naturally associated with the muscle [1], but may also include all the edible parts. It provides a range of vitamins, amino acids which are the building blocks of protein, minerals and other nutrients essential to the human physiological functions [2, 3]. Meat is a major source of animal protein available to man. Animal protein is rich in essential amino acids and is, therefore, described as first class or good quality protein [1]. The meat from cattle, goat, sheep, pig and poultry constitute the main sources of daily per capita consumption of animal protein [4]. Following the report from Food and Agriculture Organization (FAO) in 1992, the daily minimum crude protein requirement of an adult Nigerian ranges from 65gm to 85gm [5,6]. However it is recommended that, 36gm of this minimum requirement should be obtained from animal products [7,2]. The estimated per capita daily animal protein intake in the country stood at 20gm in early 1990s [5,8]. The low level of animal protein consumption in Nigeria as reported by Food and Agriculture Organization [5] and Udoh and Akintola [3], revealed that the diet of an average Nigerian contains about 20% less than the recommended requirement. Recent statistics have shown that, Nigeria's per capita meat consumption is approximately 8.8kg per person per year compared to 58.6Kg per person in South Africa; 66.4Kg per person in Gabon; 25.6Kg in Niger; 85.3Kg per person per year in Brazil and 94.3Kg per person per year in Canada as well as 120.2Kg per person per year in United States in 2009 [9]. This implies that, there is a short fall in animal protein intake among majority of Nigerian. Despite this deficiency in protein intake among Nigerian, the country is one of the largest meat producing countries in Africa, and also one of the largest meat consuming nation in the sub Saharan region of Africa [10]. A review of the data on food supplies available for consumption in different countries showed that the per caput protein intakes in developing countries, including Nigeria, is comparatively low. Not only is the total protein supply deficient, but the quality of dietary protein available is inferior to that consumed in developed countries [11]. Among

several causes of low animal protein consumption in Nigerian is the price of meats [12,13]. Other factors that affect the demand of meats include; availability of meat, cultural and religious factors and educational level as well as preference of consumers among others. Brawn [12] also highlighted poverty, illiteracy and increase in food price among other factors that are responsible for the low protein intake in Nigeria. Couple with the cyclical income, high inflation rate and prevalence of poverty among majority of Nigerian, meat price seems to be the most itching factor hindering the optimal protein intake among Nigerian.

Report from International Monetary Fund (IMF) in 2000 cited in Alexandra et al. [14], indicated that, most agricultural commodity prices exhibited a pattern of long- term price fall and short-term price instability or rises. Prices of agricultural commodities help to allocate farm resources. It is also very important in the decision making process of consumers about the quantity of farm produce to consume. In the context of the marketing environment, price shows the level of efficiency and the working mechanism among agricultural product markets [15]. Many researches in Nigeria and elsewhere have related price volatility in agricultural commodities to several factors including variances in bargaining power among consumers, cyclical income fluctuation among sellers and consumers, seasonality of production, natural shocks such as flood, pests, diseases, and inappropriate response by farmers to price signals [3,15,16,17]. Product price instability in agricultural commodities "meats" inclusive is a regular phenomenon in markets across Nigeria [18]. Prices variation become problematic when they are large and cannot be anticipated and, as a result, create a level of uncertainty which increases risks for producers, traders, consumers and governments and may lead to sub-optimal decisions. Instability in commodity prices among markets could be detrimental to the marketing system and the economy as a whole. It could cause inefficiency in resources allocation among sellers and consumers depending on the source of variability (that is, whether it is induce by supply or demand side or both). It could also increase poverty level among low income earners in the society [14]. On the other hand, a unified product price among markets is not a rational policy to pursue in a developing country like Nigeria. This is because of the deteriorating marketing infrastructures, increase in cost of externalities and the nature of most agricultural products which often resulted in significant differences in the total variable costs incurred by sellers and consumers in these markets.

Pork, goat meat, beef, exotic chicken, local chicken and snail meat are among animal protein sources whose prices are highly unstable during festive periods in Nigeria [38]. During festive periods, consumers could pay different amounts for the same product in different markets separated by few kilometers. However, price instability of agricultural commodity would be considered a normal phenomenon, if it does not significantly differs from one market to another. On the contrary, if products prices are significantly different among markets it will distort resources flow, which might have adverse effect on the self food sufficiency policy of the governments. Several empirical researches have investigated the extent to which agricultural markets are linked across space in the marketing system in Nigeria [19,20,21,17]. Meat markets have not played an important role in this body of literature in Nigeria. The extent to which market disturbances such as panic buying and festive period purchases are transmitted across marketing chain and spatially distributed markets have long been considered to be important indicator of the market power or efficient performance of the market. In the meat markets, this issue is pertinent owing to the critical roles meats played in the dietary requirement of individuals. Spatial price linkages are often interpreted as providing insights into the efficiency of infrastructures of markets. This is especially true in developing economy or society, where infrastructure issues such as road systems, market development, transportation, and so forth may be especially pertinent [22].

In separated markets, when there is significant price difference between homogenous goods, such that the differences exceeded the transfer cost; the arbitrage activities will be stimulated. The arbitrageur will purchase commodities from lower-price markets and resale in higher-price markets. This is a situation where spatial or separated markets are not integrated. On the other hand, two markets are integrated when there is co-movement or there exist a significant long-run relationship between prices of homogenous goods due to the smooth transmission of price signals and information across the two markets [21]. Market integration could be perfect if price changes in one market are fully reflected in the alternative markets [23].

Tiers of government in Nigeria over the years had initiated several agricultural programmes to boost the performance of the agricultural sector in their domains. Animal production and marketing are among priority areas that have attracted various levels of government interest in recent time. For instance, Akwa Ibom State Government in recent years has enunciated programmes like; Accelerated Livestock and Fish Production Programme (ALFIPP) and Akwa Ibom Meat Hygiene/Van Project as well as improves the management of the central abattoir aimed to provide hygienic animal products to citizenry in the state. As part of several ways to increase agricultural production and economic growth as well as meeting the FAO minimum dietary requirement of the nation, efficiency marketing policy based on sound empirical facts is one of the prerequisites. Hence, understanding the direction and magnitude of meat price transmission between rural and urban markets in a state like “Akwa Ibom” will provide indispensable input to policy makers to formulate workable policies for the agricultural sector in the state. It will also, promote the achievement of the self food sufficiency drive and also help in minimizing the menace of poverty in the state. For instance, the extent of market integration has often been used to measure the success of market liberalization and structural adjustment policies in developing countries [24]. Therefore, such information can help government at all tiers to decide the extent to which price transmission can be considered as efficient across different geo-political zones in their domains.

1.1 Objective of the Study

The main objective of the study is to analyze the dynamics of meat price transmission and market integration (pork, goat meat, beef, exotic chicken, local chicken and snail meat) in Akwa Ibom state. The specific objectives are;

- To examine the trend in prices of pork, goat meat, beef, exotic chicken, local chicken and snail meats in rural and urban markets of Akwa Ibom State,
- To identify the symmetric or asymmetric nature of meat price transmission between the rural and urban markets in the study area,
- To assess the long run Granger causality between the rural and urban price of pork, goat meat, beef, exotic chicken, local chicken and snail meat in the study area,
- Analyze the long and short run price integration of pork, goat meat, beef, exotic chicken, local chicken and snail meat in Akwa Ibom State,
- To determine the influence of seasonal dummy (festive months) on the long and short run meat markets integration in the study area and,
- Examine the degree of short run market integration between the rural and urban price of pork, goat meat, beef, exotic chicken, local chicken and snail meat in Akwa Ibom state.

2. LITERATURE REVIEW OF SOME EMPIRICAL STUDIES ON PRICE TRANSMISSION AND MARKET INTEGRATION IN NIGERIA

Several empirical investigations have dealt with agricultural price transmission and market integration of food commodities in Nigeria. For instance, Amusa, [25] in her study of the trend analysis of agricultural food prices in Nigeria reported that, food items such as vegetable oil, Garri, brown beans, ripe plantains, fresh tomatoes, green vegetables, onion bulbs, shelled melon seeds, experienced increase and fluctuations in their prices. Okoh and Egbon [21] examined the integration of Nigeria's rural and urban foodstuffs markets. The study concludes that, the rural and urban foodstuffs markets were well integrated. The result further suggested that, the urban market price drives the rural market price. The size of the adjustment coefficient for the rural foodstuffs price revealed that, the speed of adjustment from disequilibrium was moderate. In addition, the persistence profile showed that, it would take about five months for the effect of a shock on the market system to die out. Similarly, Ohen et al. [26] studied the vertical and horizontal price linkages for live catfish in Nigeria. The price variables used in the analysis were non-stationary and therefore were made stationary by first difference. The Johansen co-integration analysis was used to test for the relationship between prices. Results indicated that producer and export prices were co-integrated. Furthermore, the Granger causality Wald test suggested that, the retailed prices do have a causal relationship with producer prices. The dynamic regression analysis of prices also revealed that, the markets for live catfish have strong price linkages and thus are spatially integrated. In western Nigeria, Adeoye et al. [27] examined the price transmission and market integration of banana and plantain in Oyo state, Nigeria. Six market links rejected their respective null hypothesis of no Granger causality ($P>0.05$), two of the market links exhibited bi-directional Granger causality or simultaneous feedback relationship; while four market links exhibited uni-directional Granger causality at 5% and 10% level of significance. Urban plantain market occupies the leadership position in the commodity price formation and transmission in the markets investigated. The Index of market connection or concentration (IMC) indicated that, the markets exhibited low short run integration. Still in the region, Adenegan and Adeoye [28] examined the level of tomato market integration in the rural and urban markets of Oyo State. Secondary data on tomato price spanning from 2003 to 2010 were sourced from Oyo State Agricultural Development Programme (OYSADEP). Results of analyses revealed that, prices of tomato were stationary at their level. Also, the urban tomato market did not Granger causes rural tomato market ($P > 0.05$), while rural tomato market Granger causes urban tomato market ($P< 0.05$). None of the markets links exhibited bi -directional Granger causality or simultaneous feedback relationship. Also, Ojiako et al. [29] studied the spatial integration and price transmission in selected cassava products' (Lafun) markets in Nigeria. The study employed Vector Error Correction (VEC) model methodology. The result revealed the presence of the long-run equilibrium following exogenous shocks in the market. In addition, the result discovered unilateral Granger causality that runs from the rural to the urban market. The impulse response analysis revealed that, the rural price was more responsive to shocks emanating from the rural market, the effect of which was computed as 95.6% using the forecast error variance decompositions. The study further discovered that, the effects of the rural prices' shock on urban price were very negligible at 3.2% after 10 weeks. The implication is that the rural market was the dominant market for determining the price of *lafun* in the short-run. The error correction model revealed significant causality link between the peripheral and central markets, suggesting a clear trend in price leadership. Still in the western region, Akintunde et al. [30] studied the long run price integration of grains in Oyo state. Empirical results revealed that, the price series in all the markets were non-stationarity at their levels at 5%

significance level. The integration test showed that, none of the markets examined had prices tied together in the long- run. The Index of market concentration (IMC) indicated that, the markets exhibited low short run market integration. In the South-South region, Akpan et al. [17] examined the price transmission and market integration of local and foreign rice in rural and urban markets of Akwa Ibom State. The findings showed that, price of local and foreign rice in rural and urban markets has constant exponential growth rate of 0.59% which suggests perfect co-movement for rural and urban prices of local and foreign rice in the study area. Also, the Pearson correlation coefficient matrix revealed that, the rural price of local and foreign rice has linear symmetric relationships with their corresponding urban prices. The Granger causality test revealed bi-directional relationship between rural and urban price of local and foreign rice. The results of the co-integration test revealed the presence of co-integration between the rural and urban prices of local and foreign rice as well as support the hypothesis of perfect price transmission between the two markets. The results of the error correction (ECM) model also confirm the existence of the short run market integration between the rural and urban prices of local and foreign rice in the study area. In addition, the result shows that, the price of local rice in both rural and urban markets adjusted faster than prices of foreign rice once there is an exogenous shock in the marketing process of rice. The index of market connection (IMC) supported the high short run market integration between prices in rural and urban markets for local and foreign rice commodities and the quick adjustment of rural price of local rice in relative to rural price of foreign rice.

2.1 Limitation Spotted from the Reviewed Literature on Agricultural Commodity Price Transmission and Market Integration in Nigeria

- As widely noted, most of these researches were conducted on crop commodities [example in 27,28,17]; no attempt has been made to study meat market integration and price transmission in Nigeria.
- Most of these studies did not use comparative methods to ascertain the consistency of results [example in 21,27,28].
- The influence of festive periods or induce supply – demand shock has not been incorporated into Agricultural price transmission and market integration studies in Nigeria.
- Finally, most of these researches were conducted in the western part of the country, there is need to explore the knowledge base of the subject matter in the South-South region of the country [17].

This study is designed to specially fill these identified gaps in the literature. Price has important roles to play in the efficient production and distribution of agricultural commodities. Studies like this will provide effective policy variables needed to formulate workable marketing policies and assessing the impact of supply – demand shock on price transmission as well as availability of social infrastructures.

2.2 Theoretical Framework of the Study

We justified the inclusion of a seasonal dummy variable in our price equations from the theory of supply and demand. For instance, let the quantity of meat supplied to a rural market be solely determined by the mean aggregate price and seasonal dummy, all things being equal. That is:

$$SS_{lt} = f(\bar{P}_{lt}, D_{lt}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Explicitly, it is expressed as thus:

$$SS_{lt} = \alpha_0 + \alpha_1 \bar{P}_{lt} + \alpha_2 D_{lt} + U_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where "SS_{lt}" is the aggregate quantity (Kg) of meat supplied to the rural markets in period t; $\bar{P}_{lt}$ is the aggregate mean selling price of meat (Kg/₦) in period t, and "D_{lt}" is a seasonal dummy such as festive period's measure in months during the period under consideration. "α_2" is the price elasticity of supply of meat in the rural market. Variables are expressed in natural logarithm. The expression for the demand function will be similar since the market is assumed to be clear at the point of equilibrium. Also, the arbitrage cost is assumes to be constant among rural markets and between the rural and urban markets. Similarly, let the demand for meat in the urban or central market be a function of aggregate mean price in period t, and "D_{ut}" a seasonal dummy defined previously. "β_2" is the price elasticity of demand of meat in the urban market. Variables are also expressed in natural logarithm. The expression for the supply function is similar, because the market for meat is in equilibrium.

Since the product is homogenous, we assume that the central or urban market supplies the rural market meat commodities. In the presence of perfect market integration of meat between the local and the urban market in the study area; the information flow between the two markets would be symmetry, as such the quantity of meat demanded in the urban market will synchronize with the quantity supplied to the rural market. Then, the quantity supply will be equal to the quantity demanded at a common mean price. Thus, this can be expressed as:

$$SS_{lt} = DD_{ut} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$\alpha_0 + \alpha_1 \bar{P}_{lt} + \alpha_2 D_{lt} + U_{1t} = \beta_0 + \beta_1 \bar{P}_{ut} + \beta_2 D_{ut} + U_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\alpha_1 \bar{P}_{lt} - \beta_1 \bar{P}_{ut} = (\beta_0 - \alpha_0) + \beta_2 D_{ut} - \alpha_2 D_{lt} + U_{2t} - U_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Then the price of meat in the local or urban market can be expressed as thus;

$$\bar{P}_{lt} = (\beta_0 - \alpha_0)/(\alpha_1 - \beta_1) + \beta_2 D_{ut} - \alpha_2 D_{lt}/(\alpha_1 - \beta_1) + U_{2t} - U_{1t}/\alpha_1 \ldots\ldots\ldots (6)$$

But since the seasonal dummies are identical, $D_{ut} = D_{lt} = D_t$, then;

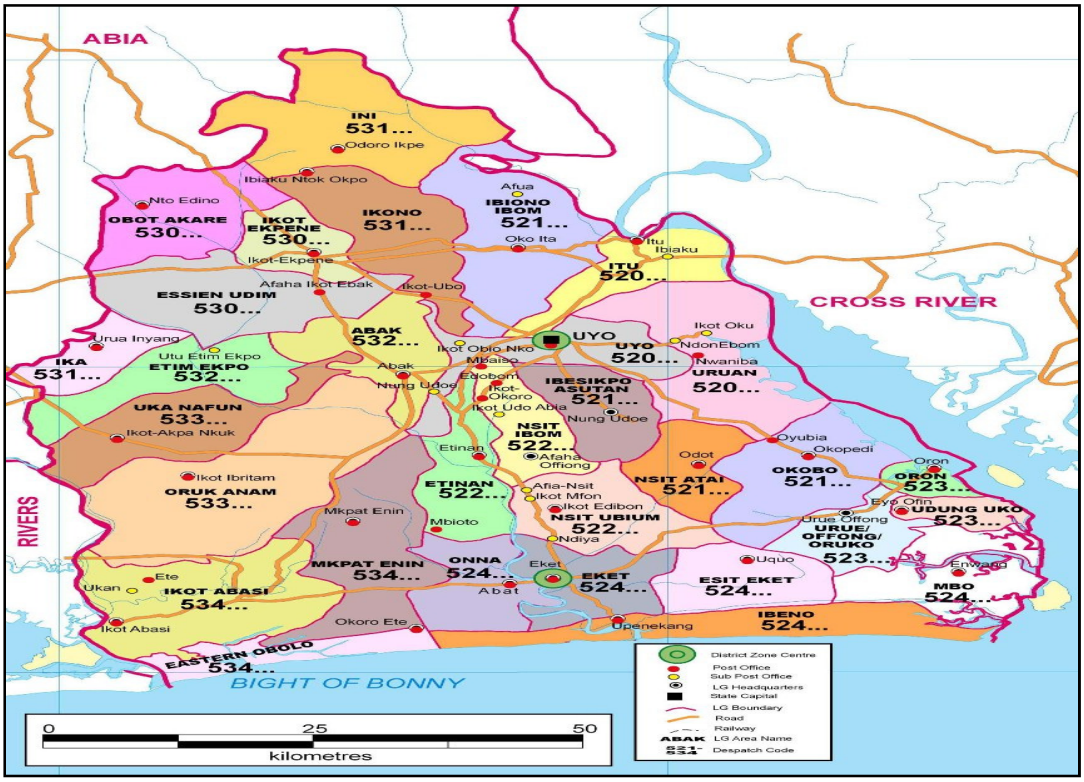
$$\bar{P}_{lt} = (\beta_0 - \alpha_0)/(\alpha_1 - \beta_1) + D_t(\beta_2 - \alpha_2)/(\alpha_1 - \beta_1) + U_{2t} - U_{1t}/(\alpha_1 - \beta_1) \ldots (7)$$

This framework revealed that, the aggregate mean price of meat in the rural or urban market is determined by the mixture of supply and demand coefficients, seasonal dummy and un-captured variables as shown in equation 7. This implies that, under the situation of symmetry information flow between the rural and urban market for meat, the seasonal dummy variable has both direct and indirect influence on the price of meat in both markets. Forces of supply and demand for meat collectively affected the price of meat in both markets in the region. In this framework, it is expected that, a shock in seasonal dummy will be transmitted simultaneously to the rural and urban market provided that prices of meat are both upward and downward flexible. This means that, the seasonal dummy to an extent is expected to alter the structural rigidity of both price functions. The speed of response of both markets to change in price is assumed to be conditioned by the seasonal dummy variable. In this study, we employed this framework to investigate the relationship between rural and urban market price of meats in the presence of a seasonal dummy in Akwa Ibom State, Nigeria.

3. RESEARCH METHODOLOGY

3.1 Study Area and Data Source

The study was conducted in Akwa Ibom State. The state is one of the states in Nigeria and is located in the coastal South-South region of the country. The region is popularly called the Niger Delta region or the oil rich region of Nigeria. The state is located between latitudes 4°32[1] and 5°33[1] north and longitudes 7°5[1] and 8°25[1] east. It has a total land area of areas of 7,246km^2. It is bordered on the east by Cross River State, on the west by Rivers State and Abia State, and on the South by the Atlantic Ocean. Akwa Ibom State has a population of about 3,902,051 [31]. The state is basically an agrarian society where crops like maize, okra, cassava, yam and rice are cultivated in large quantities. Politically and for ease of administration, the state is divided into 31 Local Government Councils or Areas; it has six distinct Agricultural Development Project (ADP) Zones [38]. The local government areas are as distributed in the map of Akwa Ibom State shown below:



Source: Official Website of Akwa Ibom State 2014.

3.2 Source of Data

Secondary data were used in this study and was obtained from the quarterly publication of the Akwa Ibom State Agricultural Development Programme (AKADEP). The data were average monthly retailed prices in naira per kilogram of various meats from sampled markets in rural and urban areas of Akwa Ibom State. The study period covered January 2005 to September 2013. A total of 105 weeks' retailed average monthly prices (₦/Kg) of various

meats were used in the study. The meat used in the study include: pork, goat, exotic chicken, local chicken and snail.

3.3 Analytical Techniques

The study used series of statistical and econometric techniques to test for the relationship among the rural and urban price of meats as well as the seasonal dummy in Akwa Ibom State. The tests used in the study include: the trend analysis, bivariate correlation analysis, Granger causality tests, cointegration and error correction model as well as the Index of market connection (IMC). Each of the tests is explained in both explicit and implicit forms as shown below:

3.4 The trend Analysis of Monthly Retailed Price of Meats in Rural and Urban Markets

The nature of the price movement and growth rate in meat prices in rural and urban markets in Akwa Ibom State was investigated. A linear double logarithm equation was specified as thus:

$$log_e P_t = b_0 + b_1 \sum_{i=1}^{n} log_e t + U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where "b_1" is elasticity or an average change in "P_t" as a result of a unit change in time measured in months.

We also tested for the effect of "seasonal fluctuation" on the structural rigidity of each meat price trend equation in the rural and urban market in the study area. The essence was to test the nature of change in the meat prices associated with seasonal fluctuations or festive period months in the State.

$$log_e P_t = b_o + b_1 log_e t_1 + b_2 \sum_{i=1}^{n} D_t + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

If $b_2 > 0$; the seasonal fluctuation has effect on the price variable investigated: when $b_2 < 0$; the reverse is the case. D_t is a dummy and represents festive months in the state. It takes the value 1 in December and January been the Christmas and New Year periods. It also assumes the unity value during March and April been Easter period. In February, May, June, July, August, September, October and November D_t was zero. Also, "P_t" was represented by:

$PK_{rt} = Monthly\ price\ of\ pork\ in\ rural\ market\ measured\ in\ naira/Kg$
$PK_{ut} = Monthly\ price\ of\ pork\ \ in\ Urban\ market\ measured\ in\ naira/Kg$
$GT_{rt} = Monthly\ price\ of\ goat\ meat\ in\ rural\ market\ measured\ in\ naira/Kg$
$GT_{ut} = Monthly\ price\ \ of\ goat\ meat\ in\ urban\ market\ measured\ in\ naira/Kg$
$BF_{rt} = Monthly\ price\ of\ beef in\ rural\ market\ measured\ in\ naira/Kg$
$BF_{ut} = Monthly\ price\ of\ beef\ in\ Urban\ market\ measured\ in\ naira/Kg$
$EC_{rt} = Monthly\ \ price\ of\ exotic\ chicken\ meat\ in\ rural\ market\ measured\ in\ naira/Kg$
$EC_{ut} = Monthly\ price\ \ of\ exotic\ chicken\ meat\ in\ urban\ market\ measured\ in\ naira/Kg$
$LC_{rt} = Monthly\ price\ of\ local\ chicken\ meat\ in\ rural\ market\ measured\ in\ naira/Kg$
$LC_{ut} = Monthly\ price\ of\ local\ chicken\ meat\ in\ Urban\ market\ measured\ in\ naira/Kg$
$SN_{rt} = Monthly\ price\ of\ snail\ meat\ in\ rural\ market\ measured\ in\ naira/Kg$
$SN_{ut} = Monthly\ price\ \ of\ snail\ meat\ in\ urban\ market\ measured\ in\ naira/Kg$

Note: Prices of meat were expressed in nominal values.

3.5 Pearson Correlation Matrix of Monthly Retailed Prices of meats in Rural and Urban Markets

The linear and symmetric association between rural and urban prices of meats was tested by estimating the Pearson correlation coefficients. The formula is as described below:

$$\boldsymbol{P_{ru}} = \frac{\boldsymbol{n\sum P_{rt}P_{ut} - (\sum P_{rt})(\sum P_{ut})}}{\sqrt{\{\boldsymbol{n\sum P_{rt}^2 - (\sum P_{rt})^2}\}\{\boldsymbol{\sum P_{ut}^2 - (\sum P_{ut})^2}\}}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{10})$$

Where, "P_{ru}" is the correlation coefficient between urban and rural market price of meats in the study area. A highly significant correlation between the rural and urban prices of meat suggests perfect linear and symmetric price transmission between the two markets; while insignificant association indicates otherwise.

3.6 Bilateral Granger Causality Test on Average Monthly Retailed Price of Meats in the Rural and Urban Markets

In this study, the bilateral Granger Causality tests were conducted on the average monthly retailed price of meats in urban and rural markets. The primary model in Vector Autoregressive Regression (VAR) form for each of the meat commodity is represented as thus:

$$\left\{\begin{array}{l} \Delta\boldsymbol{LnPK_{rt}} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\sum_{i=1}^{n}\Delta\boldsymbol{LnPK_{rt-1}} + \boldsymbol{\beta_2}\sum_{i=1}^{n}\Delta\boldsymbol{LnPK_{ut-1}} + \boldsymbol{\varepsilon_{1t}} \ldots\ldots\ldots\ldots (11) \\ \Delta\boldsymbol{LnPK_{ut}} = \boldsymbol{\delta_0} + \boldsymbol{\delta_1}\sum_{i=1}^{n}\Delta\boldsymbol{LnPK_{ut-1}} + \boldsymbol{\delta_2}\sum_{i=1}^{n}\Delta\boldsymbol{LnPK_{rt-1}} + \boldsymbol{\varepsilon_{2t}} \ldots\ldots\ldots\ldots (12) \end{array}\right\}$$

$$\left\{\begin{array}{l} \boldsymbol{Ln}GT_{rt} = \boldsymbol{\gamma_0} + \boldsymbol{\gamma_1}\sum_{i=1}^{n}\boldsymbol{Ln}GT_{rt-1} + \boldsymbol{\gamma_2}\sum_{i=1}^{n}LnGT_{ut-1} + \boldsymbol{\varepsilon_{3t}} \ldots\ldots\ldots\ldots\ldots\ldots (13) \\ \boldsymbol{Ln}GT_{ut} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\sum_{i=1}^{n}\boldsymbol{Ln}GT_{ut-1} + \boldsymbol{\alpha_2}\sum_{i=1}^{n}LnGT_{rt-1} + \boldsymbol{\varepsilon_{4t}} \ldots\ldots\ldots\ldots\ldots\ldots (14) \end{array}\right\}$$

$$\left\{\begin{array}{l} \boldsymbol{Ln}BF_{rt} = \emptyset_{\boldsymbol{0}} + \emptyset_{\boldsymbol{1}}\sum_{i=1}^{n}\boldsymbol{Ln}BF_{rt-1} + \emptyset_{\boldsymbol{2}}\sum_{i=1}^{n}LnBF_{ut-1} + \boldsymbol{\varepsilon_{5t}} \ldots\ldots\ldots\ldots\ldots\ldots (15) \\ \boldsymbol{Ln}BF_{ut} = \boldsymbol{\omega_0} + \boldsymbol{\omega_1}\sum_{i=1}^{n}\boldsymbol{Ln}BF_{ut-1} + \boldsymbol{\omega_2}\sum_{i=1}^{n}LnBF_{rt-1} + \boldsymbol{\varepsilon_{6t}} \ldots\ldots\ldots\ldots\ldots\ldots (16) \end{array}\right\}$$

$$\left\{\begin{array}{l} \boldsymbol{Ln}EC_{rt} = \boldsymbol{\vartheta_0} + \boldsymbol{\vartheta_1}\sum_{i=1}^{n}\boldsymbol{Ln}EC_{rt-1} + \boldsymbol{\vartheta_2}\sum_{i=1}^{n}LnEC_{ut-1} + \boldsymbol{\varepsilon_{7t}} \ldots\ldots\ldots\ldots\ldots\ldots (17) \\ \boldsymbol{Ln}EC_{ut} = \boldsymbol{\mu_0} + \boldsymbol{\mu_1}\sum_{i=1}^{n}\boldsymbol{Ln}EC_{ut-1} + \boldsymbol{\mu_2}\sum_{i=1}^{n}LnEC_{rt-1} + \boldsymbol{\varepsilon_{8t}} \ldots\ldots\ldots\ldots\ldots\ldots (18) \end{array}\right\}$$

$$\left\{\boldsymbol{Ln}LC_{rt} = \boldsymbol{\pi_0} + \boldsymbol{\pi_1}\sum_{i=1}^{n}\boldsymbol{Ln}LC_{rt-1} + \boldsymbol{\pi_2}\sum_{i=1}^{n}LnLC_{ut-1} + \boldsymbol{\varepsilon_{9t}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(19)\right\}$$

$$\left\{\boldsymbol{Ln}LC_{ut} = \boldsymbol{\rho_0} + \boldsymbol{\rho_1}\sum_{i=1}^{n}\boldsymbol{Ln}LC_{ut-1} + \boldsymbol{\rho_2}\sum_{i=1}^{n}LnLC_{rt-1} + \boldsymbol{\varepsilon_{10t}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(20)\right\}$$

$$\left\{\boldsymbol{Ln}SN_{rt} = \boldsymbol{\sigma_0} + \boldsymbol{\sigma_1}\sum_{i=1}^{n}\boldsymbol{Ln}SN_{rt-1} + \boldsymbol{\sigma_2}\sum_{i=1}^{n}LnSN_{ut-1} + \boldsymbol{\varepsilon_{11t}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(21)\right\}$$

$$\left\{\boldsymbol{Ln}SN_{ut} = \boldsymbol{\varphi_0} + \boldsymbol{\varphi_1}\sum_{i=1}^{n}\boldsymbol{Ln}SN_{ut-1} + \boldsymbol{\varphi_2}\sum_{i=1}^{n}LnSN_{rt-1} + \boldsymbol{\varepsilon_{12t}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(22)\right\}$$

For the Granger causality equations for pork as specified in equation 11 and 12, there is evidenced of unilateral Granger causality from urban price of pork to rural market price of pork, if $\beta_2 \neq 0$ and $\boldsymbol{\delta_2} = 0$. Similarly, there is unidirectional Granger causality from the rural market price to urban market price of pork meat if $\beta_{\boldsymbol{2}} = 0$ and $\boldsymbol{\delta_2} \neq 0$. The Granger causality is considered mutual or bi-directional if $\beta_2 \neq 0$ and $\boldsymbol{\delta_2} \neq 0$. Finally, there is no link between monthly mean price of pork in rural and urban markets if $\beta_2 = 0$ and $\boldsymbol{\delta_2} = 0$. The same interpretation applies for equations 13 to 22 for each of the meat product. A bi-directional Granger causality test indicates the presence of perfect price transmission between prices of rural and urban markets for meat in Akwa Ibom State. The market, which Granger-causes the other is tagged the exogenous market or the lead market. Spatial market price exogeneity can be described as weak or strong. According to Hendry [32] and Juselius [33], the weak exogeneity occurs when the marginal distribution of PK_{rt-1} is independent of the joint distribution of both PK_{rt-1} and PK_{ut-1}. On the other hand, strong exogeneity occurs when there is no statistically significant Granger-causality from the other variable. For instance, if we have two spatial prices, PK_{rt-1} and PK_{ut-1}, the price PK_{rt-1} is weakly exogenous to PK_{ut-1} if PK_{rt-1} is tested to be weakly exogenous and PK_{ut-1} is not weakly exogenous to PK_{rt-1} . This implies that, PK_{rt-1} is causing PK_{ut-1} to change and not vice-versa [34].

3.7 The Cointegration Test for the Market Price of Meat in Rural and Urban Markets

If spatially separated markets are integrated, then there exists an equilibrium or long run relationship among these markets [23, 35, 36]. The study applied the Engle and Granger two-step technique and Johansen co-integration approach to examine the co-integration or long run relationships between rural and urban market price of meats in the presence of seasonal dummy (proxy by festive months) in the study area. We assumed that, if two prices ($PK_{rt}\ and\ PK_{ut}$) are perfectly integrated in the presence of a seasonal dummy, then $\beta_1 = 1\ in\ equation\ (23)$. In this case, price changes in rural market ($\boldsymbol{PK_{rt}}$) are fully reflected in the urban (PK_{ut}) market despite the influence of a seasonal dummy. When $\beta_1 \neq 1\ (i.e.\ \beta_1 < 1\ or\ \beta_1 > 1)$, then the degree of market integration needs to be determined by investigating the variance of β_1 from the benchmark of 1. Following the law of one price in addition to the influence of seasonal dummy, the time dependent rural and urban price equation for pork, goat meat, beef, exotic chicken, local chicken and snail meat in the study area is specified as thus:

$$\left.\begin{matrix}LnPK_{rt} = \beta_0 + \beta_1\sum_{i=1}^{n}LnPK_{ut} + \beta_2\sum_{i=1}^{n}D_t + U_{1t} \ldots\ldots\ldots\ldots(23)\\ LnPK_{ut} = \delta_0 + \delta_1\sum_{i=1}^{n}LnPK_{rt} + \delta_2\sum_{i=1}^{n}D_t + U_{2t} \ldots\ldots\ldots\ldots(24)\end{matrix}\right\} \quad \text{Pork}$$

$$\left.\begin{matrix} LnGT_{rt} = \gamma_0 + \gamma_1 \sum_{i=1}^{n} LnGT_{ut} + \gamma_2 \sum_{i=1}^{n} D_t + U_{3t} \ldots\ldots\ldots\ldots (25) \\ LnGT_{ut} = \alpha_0 + \alpha_1 \sum_{i=1}^{n} LnGT_{rt} + \alpha_2 \sum_{i=1}^{n} D_t + U_{4t} \ldots\ldots\ldots\ldots\ldots (26) \end{matrix}\right\}$$ Goat

$$\text{meat}\left\{\begin{matrix} LnBF_{rt} = \emptyset_0 + \emptyset_1 \sum_{i=1}^{n} LnBF_{ut} + \emptyset_2 \sum_{i=1}^{n} D_t + U_{5t} \ldots\ldots\ldots\ldots (27) \\ LnBF_{ut} = \omega_0 + \omega_1 \sum_{i=1}^{n} LnBF_{rt} + \omega_2 \sum_{i=1}^{n} D_t + U_{6t} \ldots\ldots\ldots\ldots (28) \end{matrix}\right\}$$ Beef

$$\left.\begin{matrix} LnEC_{rt} = \vartheta_0 + \vartheta_1 \sum_{i=1}^{n} LnEC_{ut} + \vartheta_2 \sum_{i=1}^{n} D_t + U_{7t} \ldots\ldots\ldots\ldots (29) \\ LnEC_{ut} = \mu_0 + \mu_1 \sum_{i=1}^{n} LnEC_{rt} + \mu_2 \sum_{i=1}^{n} D_t + U_{8t} \ldots\ldots\ldots\ldots\ldots (30) \end{matrix}\right\}$$ Exotic chicken

$$\left.\begin{matrix} LnLC_{rt} = \pi_0 + \pi_1 \sum_{i=1}^{n} LnLC_{ut} + \pi_2 \sum_{i=1}^{n} D_t + U_{9t} \ldots\ldots\ldots,,\ldots (31) \\ LnLC_{ut} = \rho_0 + \rho_1 \sum_{i=1}^{n} LnLC_{rt} + \rho_2 \sum_{i=1}^{n} D_t + U_{10t} \ldots\ldots\ldots\ldots (32) \end{matrix}\right\}$$ Local chicken

$$\left.\begin{matrix} LnSN_{rt} = \sigma_0 + \sigma_1 \sum_{i=1}^{n} LnSN_{ut} + \sigma_2 \sum_{i=1}^{n} D_t + U_{11t} \ldots\ldots\ldots\ldots (33) \\ LnSN_{ut} = \varphi_0 + \varphi_1 \sum_{i=1}^{n} LnSN_{rt} + \varphi_2 \sum_{i=1}^{n} D_t + U_{12t} \ldots\ldots\ldots\ldots (34) \end{matrix}\right\}$$ Snail meat

Note: "D_t" is a dummy variable representing festive months in the study area. The inclusion of a dummy variable is meant to test the effect of the festive months on the structural rigidity of the meat prices in the long run in both rural and urban markets.

Following the Granger Representation Theorem, we specified the Vector Error Correction Model (VECM) for the co-integrating series in the study. The general VECM that was estimated for the rural and urban price of meats in the study is shown below:

$$\left.\begin{matrix} \Delta LnPK_{rt} = \beta_0 + \beta_1 \sum_{i=1}^{n} \Delta LnPK_{rt-1} + \beta_1 \sum_{i=1}^{n} \Delta LnPK_{ut-i} + \beta_2 \sum_{i=1}^{n} D_t + \beta_2 \sum_{i=1}^{n} ECM_{t-1} + U_{11t} \ldots\ldots (35) \\ \Delta LnPK_{ut} = \delta_0 + \beta_1 \sum_{i=1}^{n} \Delta LnPK_{ut-1} + \beta_1 \sum_{i=1}^{n} \Delta LnPK_{rt-i} + \delta_2 \sum_{i=1}^{n} D_t + \delta_2 \sum_{i=1}^{n} ECM_{t-1} + U_{12t} \ldots\ldots (36) \end{matrix}\right\}$$
Pork

$$\left\{\begin{matrix} \Delta LnGT_{rt} = \gamma_0 + \gamma_1 \sum_{i=1}^{n} \Delta LnGT_{rt-1} + \gamma_1 \sum_{i=1}^{n} \Delta LnGT_{ut-i} + \gamma_2 \sum_{i=1}^{n} D_t + \gamma_2 \sum_{i=1}^{n} ECM_{t-1} + U_{11t} \ldots\ldots\ldots (37) \\ \Delta LnGT_{ut} = \alpha_0 + \alpha_1 \sum_{i=1}^{n} \Delta LnGT_{ut-1} + \alpha_1 \sum_{i=1}^{n} \Delta LnGT_{rt-i} + \alpha_2 \sum_{i=1}^{n} D_t + \alpha_2 \sum_{i=1}^{n} ECM_{t-1} + U_{12t} \ldots\ldots (38) \end{matrix}\right\}$$
Gat meat

$$\left.\begin{matrix} \Delta LnBF_{rt} = \emptyset_0 + \emptyset_1 \sum_{i=1}^{n} \Delta LnBF_{rt-1} + \emptyset_1 \sum_{i=1}^{n} \Delta LnBF_{ut-i} + \emptyset_2 \sum_{i=1}^{n} D_t + \emptyset_2 \sum_{i=1}^{n} ECM_{t-1} + U_{11t} \ldots\ldots (39) \\ \Delta LnBF_{ut} = \omega_0 + \omega_1 \sum_{i=1}^{n} \Delta LnBF_{ut-1} + \omega_1 \sum_{i=1}^{n} \Delta LnBF_{rt-i} + \omega_2 \sum_{i=1}^{n} D_t + \omega_2 \sum_{i=1}^{n} ECM_{t-1} + U_{12t} \ldots\ldots (40) \end{matrix}\right\}$$
Beef

$$\left.\begin{matrix} \Delta LnEC_{rt} = \vartheta_0 + \vartheta_1 \sum_{i=1}^{n} \Delta LnEC_{rt-1} + \vartheta_1 \sum_{i=1}^{n} \Delta LnEC_{ut-i} + \vartheta_2 \sum_{i=1}^{n} D_t + \vartheta_2 \sum_{i=1}^{n} ECM_{t-1} + U_{11t} \ldots\ldots (41) \\ \Delta LnEC_{ut} = \mu_0 + \mu_1 \sum_{i=1}^{n} \Delta LnEC_{ut-1} + \mu_1 \sum_{i=1}^{n} \Delta LnEC_{rt-i} + \mu_2 \sum_{i=1}^{n} D_t + \mu_2 \sum_{i=1}^{n} ECM_{t-1} + U_{12t} \ldots\ldots 42) \end{matrix}\right\}$$
Exotic chicken

$$\left.\begin{matrix} \Delta LnLC_{rt} = \pi_0 + \pi_1 \sum_{i=1}^{n} \Delta LnLC_{rt-1} + \pi_1 \sum_{i=1}^{n} \Delta LnLC_{ut-i} + \pi_2 \sum_{i=1}^{n} D_t + \pi_2 \sum_{i=1}^{n} ECM_{t-1} + U_{11t} \ldots\ldots (43) \\ \Delta LnLC_{ut} = \rho_0 + \rho_1 \sum_{i=1}^{n} \Delta LnLC_{ut-1} + \rho_1 \sum_{i=1}^{n} \Delta LnLC_{rt-i} + \rho_2 \sum_{i=1}^{n} D_t + \rho_2 \sum_{i=1}^{n} ECM_{t-1} + U_{12t} \ldots\ldots (44) \end{matrix}\right\}$$
Local chicken

$$\left.\begin{matrix} \Delta LnSN_{rt} = \sigma_0 + \sigma_1 \sum_{i=1}^{n} \Delta LnSN_{rt-1} + \sigma_1 \sum_{i=1}^{n} \Delta LnSN_{ut-i} + \sigma_2 \sum_{i=1}^{n} D_t + \sigma_2 \sum_{i=1}^{n} ECM_{t-1} + U_{11t} \ldots\ldots (45) \\ \Delta LnSN_{ut} = \varphi_0 + \varphi_1 \sum_{i=1}^{n} \Delta LnSN_{rt-1} + \varphi_1 \sum_{i=1}^{n} \Delta LnSN_{rt-i} + \varphi_2 \sum_{i=1}^{n} D_t + \varphi_2 \sum_{i=1}^{n} ECM_{t-1} + U_{12t} \ldots\ldots (46) \end{matrix}\right\}$$
Snail

The specified variables are as defined previously in equation (9) and the coefficient of the ECM_{t-1} measures the deviations from the long-run equilibrium in period (t_{-1}) in both rural and urban price equation of meats. The VECM for the rural and urban price of pork is represented by equation 35 and 36 respectively. Also equation 37 and 38 represents the

VECM for the rural and urban price of goat meat respectively; likewise for equation 39 and 40 for beef price; equation 41 and 42 for exotic chicken; equation 43 and 44 for local chicken and equation 45 and 46 for snail meat. The specification of equations 35 to 46 was meant to test for the short run market integration and also determined the adjustment coefficient of the rural and urban price to equilibrium level in the long run when there is exogenous shock in the marketing system of meats in Akwa Ibom State.

3.8 Index of Market Connection (IMC)

The index of market connection (IMC) was used to measure the degree of short run price transmission or price relationship between integrated meat markets. Following Oladapo and Momoh [37] technique, the relationship between the price of meat in the rural and urban market for each of the sampled meat is given by the equations below:

$$PK_{rt} = \beta_0 + \beta_1 PK_{rt-1} + \beta_2(PK_{ut} - PK_{ut-1}) + \beta_3 PK_{ut-1} + U_{1t} \dots\dots\dots\dots\dots\dots (47)$$
$$GT_{rt} = \gamma_0 + \gamma_1 GT_{rt-1} + \gamma_2(GT_{ut} - GT_{ut-1}) + \gamma_3 GT_{ut-1} + U_{2t} \dots\dots\dots\dots\dots\dots (48)$$
$$BF_{rt} = \emptyset_0 + \emptyset_1 BF_{rt-1} + \emptyset_2(BF_{ut} - BF_{ut-1}) + \emptyset_3 BF_{ut-1} + U_{3t} \dots\dots\dots\dots\dots\dots (49)$$
$$EC_{rt} = \vartheta_0 + \vartheta_1 EC_{rt-1} + \vartheta_2(EC_{ut} - EC_{ut-1}) + \vartheta_3 EC_{ut-1} + U_{4t} \dots\dots\dots\dots\dots\dots (50)$$
$$LC_{rt} = \pi_0 + \pi_1 LC_{rt-1} + \pi_2(LC_{ut} - LC_{ut-1}) + \pi_3 LC_{ut-1} + U_{5t} \dots\dots\dots\dots\dots\dots (51)$$
$$SN_{3t} = \sigma_0 + \sigma_1 SN_{3t-1} + \sigma_2(SN_{4t} - SN_{4t-1}) + \sigma_3 SN_{4t-1} + U_{6t} \dots\dots\dots\dots\dots\dots (52)$$

Variables are as defined in equation 9. Then IMC = β_1/β_3 for pork; γ_1/γ_3 for goat meat; $\emptyset_1/\emptyset_3$ for beef; ϑ_1/ϑ_3 for exotic chicken; π_1/π_3 for local chicken and σ_1/σ_3 for snail meat. Note, when the estimated IMC < 1, it implies high short run market Integration; IMC > 1 implies low short run market Integration; IMC = ∞ implies no market integration or presence of market segmentation; IMC = 1, implies either high or low short run market integration. Variables are as defined in equations 9.

4. RESULTS AND DISCUSSIONS

4.1 Augmented Dicker Fuller Unit Root Test Result

In time series analysis, stationary of series is examined by the unit root tests. Among most commonly used tests in the literature is Augmented Dicker Fuller (ADF) test developed by Dickey and Fuller [39] and ADF-GLS unit root test developed by Elliott, Rothenberg and Stock in (1996) which is an improvement of the original ADF test. These two tests were used in this study to determine the stationary level of series.

PC-Give 10 and gretl econometric software were used to carry out the tests and the result is presented in Table 1. The result for both ADF and ADF-GLS unit root tests showed that, the price of pork was stationary at level; while the price of local chicken was non- stationary at level but was at the first difference. Also, both test results were consistent for the price of exotic chicken and goat meats; but was inconsistent for snail and beef prices. To avoid mis-specification of subsequent equations and to subject the specified price variables to further empirical tests; we decided to subject all the price variables to long and short run tests irrespective of the stationary status of the variables. This implies that, the time series regression of co-integration and error correction model (ECM) was tested for each meat market in the study area. The mixed stationary of meat price variables in the study area conforms to the report of several researchers on different food stuffs in Nigeria. They

include; Okoh [19], Okoh and Akintola [20], Okoh *and* Egbon [21], Ojiako et al. [29] and Akpan et al. [17].

Table 1. Result of the unit root test for the price variable of meat in Akwa Ibom State

Variables	Augmented Dicker Fuller test with constant			Augmented Dicker Fuller –GLS test with constant		
	Level	1st diff.	OT	Level	1st diff.	OT
$\mathrm{LnPK_{rt}}$	-4.640**	—	1(0)	-4.195**	—	1(0)
$\mathrm{LnPK_{ut}}$	-3.930**	—	1(0)	-3.721**	—	1(0)
$\mathrm{LnGT_{rt}}$	-3.678**	—	1(0)	-2.785**	—	1(0)
$\mathrm{LnGT_{ut}}$	-2.783	-15.90**	1(1)	-2.308	-12.928**	1(1)
$\mathrm{LnBF_{rt}}$	-2.738	-13.55**	1(1)	-2.383	-12.318**	1(1)
$\mathrm{LnBF_{ut}}$	-2.937	-13.71**	1(1)	-2.635**	—	1(0)
$\mathrm{LnEC_{rt}}$	-3.890**	—	1(0)	-3.236**	—	1(0)
$\mathrm{LnEC_{ut}}$	-3.175	-13.13**	1(1)	-2.479	-13.196**	1(1)
$\mathrm{LnLC_{rt}}$	-3.016	-16.57**	1(1)	-2.552	-11.604**	1(1)
$\mathrm{LnLC_{ut}}$	-2.831	-15.69**	1(1)	-2.105	-15.075**	1(1)
$\mathrm{LnSN_{rt}}$	-5.041**	—	1(0)	-4.294**	—	1(0)
$\mathrm{LnSN_{ut}}$	-5.033**	—	1(0)	-2.501	-11.370**	1(1)
1%	-3.49	-3.49				

*Note: OT means order of integration. Critical value (CV) is defined at 1% significant level and asterisks ** represent 1% significance level. Variables are as defined in equation 9*

4.2 Descriptive Analysis of average monthly Price of meats in Akwa Ibom State (from January 2005 to September 2013)

The descriptive statistics of the price variable associated with each sampled meat as used in the analyses is shown in Table 2 and Table 3. The average price of pork in the rural and urban markets of Akwa Ibom State stood at ₦473.92/kg (or $3.04/Kg) and ₦459.18/kg ($2.94/Kg) respectively. Also, the average price of goat meat, beef, exotic chicken, local chicken and snail in the rural market was ₦729.11/kg, ₦670.11, ₦559.73/kg, ₦493.29/kg and ₦193.93/kg respectively. On the other hand, their respective urban price was; ₦719.98; ₦643.53, ₦564.57; ₦519.13 and ₦217.29. There were no significant deviations from the mean price of rural and urban price of meats. The coefficient of variability in meat prices revolved around 30% to 41% in both rural and urban prices; but it was higher in rural price of meat than the urban price.

In addition, it is observed that, the standard deviations and linear growth rate in the rural price of meat was higher than its corresponding urban price for each of the sampled meat. This result revealed that, rural price of meat are more volatile or fluctuate more compared to its respective urban price in the study area.

Table 2. Descriptive statistic of price variables used in the model

Parameters	Pork price		Goat meat price		Beef price	
	Rural Market (₦/Kg)	Urban Market (₦/Kg)	Rural Market (₦/Kg)	Urban Market (₦/Kg)	Rural Market (₦/Kg)	Urban Market (₦/Kg)
Mean	473.92	459.18	729.11	719.98	670.11	643.53
Median	448.22	445.23	666.60	661.88	634.98	602.49
Minimum	221.14	231.34	299.61	390.77	314.58	335.43
Maximum	973.06	830.77	1500.00	1500.00	1243.50	1205.4
Standard deviation	158.20	133.22	280.67	238.36	223.74	203.08
Coefficient of Variation	0.334	0.290	0.385	0.331	0.334	0.316
Skewness	0.882	0.537	0.795	0.578	0.486	0.615
Kurtosis	0.247	-0.454	-0.037	-0.373	-0.736	-0.560
Average Growth rate (%)	4.317	2.984	4.167	2.162	2.351	2.309

Note: Computed by authors (2014), and prices are expressed in nominal terms. 1USDollar = 156 Naira (As of February, 2014).

Table 3. Descriptive Statistic of Price variables used in the model

Parameters	Price of exotic chicken		Price of local chicken meat		Snail price	
	Rural Market (₦/Kg)	Urban Market (₦/Kg)	Rural Market (₦/Kg)	Urban Market (₦/Kg)	Rural Market (₦/Kg)	Urban Market (₦/Kg)
Mean	559.73	564.57	493.29	519.93	193.93	217.29
Median	538.41	541.52	481.82	530.12	182.80	219.20
Minimum	209.17	302.00	212.20	199.90	22.61	66.94
Maximum	1088.0	1154.0	863.60	950.00	615.50	493.75
Standard deviation	189.82	179.68	165.72	165.67	103.15	90.11
Coefficient of Variation	0.339	0.318	0.336	0.319	0.532	0.415
Skewness	0.467	0.728	0.165	0.161	0.020	0.482
Kurtosis	-0.475	0.334	-1.149	-0.911	1.456	-0.319
Average Growth rate (%)	3.713	2.321	2.803	2.341	13.626	8.945

Note: Computed by authors (2014), and prices are expressed in nominal terms. 1USDollar = 156 Naira (As of February, 2014).

4.3 The Linear Trend Analysis of Price of Meats in Rural and Urban Markets of Akwa Ibom State (2005 to 2013)

The logarithm linear trend equation for each of the price variable in rural and urban markets as specified in equation 8 is presented in Table 4 and Table 5. The log-linear regression result estimates for each of the price variables in both markets is followed by the second equation estimates which include seasonal dummy and a conclusion derived from the interaction between the seasonal dummy and the respective price trend. The second estimated equation is specified in equation 9. The result revealed that, price of meats in rural and urban markets have positive significant inelastic association with time in Akwa Ibom State. This implies that, the rate of change in time is greater than the rate of change in

individual meat price in rural and urban markets. This connotes that, meat prices do not change as fast as time changes in Akwa Ibom State. For instance, 100% increase in time variable induces about 22.6% and 20.7% increase in the price of pork in rural and urban market respectively. In a similar manner, about 29.2% and 26.9% increase occur in the price of goat meat for every 100% increase or one month increase in time variable.

Table 4. Linear trend equation estimates for the average monthly price of meats in rural and urban markets (2005 to 2013)

Variables	Pork		Goat Meat		Beef	
	PK_{rt}	PK_{Ut}	GT_{rt}	GT_{Ut}	BF_{rt}	BF_{Ut}
Constant	5.28 (54.27)***	5.33 (61.42)***	5.45 (52.16)***	5.535 (64.92)***	5.508 (57.94)***	5.56 (63.03)***
Log Time	0.23 (8.82)***	0.21 (9.06)***,	0.29 (10.61)***	0.269 (11.99)***	0.256 (10.24)***	0.23 (10.10)***
F- cal.	77.86***	82.10***	112.57***	143.77***	104.88***	102.06***
R-square	0.431	0.444	0.522	0.583	0.505	0.498
Effect of seasonal fluctuation on meat price rigidity						
Constant	5.25 (52.72)***	5.31 (59.55)***	5.42 (50.61)***	5.526 (62.87)***	5.474 (56.44)***	5.54 (61.07)***
Log Time (b_1)	0.23 (8.91)***	0.21 (9.09)***	0.29 (10.68)***	0.270 (11.94)***	0.259 (10.38)	0.24 (10.10)***
Seasonal dummy	0.06 (1.27)	0.040 (0.89)	0.061 (1.13)	0.018 (0.40)	0.074 (1.52)	0.032 (0.70)
F- cal.	39.97***	41.36***	57.07***	71.38***	54.26***	51.03***
R-square	0.439	0.448	0.528	0.583	0.516	0.500
Nature of effect	No effect	No effect	No effect	No effect	No effect	No effect

*Note: Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are as defined in equation 9*

In prices of other meats, 100% increase in time variable (or one month increase) causes the following increase in their respective prices: 25.6% (rural) and 23.4% (urban) for beef; 26.7% (rural) and 24.8% (urban) for exotic chicken, 28.7% (rural) and 28.8% (urban) for local chicken and 33.3% (rural) and 31.1% (urban) for snail meat. This result means that, snail prices change or increase faster in a month than other meat prices in the study area. It is also observed that, changes in time variable induces more change in the rural price of meat than the urban price. In addition, the difference or dispersion in the level of change in prices of meats in rural and urban market revealed that, interaction do occur between the two markets in the study area. The impact of the seasonal dummy on the structural rigidity of the price trend equation was tested and the result is presented in the lower portion of Table 4 and Table 5. The result revealed insignificant relationship between the festive months and the structural rigidity in the trend equation of pork, goat meat, beef and snail meat in both rural and urban markets in the study area. Similar result was found in the rural price of exotic chicken. The finding suggests that, the price trend of these meats over time in their respective markets are not significantly affected by changes in demand and supply or even consumer preference during festive periods in Akwa Ibom State. Though prices of these meats increase over time, the result revealed that, they are not significantly affected by the behaviour of consumers and suppliers during festive periods in the state. On the other hand, the coefficient of the seasonal dummy significantly and positively affected the structural rigidity of the trend equation in urban price of exotic chicken and rural as well as urban price of local chicken.

For instance, a unit increase in the seasonal dummy induces marginal increase of about 0.094% in the urban price of exotic chicken. Similarly, about 0.097% and 0.092% increase will occur in the price of local chicken in rural and urban markets respectively for a unit increase in the seasonal variable. The result indicates that, the behaviour of the markets during festive periods significantly affected the price trend structure in local chicken in rural and urban markets as well as the exotic chicken in urban market.

To further substantiate the result of meat price trend analyses; graphical representation of the linear trend in price of meats in the rural and urban markets of Akwa Ibom State is showed in figure 1. The price trends for all sampled meats in both rural and urban markets show undulated fluctuations throughout the study period. The rural and urban prices seem to move together in most part of the years except for few noticeably dispersions in some years. The graphical trend implies that, the rural and urban price of meat almost moves perfectly together in the period of investigation. This assertion is due to the minimal deviations between the rural and urban price of meat in the trend diagrams. Following this nature of fluctuations in the price of meat in both markets; it is suggested that, there is a strong evidence of symmetric price transmission and market integration between the rural and urban price of sampled meats. The result on the trend analysis is consistent to the research report by Amusa, [25] and Akpan et al.,[17] in southern Nigeria. The later report asserted that, agricultural commodity prices exhibited undulated trend and have positive relationship with time.

4.4 Pearson correlation matrix of Monthly Price of Meats (expressed in ₦/Kg) in Rural and Urban Markets

The linear and symmetric relationship between the average monthly price of meats (in ₦/Kg) in rural and urban market was established by the Pearson correlation coefficient. Table 6 presents the correlation matrix of rural and urban price of meats (pork, goat meat, beef, exotic chicken, local chicken and snail meat) from January 2005 to September 2013. The result indicates that, prices of meats in the rural market have positive significant (at 1% probability level) linear associations with their corresponding prices in the urban markets. This means that, the price of meats in rural market has a strong linear association with its own price in urban market. For instance, about 81.3% of positive linear correlation exists between the rural and urban price of pork in the study area. Also, about 90.9%, 93.9%, 91.9%, 94.6% and 76.6% of positive linear relationships exist between the rural and urban prices of goat meat, beef, exotic chicken, local chicken, and snail meat respectively in the study area. These results further provided a strong support for the existence of a good price transmission mechanism and possible market integration between the rural and urban markets of meats (pork, goat meat, beef, exotic chicken, local chicken, and snail meat) in the study area. The high level of linear correlation and almost perfect trend co-movement between the rural and urban price of meats suggest that, factors that influence price of meat in the rural markets are most likely similar to those in urban markets. Though this result does not reveal the direction of market flow, and the contribution of each market to the linear relationship, but it did gives an idea on the competitive nature of meat markets in the region.

Table 5. Linear Trend equation estimates for the Average monthly Prices of Meat in Rural and Urban Markets (2005 to 2013)

Variables	Price of Exotic Chicken		Price of Local Chicken		Snail Price	
	EC_{rt}	EC_{Ut}	LC_{rt}	LC_{ut}	SN_{rt}	SN_{Ut}
Constant	5.28(54.33)***	5.37(63.12)***	5.08(54.12)***	5.14(61.64)***	3.89 (20.76)***	4.15 (30.98)***
Time	0.27(10.44)***	0.25(11.08)***	0.29(11.62)***	0.29 (13.11)***	0.33 (6.75)***	0.31 (8.808)***
F- cal.	109.04***	122.68***	135.08***	171.93	45.52	77.57
R-square	0.514	0.544	0.567	0.625	0.306	0.429
Effect of seasonal fluctuation on meat price rigidity						
Constant	5.25 (52.83)***	5.33 (62.06)***	5.04(53.04)***	5.09(60.61)***	3.87(20.02)***	4.14(29.97)***
Time (b_1)	0.27 (10.55)***	0.25 (11.33)***	0.290(11.90)***	0.291(13.46)***	0.335(6.76)***	0.311(8.77)***
Seasonal dummy	0.069 (1.375)	0.094 (2.161)**	0.097(2.03)**	0.092(2.174)**	0.063(0.649)	0.023 (0.34)
F- cal.	55.93***	65.86***	71.649***	91.438***	22.84***	38.509***
R-square	0.523	0.564	0.584	0.642	0.309	0.430
Nature of effect	No effect	Positive effect	Positive effect	Positive effect	No effect	No effect

*Note: Values in bracket represent t-values. The asterisks ** and *** represent 5% and 1% significance levels respectively. Variables are as defined in equation 9*

Figure 1: Linear Trend in Prices of Meats in Rural and Urban Markets in Akwa Ibom State (2005 - 2013)

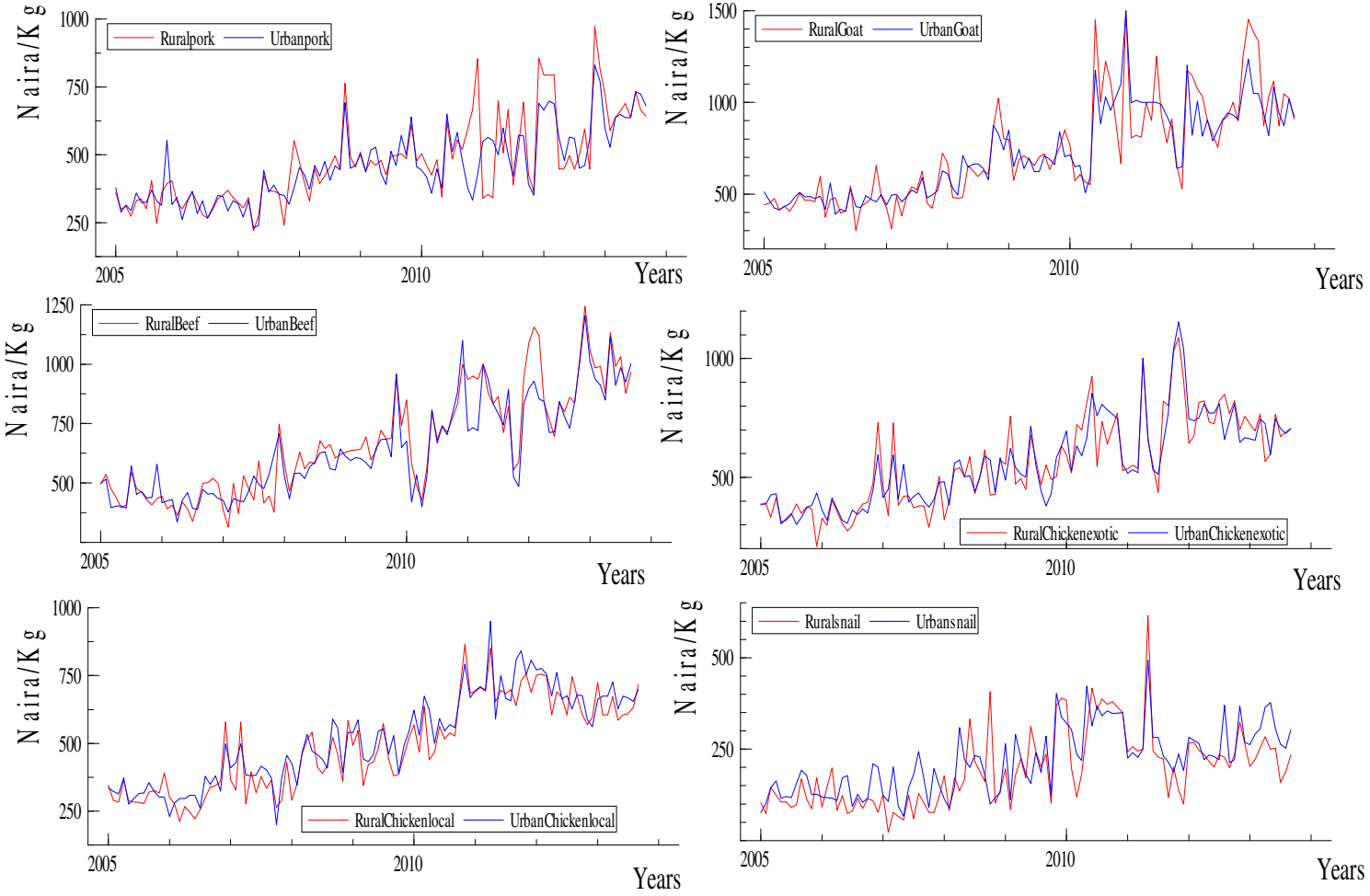


Table 6. Pearson correlation matrix for prices of Meats in Rural and Urban Markets (2005 - 2013)

Variables	PK_{rt}	PK_{Ut}	GT_{rt}	GT_{Ut}	BF_{rt}	BF_{Ut}	EC_{rt}	EC_{Ut}	LC_{rt}	LC_{Ut}	SN_{rt}	SN_{Ut}
PK_{rt}	**1.000**	***0.813***	0.834	0.788	0.817	0.827	0.544	0.577	0.641	0.670	0.526	0.559
PK_{Ut}		**1.000**	0.764	0.740	0.824	0.791	0.527	0.538	0.588	0.623	0.543	0.546
GT_{rt}			**1.000**	***0.90***9	0.855	0.865	0.571	0.607	0.684	0.685	0.614	0.626
GT_{Ut}				**1.000**	0.873	0.889	0.617	0.642	0.780	0.766	0.657	0.678
BF_{rt}					**1.000**	***0.939***	0.610	0.624	0.784	0.773	0.596	0.654
BF_{Ut}						**1.000**	0.585	0.597	0.739	0.726	0.594	0.672
EC_{rt}							**1.000**	***0.919***	0.826	0.845	0.439	0.540
EC_{Ut}								**1.000**	0.819	0.854	0.500	0.538
LC_{rt}									**1.000**	***0.946***	0.527	0.618
LC_{Ut}										**1.000**	0.514	0.595
SN_{rt}											**1.000**	***0.766***
SN_{Ut}												**1.000**

Note: variables are as expressed in equation 9. All correlation coefficients are significant at the 0.01 level (2-tailed).

This result is in consonance with Akpan et al. [17] report in Southern Nigeria. The research report supported significant linear symmetrical relationships among prices of agricultural commodities in the rural and urban markets in the Southern region of the country.

4.5 Bilateral Granger Causality Test for price of Meats in rural and urban markets (2005 - 2013)

The bilateral Granger causality relationships between rural and urban price of pork, goat meat, beef, exotic chicken, local chicken, and snail meat were tested in Akwa Ibom State. The result of the analysis is presented in Table 8. The result in Table 7 shows the optimal lag period used in the causality equation specified in equations 11 to 22. The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

Table 7. The optimal lag length for the causality equation

Lag	Loglikelihood	P(LR)	AIC	BIC	HQC
1	-3413.99	-	69.029*	70.894*	69.784*
2	-3393.01	0.228	69.327	72.123	70.459
3	-3358.49	0.001	69.356	73.085	70.866

The corresponding lag length indicated by asterisk shows the best lag length for generating a more parsimonious and meaningful causality equation for the specify series. The result of the exercise indicated that lag 1 was more appropriate for the Granger causality equations. This implies that the causality equations generated were done by using one period lagged of the variables involved. The estimated Granger causality results are presented in Table 8 below:

Table 8. The vector autoregressive regression Granger causality estimates for meat prices

Hypotheses	Lag	Sample size	F-Statistic	Prob.	Decision
$LnPK_{rt}$ does not Granger Cause $LnPK_{ut}$	1	104	58.397	0.000	Rejected
$LnPK_{ut}$ does not Granger Cause $LnPK_{rt}$	1	104	43.015	0.000	Rejected
$\Delta LnGT_{rt}$ does not Granger Cause $\Delta LnGT_{ut}$	1	103	11.702	0.000	Rejected
$\Delta LnGT_{ut}$ does not Granger Cause $\Delta LnGT_{rt}$	1	103	10.741	0.000	Rejected
$\Delta LnBF_{rt}$ does not Granger Cause $\Delta LnBF_{ut}$	1	103	5.063	0.000	Rejected
$\Delta LnBF_{ut}$ does not Granger Cause $\Delta LnBF_{rt}$	1	103	5.603	0.000	Rejected
$\Delta LnEC_{rt}$ does not Granger Cause $\Delta LnEC_{ut}$	1	103	3.668	0.029	Rejected
$\Delta LnEC_{ut}$ does not Granger Cause $\Delta LnEC_{rt}$	1	103	9.777	0.000	Rejected
$\Delta LnLC_{rt}$ does not Granger Cause $\Delta LnLC_{ut}$	1	103	10.976	0.000	Rejected
$\Delta LnLC_{ut}$ does not Granger Cause $\Delta LnLC_{rt}$	1	103	13.514	0.000	Rejected
$LnSN_{rt}$ does not Granger Cause $LnSN_{ut}$	1	104	36.542	0.000	Rejected
$LnSN_{ut}$ does not Granger Cause $LnSN_{rt}$	1	104	35.625	0.000	Rejected

Note: Variables are as defined in equation 9. F- Statistics were defined at 5% and 1% of significant levels. The analysis was done at the level of pork and snail meat price series because they were stationary at level

The result presented in Table 8 suggests that, there is evidence of bi-directional Granger causality between urban and rural price of pork, goat meat, beef, exotic chicken, local

chicken and snail from January 2005 to September 2013. The result implies that, the rural prices of sampled meats are strongly endogenous to their corresponding urban prices. The result means that, the Granger causality runs from the price of urban market to rural market and vice versa. Alternatively, the result implies that, urban price of meats influence on their respective rural prices; and in the same manner the rural price of meats influences their respective urban prices. In the similar way, the previous market price of meats in urban market significantly predicted the current price in the rural market. The reverse relationship also holds. The presence of the bi-directional Granger Causality between the rural and urban prices of meat connotes the existence of perfect price transmission mechanism or market integration in the two markets in Akwa Ibom State. The result indicates that, the flow of markets information between the rural and urban markets for meats section in the study area could be described as symmetric because the effect of transfer costs are minimal and insignificant. The result further suggests that, the rural and urban prices of meats might be tight together in the long run. Based on the magnitude of the diagnostic statistics, it appears that, the urban market is the lead or the driving market for beef, exotic chicken and local chicken; while the rural market is the lead market for pork, goat meat and snail meat. This result however attests to the prevalence of perfect competitive market structure and strong endogeneity in the rural and urban prices of meats in Akwa Ibom State. This result corroborates reports of Okoh *and* Egbon [21] and Adeoye et al*.,* [27] in western Nigeria. Akpan et al*.,* [17] obtained similar result for local and foreign rice commodities in Southern Nigeria.

4.6 Regression Estimates for the Co-integration Model and the Law of one Price (LOP) for Price of Meats in Rural and Urban Markets

The long run relationships among the rural and urban prices of pork, goat meat, beef, exotic chicken, local chicken and snail meats as well as the seasonal dummy were tested in the study area. The result of the estimation based on the ordinary least squares technique is presented in the upper part of Table 9 and Table 10. Results in Table 9 contain the rural price equations of the sampled meats in the study area. The estimates of the rural price equation for pork, goat meat, beef, exotic chicken, local chicken and snail meats revealed the R-square values of; 0.673, 0.848, 0.873, 0.821, 0.878 and 0.548 respectively. The result shows that more than 50% of variability in the rural price of sampled meats is attributed to the urban price and seasonal dummy variable. The F-statistics for the rural price equation for all meats were significant at 1% probability level respectively; thus confirming the significant of the estimated R-squares and the fitness of each rural meat price equation. The empirical result shows that, the rural price of meat has a positive significant (inelastic) relationship with its respective urban price. In the rural price equation, the urban price coefficients were approximately unity in goat meat, beef, exotic chicken and local chicken. Also, the result indicates that, the seasonal dummy in each meat equation did not significantly affect the rural price and thus its structural rigidity. These results however support the null hypothesis of strong market integration in the long run between the rural and urban price of meats and the insignificant contribution of the seasonal dummy to such relationship in Akwa Ibom State.

Table 9. Long run Relationships between Rural and Urban price of Meat (2005 – 2013)

Variable	PK_{rt}	GT_{rt}	BF_{rt}	EC_{rt}	LC_{rt}	SN_{rt}
Constant	0.577(1.507)	-0.369(-1.279)	-0.590(-0.242)	-0.049(-0.169)	0.055(0.246)	0.134(0.298)
Estimate 1	0.907(14.45)***	1.054(23.85)***	1.012(26.40)***	1.010(21.59)***	0.981(26.97)***	0.94(11.11)***
Dummy	0.022(0.59)	0.041(1.340)	0.039(1.570)	-0.027(-0.89)	0.006(0.235)	0.036(0.459)
R^2	0.673	0.848	0.873	0.821	0.878	0.548
F-cal	104.81***	284.68***	349.95***	233.67***	366.65***	61.80***
ADF test for errors from above equations						
ECM	-8.835***	-9.057***	-8.873***	-9.153***	-10.046***	-8.256***

Note: *the equation for the ADF test include constant and trend. Critical value at 1% = -4.05, Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are as defined in equation 9*

Table 10. Long run Relationships between urban and rural price of Meat (2005 – 2013)

Variable	PK_{ut}	GT_{ut}	BF_{ut}	EC_{ut}	LC_{ut}	SN_{ut}
Constant	1.569(5.015)***	1.291(5.860)***	0.871(4.135)***	1.166(4.92)***	0.710(3.494)***	2.317(8.57)***
Estimate 1	0.740(14.45)***	0.805(23.85)***	0.862(26.40)***	0.815(21.59)***	0.894(26.97)***	0.582(11.11)***
Dummy	-0.012(-0.35)	-0.035(-1.320)	-0.033(-1.45)	0.034(1.21)	0.001(0.06)	-0.028(-0.45)
R^2	0.672	0.848	0.872	0.822	0.878	0.548
t-cal	104.45***	284.51	348.51***	235.57***	366.44***	61.79***
ADF test for errors from above equations						
ECM	-8.522***	-8.822***		-8.657***	-10.137***	-8.949***

*Note: the equation for the ADF test include constant and trend. Critical value at 1% = -4.05, Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are as defined in equation 9*

The result for the urban price equation for pork, goat meat, beef, exotic chicken, local chicken and snail meat is shown in Table 10. The diagnostic statistics support the fitness and reliability of regression estimates. The result shows that, the coefficient of the rural price of meats positively and significantly affected the variability of their respective urban price. The seasonal dummy did not have significant effect on the structural rigidity of urban price of meats. However, considering the flow of market information from urban market to rural markets, the degree of meat price integration in the long run is stronger when compared to the reverse flow of the same market information. This result shows strong support for the law of one price when market transmission flows from urban to rural markets. This also indicates that, the meat price transmission between the rural and urban market exhibited significant but not perfect symmetric relationships especially in snail meat.

In other words, if the rural market is the central or lead market and the urban market the spatial market, then the meat price transmission and the long run market integration will be weaker compared to when the urban market is the lead market. The result further suggests that, the urban price of meat impact on it respective rural price is more effective relative to the impact of rural on urban price of meats. The result provided additional evidence which shows that, the price of meat in the urban market plays a major role compared to price of meat in rural markets in the meat marketing chain prevalence in Akwa Ibom State. These results also revealed the prevalence of the competitive market structure for meats in the study area. This result is in line with results from several researches conducted in different part of the country on different agricultural commodities. For instance, the result supported the findings of Okoh and Egbon [21]; Ohen et al. [26]; Ojiako et al. [29] and Akpan et al. [17].

4.7 The Engle Granger two step technique and Johansen co-integration test for meat price variables

The result of the Engle and Granger two-step technique of co-integration regression test for the residuals (ECM) generated in the long run equations specified in equation 23 to 34 is presented in the lower portion of Table 9 and Table 10 for each of the respective price equation. The results showed that at 1% probability level of significance, the Augmented Dicker-Fuller test (ADF) for the residuals at level of each meat price equation is greater than the critical value at 1% probability value (-4.05). Thus the Engle–Granger co-integration test rejects the null hypothesis of no co-integration in the sampled meat price equation for both rural and urban markets. Hence, there exist long run equilibria relationships between the rural and urban price of meats in the study area.

Following the above results, the evidence of the long-run equilibria among pairs of meat prices was strong, hence there was need to verify the result by conducting Johansen cointegration test. Table 11 presents results of the Johansen test meant to examine the long-run relationships between rural and urban price of meats. The null hypothesis of no cointegration between rural and urban price of meat was rejected for all sampled meat at conventional levels for both Trace and Max-Eingen statistics.

Table 11. Results of Johansen Cointegration test

Markets	Hypotheses	Trace Statistics	Hypotheses	Max.-Eigen Statistics
$PK_{rt} \rightarrow PK_{ut}$	r = 0 r ≤ 1	38.295** 1.549	r = 0 r = 1	38.747** 1.549
$GT_{rt} \rightarrow GT_{ut}$	r = 0 r ≤ 1	26.489** 1.881	r = 0 r = 1	24.606** 1.881
$BFrt \rightarrow BF_{ut}$	r = 0 r ≤ 1	24.656** 1.237	r = 0 r = 1	23.229** 1.237
$EC_{rt} \rightarrow EC_{ut}$	r = 0 r ≤ 1	32.223** 2.153	r = 0 r = 1	30.070** 2.153
$EC_{rt} \rightarrow EC_{ut}$	r = 0 r ≤ 1	28.882** 1.479	r = 0 r = 1	27.403** 1.479
$SN_{rt} \rightarrow SN_{ut}$	r = 0 r ≤ 1	18.301** 2.568	r = 0 r = 1	15.734** 2.568

*Source: Computed by authors. Trend assumption: linear deterministic trend. "r" indicates the number of co-integrating equation. Asterisk ** represents rejection of the null hypothesis at 5% significance level. P-values derived from Mackinnon-Haug-Michelis, (1999) methodology. Critical values for the trace test are 15.495 and 3.842 respectively; while critical values for the Maximum Eingenvalue test are 14.265 and 3.841 respectively*

There was no conflict between the Trace and Max-Eingen statistics, so the Johansen approach further confirms at least one cointegration equation between the rural and urban price of the respective meat.

4.8 Error Correction Model (ECM) for price of Meats in Rural and Urban markets (2005 – 2013)

The presence of co-integration among the specified variables demanded the specification of the Error Correction Model. Table 12 contains estimates of ECM generated for the rural price equations for pork, goat meat, beef, exotic chicken, local chicken and snail meat. The diagnostic tests for the ECM of rural price equation revealed the R^2 value of 0.56 for pork, 0.68 for goat meat, 0.66 for beef, 0.66 for exotic chicken, 0.66 for local chicken and 0.52 for snail meat. This means that, the urban price, previous rural price of meats and seasonal dummy explained about 56%, 68%, 66%, 66%, 66% and 52% of total variations in the short run in the respective rural price of meat in the study area. The F-statistic for each rural price equation is significant at 1% probability level, indicating that the R^2 of the respective rural price of sampled meats are significant and this implies that, the ECM of rural price of meat has goodness of fit. The auto-correlation was not a serious problem in the estimated equations. The coefficient of the error correction terms in each price equation is negative and statistically significant at 1% probability level respectively. The result validates the existence of the long-run equilibria relationships between the rural and urban market prices of sampled meats. The result further implies that, the rural prices of meats are sensitive to departure from their equilibrium levels in the previous periods. The slope coefficients of the error correction term in each of the rural price equation (i.e. -0.801 for pork; -0.758 for goat meat; -0.724 for beef; -0.874 for exotic chicken; -0.866 for local chicken and -0.609 for snail meat) represents the speed of adjustment and also is consistent with the hypothesis of convergence towards the long-run equilibrium once the respective meat price equation is disturbed.

The value of adjustment coefficient implies that, about 80.1% and 75.8% of the rural price adjustments in pork and goat meat take place respectively within every month due to exogenous shock. Similarly, 72.4%, 87.4%, 86.6% and 60.9% of adjustment also occur in beef, exotic chicken, local chicken and snail meat respectively every month. By comparison, it will take about 5 weeks for the rural price of pork to fully adjust to equilibrium position in the long run due to shock in the marketing system in the study area. Similarly, it will take about 5 weeks 2 day, 5 weeks 3 days, 4 weeks 4 days, 4 weeks 4 days, and 6 weeks 4 days for

the rural price of goat meat, beef, exotic chicken, local chicken and snail meat respectively to adjust fully in the long run following disturbance in the marketing system in the state. Based on the speed of adjustment, it appears that the rural price of meats in the study is strongly endogenous to its respective urban price.

In the same way, Table 13 contains estimates of ECM generated for the urban price of sampled meats. The diagnostic statistics revealed significant R^2 values; F-statistics and insignificant incidence of auto correlation in each price equation. The slope coefficient of the error correction term in each urban price equation is negative and statistically significant at 1% probability level. The coefficient of the error correction terms shows the speed of convergence to the long run equilibrium as a result of shock in the urban price equations. The significant value of the error correction term implies that, the urban price of meat will always react to bring stability in the rural price whenever there is significant variation in the rural price and vice versa. The result revealed the following adjustment coefficients for the urban price of meat; 62.8% for pork; 43.7% for goat meat; 84.3% for beef; 71.4% for exotic chicken; 75.6% for local chicken and 69.6% for snail. That is, it will take approximately takes 6 weeks 3days and 9 weeks 1day for urban price of pork and goat meat respectively to fully adjust to equilibrium position in the long run due to shock in the system. In a similar way, it will take; 4 weeks 5days; 5 weeks 4 days; 5 weeks 2 days and 5 weeks 5 days for urban price of beef, exotic chicken, local chicken and snail to fully adjust in the long run following marketing shock in the system. Comparing the speed of adjustment in price of meats in the rural and urban markets, the result revealed that, the urban price of beef and snail adjusts faster than their rural counterpart. On the other hand, the rural price of pork, goat meat, exotic chicken and local chicken adjusted faster than its corresponding urban price. Based on the two - way adjustment coefficients of the price equation of meats; it is suggested that, the meats prices has a strong endogeneity property. By implication, movements in the urban price of meats is significantly detected by it respective rural price and vice versa. Following this result, it appears that, in the short run, the urban price of meat plays a leading role compared to its corresponding rural price in the price transmission and integration of meat markets in the state. Shock in the urban price of meats is spontaneously transmitted to its rural price counterpart and the adjustment speed of the rural price equation due to shock from urban price is relatively faster than the urban price equation. On the other hand, the adjustment speed in the urban price equation due to variation in the rural price of meats is relatively slower than the rural price equation. This result means that, in the short run, the urban price of meat impact on its respective rural price is more effective and efficient than the reverse case in majority of meat sampled. This result corroborates with the previous result discussed earlier on the long run relationships of sampled meats. By implication, any shock or government intervention that is targeted on the urban price of meat in the short run will easily be transmitted to the rural price compared to the reverse side of such shock. The result is in consonance with the research report of Okoh *and* Egbon [21] and Akpan et al. [17] on crop commodities.

Table 12. ECM estimates for the rural Price of Meat in Akwa Ibom State, Southern Nigeria

Variable	PK_{rt}	GT_{rt}	BF_{rt}	EC_{rt}	LC_{rt}	SN_{rt}
Constant	-0.001(-0.032)	-0.012(-0.651)	-0.007(-0.549)	0.006(0.332)	0.002(-0.162)	-0.018(-0.429)
Self lag	-0.015(-0.148)	-0.105(-1.057)	-0.040(-0.418)	-0.006(-0.055)	-0.093(-0.911)	-0.189(-1.946)*
Urban price(level)	0.734(7.972)***	1.018(10.93)***	0.747(11.77)***	0.953(11.11)	0.785(10.27)	0.601(5.853)***
Urban price (lag 1)	-0.078(-0.659)	0.306(2.258)**	-0.019(-0.186)	-0.00(-0.044)	-0.039(-0.357)	-0.040(-0.328)
Dummy	0.011(0.277)	0.036(1.41)	0.029(1.228)	-0.019(-0.574)	0.014(0.533)	0.069(0.902)
ECM_{t-1}	-0.801(-6.005)***	-0.758(-5.624)***	-0.724(-6.129)***	-0.874(-6.248)***	-0.866(-6.123)***	-0.609(-5.074)***
R^2	0.556	0.679	0.655	0.655	0.663	0.524
F-cal	24.264***	41.215***	36.807***	36.816***	38.088***	21.314***
DW	2.015	2.035	1.998	1.964	2.034	2.012

*Note: Values in bracket represent t-values. Asterisk * and *** represent 10% and 1% significance level respectively. Variables are as defined in equation 9 and arranged as presented in equations 35 to 46*

Table 13. ECM estimates for the urban price of meats in Akwa Ibom State, Southern Nigeria

Variable	PK_{ut}	GT_{ut}	BF_{ut}	EC_{ut}	LC_{ut}	SN_{ut}
Constant	0.003(0.152)	0.016(1.198)	0.009(0.694)	-0.007(-0.524)	-0.003(-0.201)	0.007(0.221)
Self lag	-0.067(-0.658)	-0.326(-3.391)***	0.039(0.387)	-0.014(-0.146)	-0.113(-1.123)	-0.027(-0.268)
Rural price (level)	0.492(7.918)***	0.520(10.90)***	0.769(12.05)***	0.545(10.50)***	0.641(10.28)***	0.399(6.098)***
Rural price (lag 1)	0.001(0.017)	0.051(0.727)	-0.057(-0.611)	-0.063(-0.788)	0.032(0.355)	-0.031(-0.411)
Dummy	0.003(0.103)	-0.035(-1.50)	-0.025(-1.073)	0.033(1.309)	0.019(0.783)	0.006(0.107)
ECM_{t-1}	-0.628(-5.181)***	-0.437(-3.912)***	-0.843(-6.471)***	-0.714(-6.181)***	-0.756(-5.636)***	-0.696(-5.765)***
R2	0.514	0.642	0.661	0.617	0.641	0.474
F-cal	20.552***	34.761***	37.879***	31.231***	34.684***	17.476***
DW	1.993	2.162	2.022	1.928	2.000	2.022

*Note: Values in bracket represent t-values. The asterisk *** represent 1% significance level. Variables are as defined in equation 9 and arranged as presented in equation 35 to 46*

4.9 Discussion of the Long Run and Short Run Model Results

The empirical results revealed that, the long run rural price cointegration coefficient for goat meat, beef, exotic chicken and local chicken converge to the postulate of the law of one price. This means that, the respective long run market integration coefficient for each of the meat commodity is approximately unity (i.e. 1.03 for goat meat, 1.01 for beef, 1.01 for exotic chicken and 0.98 for local chicken). This confirms the existence of high degree of long run market integration between the rural and urban prices of the respective meats in Akwa Ibom State. This implies that, a shock on the urban price of these meats is instantaneously transmitted to its corresponding rural price. This is so when considering the flow of market information from urban to rural market. Also, the degree of market integration in pork (0.907) and snail (0.941) was far from the bench mark of unity. Although these also confers high degree of market integration, but is not perfect as compare to the rest of the rural price of meats. The dummy variable or seasonal variable was not a significant determinant of the rural – urban price relationship of meats in the study area. The result suggested that, despite probable panic buying and variation in quantity of meat supplied during the festive periods in the state, the effect did not significantly alter the long run rural-urban meat price relationships of sampled meats. This means that, the supply-demand shock in the meat section will likely be transmitted simultaneously to the rural and urban markets in the study area.

On the other hand, the long run model for the urban price of meats showed various degrees of divergence of the long run cointegration coefficient from unity (i.e. 0.74 for pork, 0.805 for goat meat, 0.862 for beef, 0.815 for exotic chicken and 0.894 for local chicken); the magnitude of the coefficient was really far from unity in snail meat (0.582). The result however confirms the presence of significant long run market integration between the urban and rural price of meat; but it failed to uphold instantaneous response of the urban price to rural price shock. This is valid when considering the flow of market information from rural to urban market. This result indicates that, there are mounted externality costs in the marketing of meats when market activities flow from rural to urban areas. It is suggested that, there are some levels of inefficiency in market information transmission (for pork, goat meat, beef, exotic chicken, local chicken and snail meat) in the long run between the urban and rural markets in the state. This result could be connected to the poor or inefficient marketing and social infrastructures in the rural areas of the state. In addition, the seasonal variable was not significant in determining the structural rigidity of urban – rural meat price relationship in the study area. This means that, the effect of supply-demand shock during festive periods does not have significant long run impact on the meat price transmission between the urban and rural markets. Based on the result obtained from the rural and urban price of meat, it implies that, in the long run, the price of meat in urban and rural markets will synchronize despite supply-demand shock during festive months in the state. But the extent or degree at which the rural and urban prices synchronize is much higher when market activities or information flow from urban to rural markets compared to the reverse case. Similar results on the long run relationships among agricultural commodities have been established by Okoh and Egbon [21]; Ohen et al. [26] Ojiako et al. [29] and Akpan et al. [17].

For the short run model; the behavior of the rural price equation for the sampled meats showed significant contribution of the urban price of meat to the total variations in the rural price of meats. The coefficient of urban price of meats in the rural price equation was significant for all sample meats. These coefficients were approximately unity in goat meat (1.018) and exotic chicken (0.953); while significant deviations was noticeable in pork (0.734), beef (0.747), local chicken (0.785) and snail meat (0.601). This result connotes the existence of various degrees of short run market integration in the sampled meats. The short

run coefficient of seasonal variable or dummy did not have significant impact on the structural rigidity of rural – urban meat price relationship in the study area. This also means that, the aggregate effect of supply-demand shocks during festive periods do not have significant short run impact on the meat price transmission between the rural and urban market. Similarly, the short run urban price equations showed significant coefficient of rural price variables. However, the short run market cointegration coefficients in the urban price equation showed significant deviations from unity (i.e. 0.492 for pork, 0.520 for goat meat, 0.769 for beef, 0.545 for exotic chicken, 0.641 for local chicken and 0.377 for snail meat). This result implies that, though there is significant short run market integration between the urban and rural prices of sampled meats irrespective of the direction of flow of market activities; but the degrees of short run cointegration varies among meat prices. The short run integration in sampled meats appears to be stronger when information or price movement flows from urban to rural markets than the reverse case. The short run model of urban price of meats also confirmed the insignificant influence of the seasonal dummy on the urban meat price variation in the study area. This result further reaffirms the leading role of urban price relative to rural price of meats in meat marketing in Akwa Ibom State. The short run results are consistent with the opinion of Okoh and Egbon [21]; Ohen et al. [26] and Akpan et al. [17].

4.10 Index of Market Connection (IMC) for Meats' Markets

The IMC was estimated for pork, goat meat, beef, exotic chicken, local chicken and snail meat in the study area. Results contain in Table 14 are regression estimates from which the IMC was calculated for each sampled meat. The calculated value of IMC for pork is 0.227; it is 0.235 for goat meat; about 0.590 for beef; 0.201 for exotic chicken; 0.022 for local chicken and 0.257 for snail meat.

The calculated IMC for each of the meat is less than unity. The result implies that, there is high short run market integration between rural and urban markets for the sampled meats in Akwa Ibom State. The short run market integration was stronger in the local chicken, exotic chicken, pork and goat meat compared to snail meat and beef. This however confirms the ECM results discussed previously and further substantiates the presence of good price transmission mechanism in the short run between rural and urban price of meats in Akwa Ibom State. High degree of short run market integration has been reported for several agricultural commodities in Nigeria in the research work of Adeoye et al. [27]; Akintunde et al. [30] and Akpan et al. [17].

Table 14. Estimates of IMC regression for meats in Akwa Ibom State, Southern Nigeria

Variable	PK_{rt}	GT_{rt}	BF_{rt}	EC_{rt}	LC_{rt}	SN_{rt}
Constant	16.723(0.473)	-44.345(-1.15)	-19.337(-0.836)	20.683(0.799)	-5.356(-0.289)	-12.576(-0.672)
Estimate 1	0.184(1.85)*	0.204(2.08)**	0.392(4.49)***	0.160(1.60)	0.021(0.208)	0.199(2.04)**
Estimate 2	0.866(8.79)***	0.999(12.10)***	0.791(13.90)***	1.012(14.30)***	0.860(13.1)***	0.715(7.79)***
Estimate 3	0.808(8.79)***	0.869(7.51)***	0.664(6.72)***	0.795(7.29)***	0.939(8.91)***	0.773(6.26)***
R^2	0.670	0.833	0.914	0.847	0.894	0.618
F-cal	67.13***	165.00***	349.40***	182.80***	279.7***	53.30***
DW	2.01	2.01	1.99	1.96	2.01	2.06
IMC	0.227	0.235	0.590	0.201	0.022	0.257

*Note: Values in bracket represent t-values. The asterisks * and *** represent 10% and 1% significance levels respectively. Variables are as defined in equation 9.*

5. SUMMARY OF FINDINGS

The study used statistical and econometric techniques to analyze the price transmission and market integration between the rural and urban prices of pork, goat meat, beef, exotic chicken, local chicken and snail meat in Akwa Ibom State, Southern Nigeria. The study also investigated the impact of seasonal festive months on the structural rigidity of both rural and urban meat price equation. Results of the linear trend analysis revealed that, prices of meats in rural and urban markets have positive inelastic relationships with time. The graphical analysis substantiated the upward trend in meat prices earlier identified and further revealed minimal deviations of rural price of meats from urban price in the period on consideration. The result of the trend analysis suggested the prevalence of efficient meat price transmission between the rural and urban market in Akwa Ibom State. Also, the estimated Pearson correlation coefficient matrix revealed that, the rural price of pork, goat meat, beef, exotic chicken, local chicken and snail meat have significant linear symmetric relationships with their corresponding urban prices in the study area. The relationships were however strongest in local chicken and beef compared to other meats. The result connotes the existence of symmetric market information flow between rural and urban markets for the various meats sampled in the state. The Granger causality test revealed bi-directional relationship between the rural and urban price of pork, goat meat, beef, exotic chicken, local chicken and snail meat in Akwa Ibom State, Nigeria. This also suggests that, the price transmission mechanism between the rural and urban markets of the sampled meats is somehow efficient; and has high tendency for market integration as well as strong endogeneity of both prices.

The results of the co-integration regression revealed the presence of the long run market integration between the rural and urban prices of pork, goat meat, beef, exotic chicken, local chicken and snail meat in Akwa Ibom State. The long run cointegration coefficients for the rural- urban price equations of the sampled meats were close or approximately unity which suggests instantaneous price transmission in the study area. The result also revealed that, the long run cointegration coefficients for the urban – rural price equations of the sampled meats showed significant deviations from unity which indicates weaker price transmission. This result implies that, when market activities or information flows from urban to rural markets, a shock in the system will be instantly transmitted to both markets with less inefficiency. The result also implied the reverse situation when market information flows from rural – urban markets. The seasonal festive dummy did not exhibit any significant impact on the structural rigidity of both rural and urban meat price equations in the long run. This means that, the supply – demand shock during festive months in the state did not significantly alter the meat price movement between the rural and urban markets and between urban and rural markets during the time frame considered in the study.

The results of the short run model or error correction model (ECM), confirm the existence of the short run market integration between the rural and urban prices of pork, goat meat, beef, exotic chicken, local chicken and snail meats in the study area. Similarly, the short run market integration coefficients in both rural and urban price equations varied in magnitude base on the direction of flow of market information or price movement between the two markets. Based on the magnitude of the coefficient of error correction term, it was discovered that, the rural price of pork, goat meat, exotic chicken and local chicken adjusted faster than their corresponding urban prices to the stable state in the long run once there is exogenous shock in the marketing system in Akwa Ibom State. On the other hand, the urban price of beef and snail adjusted faster than the respective rural price. Furthermore, the impact of festive months on the short run rural and urban meat price equations was

statistically insignificant for all meat prices. This implies that, the supply – demand shock in the meat market during festive periods does not have significant influence on the meat price transmission in the short run in the study area.

The estimation of index of market concentration (IMC) supported the high short run market integration between prices in rural and urban markets for pork, goat meat, beef, exotic chicken, local chicken and snail meats.

5.1 Recommendations

- Our findings revealed that, government can used both rural and urban price of meats to intervene in the equitable distribution of meats among citizenry in the study area. For instance, government fiscal or monetary policy aimed at altering consumption of pork, goat meat, beef, exotic chicken, local chicken and snail in the long run will be more efficient if the urban price of the respective meat is the policy option. In the short run, such policy framework should be built upon urban price of pork, goat meat, exotic chicken and local chicken; while the rural price of beef and snail meat should also be considered in the short run.
- Based on the findings of this study, it is recommended that, the Akwa Ibom State government should continue to provide marketing infrastructures (such as good road network, storage facilities, electricity, pipe borne water and abattoirs) to improve on the symmetric nature of information among meats markets in the state.
- Attempts should be made by governments, trade unions, individuals and other organizations to reduce excessive externality costs (such as transportation cost, toll gate levies, market levies, market union association levies among others) associated with the marketing of meats in the state. This attempt will help to minimize the total variable cost and bring about insignificant price differential among meat markets in the state. Also, this will enhance efficient resource allocation and help to synchronize government marketing policy across spatial markets in the state.
- The government of Akwa Ibom State should established market information centers and awareness programmes on mass medias (such as radio, television and newspaper), to facilitate efficient communication and flow of market information among meat consumers and suppliers in the state.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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