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Commercial Fish Price Shock Behaviour in Akwa Ibom State, Southern Nigeria

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Abstract

Producer – consumer price behaviour in the long run depends on several factors. This study tested for the long run price adjustment behaviour between the producer price of captured fish and its urban or retailed price in the Southern region of Nigeria. Monthly price of low quality fresh fish; high quality fresh fish; low quality dry fish; high quality dry fish; imported fish; cocokle, periwinkle, dry Bonga fish; and dried cray fish were used in the study. The study covers the period from January 2004 to December 2014. The study used the Engle –Granger (1987) and Enders - Siklos (2001) methodologies to verify the symmetric and asymmetric price relationship between the source (fisherman price) and its corresponding urban price alone the food chain. The result confirmed significant short and long run market integration between the source and its corresponding urban price. However, the source price equilibrium in the long run followed asymmetric adjustment with respect to urban prices in cockle and periwinkle; whereas symmetric adjustments were obtained from prices of low quality fresh fish; high quality fresh fish; low quality dry fish; high quality dry fish; imported fish; dry Bonga fish; and dried cray fish. The symmetric price adjustment was not instantaneous, while the asymmetric price relationship showed persistent positive shock in the long run. It is suggested that, fish market/industry in the study area has problems that need intervention in order to remove price distortion in the long run. Issues such contract fishing, large intermediaries in the marketing chain, unnecessary market power and poor processing among others were mentioned. Hence, these issues need to be addressed adequately in order to achieve high efficiency in the local fishing industry in the region.

Key Words: Market integration, asymmetric price transmission, symmetric transmission, fishery, Nigeria.

Introduction

Fishery sub sector provides one of the most important sources of high quality animal protein in Nigeria. It provides about 40% to 60% of the dietary intake of animal protein among Nigerian (Federal Department of Fisheries, FDF, 1997 and Adekoya 2004). The sub sector contributed about 1.94%, 1.97%, 2.03% and 2.08% of agricultural contribution in the GDP in 2010, 2011, 2012 and 2013 respectively. Thought the sector is yet to contribute up to 1% (but contributes an average of 0.45% to the country GDP from 2010 to 2013) in the country GDP; but it has made a considerably impact in job creation and self- food sufficiency drive of the federal government (Central Bank of Nigeria, 2014). For instance, almost 100% of the inland fish production is marketed internally for domestic consumption. The country is endowed with enormous natural potentials in fish production. The Nigerian coastline is about 900 km in length with a total shelf area of about 42,000 km2 (Etim, 2010). The domestic fishing industry operates in three major areas namely; the artisanal (inland rivers, lakes, coastal and brackish water), industrial and aquaculture. Large quantity (about 85%) of domestic production came from the artisanal sources. The country's total demand for fish stood at 2.7 million tons; while domestic production was 800,000 tons in 2014. It is reported that, the country spent an estimated N125.38b or about

$626.9m to import approximately 1.9 million tons of fish in 2014 (Federal Ministry of Agriculture report, 2014).

In Nigeria, captured fish is mostly marketed fresh or dried in small scattered fishing communities alone the coastal region. The potential of the sub sector is hindered by several factors ranging from contract fishing arrangement, poor marketing facilities, inefficiency in resource use, imperfect market structure leading to unnecessary market power, large intermediaries in the marketing channel, lack of incentives and poor policy implementation by various tiers of government among others. Price differential and distortion among agents in the marketing chain of captured fish seems to be one of the draw back in the fishery sub sector in Nigeria. Significant price differential among stages in the marketing chain of captured fish in the coastal region of Nigeria is possibly cause by aforementioned abnormalities. The extent of price transmission or movement from one level of the supply chain to another and its direction are important factors needed to adequately explore useful information on market adjustments of supply and demand shocks. Such information on price transmission and the nature of price adjustment is imperative in understanding agricultural market structure and the role of market agents. It is also a decisive factor on the type of policy the sector needs to improve its productivity.

However, markets do not usually adjust immediately to equilibrium due to transaction costs (Carman, 1997). For instance, asymmetric price transmission has been a subject of considerable attention in agricultural economics. Asymmetric price transmission is not only important because its presence is often considered for policy purposes to be evidence of market failure (Meyer and von Cramon-Taubadel 2002). Findings based on asymmetric price transmission may allow a researcher to make some inferences about the behaviour of agents in the market, particularly as their actions impact on links across different market levels (Goodwin and Schroeder, 1991). Vavra and Barry (2005) noted that, the speed with which markets adjust to shocks is determined by the actions of market agents who are involved in the transactions that link market levels. Peltzman (2000) also argues that asymmetric price transmission is prevalent in majority of producer and consumer markets, but reiterated that, any economic framework that does not account for this situation in the analysis of price transmission must be incorrect. Similarly, Meyer and von Cramon-Taubadel (2004) observed that a possible implication of asymmetric price transmission is that consumers are not benefiting from price reduction at the producers' level, or producers might not benefit from price increase at the retail level. Thus, under asymmetric price transmission, the distribution of welfare effects across levels and among agents following market shocks will be altered relative to the case of symmetric price transmission. On the other hand, symmetric price adjustment has been noted to help optimized resource use; increase farm income; signal the degree of competitiveness, widen commodity market and encourage value addition as well as create employment (Sexton *et al.*, 1991, Acquah and Rebecca 2012 and Akpan *et al.*, 2014).

Based on the above premised, it is important to study price transmission of agricultural commodity on the assumption of symmetric and asymmetric adjustments in the long run. This is why this study attempt to provide answer to the nature of price adjustment between the fishermen or producer price and consumer price of captured fishes in one of the coastal state in Nigeria. The finding provides fundamental framework on how policy on fishery should be implemented in the region. It also gives a first-hand information on the performance evaluation of the sub sector in the region. In order to provide these fundamental information, the study specifically established the nature of producer price adjustment of captured fishes in response to variation in consumer price (urban market) in Akwa Ibom State.

Research Methodology

Study Area and Data Source

The study was carried out in the Southern region of Nigeria. Time series data were used and were collected in Akwa Ibom State; one of the states in the region. The state was picked for this study because it is one of the coastal states and availability of good data. The state also has well established fishing communities known over Nigeria. It is located between latitudes 4°321 and 5°331 north and longitudes 7°251 and 8°251 east. It has a total land area of areas of 7,246km2. 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 3,902,051 (National Population Commission (NPC), 2006). More than 80% of the state population is involved in agricultural activities.

Source of Data

Secondary data were used in this study. The data were obtained from the quarterly publications of the Akwa Ibom State Agricultural Development Programme reports (AKADEP) (2015). It consisted of the average monthly producer/fishermen price (measured in naira per kilogram) of captured fishes and their corresponding retailed prices in urban markets. These prices represented the equilibrium prices of sampled fishes in both markets. The study deliberately included the rural and urban prices of imported fish (*Scomber scombrus* and *Scomber colias*) because it is one of the important components of fishing sub unit in the region. The rural price of imported fish was proxy for producer price; while the urban price represents consumer price. The study covers the period from January 2004 to December 2014. A total of 132 months of producer prices of captured fishes and their corresponding retailed prices in urban

Description of Data Used

Table 1 presents the nine categories of fishes available in the study area. The Akwa Ibom State Agricultural Development Programme reports (AKADEP) classified fishery products into the nine categories namely: High quality fresh fishes are fleshy or lively captured fishes. They are appealing and show little form of deterioration. On the other hand, low quality fresh fishes have some forms of deterioration due to improper storage or transportation system. They can also be classified as low quality depending on the size and the type of fish. In addition, high and low quality dried fishes classification is based on the quality of drying and preservative method used. A dry fish is high quality when the best form of preservative is used, otherwise it is low quality. Note, several marine and fresh water fishes fell in above described categories.

Some of the marine species that support artisanal fishing in the study area are; *Ethmalosa fimbriata* (Bonga Fish), *Ilisha Africana, Sardinella Africana, Pellonula leonensis, Penaeus notialis, Pseudotolithus elongates, Parapenaeus longirostris and Parapenaeopsis atlantica among others.* The brackish water species include; *Tilapia guineensis, Sarotherodon galilaeus, Chrysichthys nigrodigitatus*s, Mussel, Oysters, Crabs and Periwinkles among others (Ekpo and Mandu 2013).

Analytical Techniques

The study applied Engle-Granger (1987) and Enders and Siklos (2001) cointegration methodologies to analyze the nature of price movement and adjustment between the producer/fishermen price of capture fish and its respective urban price in the study area.

Stationarity Analysis of Variables Used in the Study

Augmented Dickey-Fuller (ADF) test

Stationarity in time series is needed to avoid the incidence of spurious regression. It is therefore necessary to convert non- stationary series to stationarity status in order to obtain reliable regression estimates. According to Kennedy (1996), a variable is integrated of order d, *I(d),* if it has to be differenced *d* times to become stationary. In order to estimate the cointegration and error correction mechanism of fish prices, this study applies the Augmented Dickey- Fuller (ADF) test to first examine the stationarity characteristics of the series. As suggested by Dickey and Fuller (1981), equation (1) is used to test the stationarity of price series:

$$\Delta X_t=\alpha_0+ \alpha_1 t+\alpha_2 X_{t-1}+\Sigma_{i=1}^{k}\delta_i \Delta X_{t-i}+\varepsilon_t \quad \text{…………………………(1)}$$

Where ‘X’ represents variables to be tested, Δ represents the first difference operator; *t* is the time drift; *k* represents the number of lags used and ε is the error term, which is assumed to be normally and identically distributed with constant means and variance;’

α and δ are the model bounds. It is a one-sided test whose null hypothesis is $\alpha 2=0$ versus the alternative $\alpha 2 < 0$.

Test for Engle Granger Symmetric and Enders and Siklos Asymmetric co-integration between Producer/fishermen price of capture fish and its urban (consummer's) price

The concept of co- integration as developed by Granger (1981) involved the determination of the long-run associations among non-stationary time series. If two markets are co-integrated in Engle Granger methodology, then there exists an equilibrium long run relationship with underlying symmetric adjustment between them (Goodwin & Schroeder 1991; Gonzalez-Rivera & Helfand, 2001; Sexton *et al.*, 1991). The study firstly applied the Engle and Granger two-step technique to examine the co-integration relationship between the producer/fishermen price of captured fish and its urban retailed price in the study area. Hence, the time dependent fishermen price equation is specified as follows:

$LnP_{rt}= \gamma_0+ \gamma_1\sum_{i=1}^{n} LnP_{ut}+ \varepsilon_t$ ……………………………………(2)

Where P_{rt} and P_{ut} are average monthly fisherman and retailed (urban or consumer) prices of captured fish respectively. Possible cointegration between the two prices was examined through the order of integration of the residual from equation 2, using a Dicker-Fuller test as below:

$\Delta\varepsilon_t= \rho\varepsilon_{t-1}+ v_t$………………………………………………….…………….…… (3)

Following the Granger Representation Theorem, we specified the Engle Granger error correction model (ECM) model for the co-integrating series in the study with underlying symmetric adjustment or linear assumption of the error term in the long run. The general specification of the error correction model (ECM) specified for the fishermen price of captured fish in the study area is shown below:

$\Delta LnP_{rt}=\gamma_0+\gamma_1\sum_{i=1}^{n}\Delta LnP_{rt-1}+\gamma_2\sum_{i=1}^{n}\Delta LnP_{ut-i}+\gamma_3 ECM_{t-1}+ U_t$…………. (4)

Variables are as defined previously in equation (2), and coefficients ($\boldsymbol{\gamma_3}$) of the ECMt ($-1< \boldsymbol{\gamma_3}< 0$) measures the deviations from the long-run equilibrium in period (t-1) in P_{rt}. The study applied these methodologies in nine different captured fishes in the study area. The implicit assumption of symmetric price Adjustment could be problematic if the error adjustments are asymmetric. Based on this assertion, Enders and Siklos (2001) argued that the test for cointegration could be mis-specified and thus proposed a two-regime threshold cointegration approach to test for asymmetric adjustment in the cointegration analysis. The proposed model modifies equation 3, to test for the long run equilibrium that allows for asymmetric adjustment such that:

$\Delta\varepsilon_t=M_t\rho_1\varepsilon_{t-1}+(1-M_t)\rho_2\varepsilon_{t-1}+\sum_{i=1}^{k}\delta_i\Delta\varepsilon_{t-i}+ V_t$.................................. (5)

Where $\rho 2, \rho 2$ *and* δi are coefficients, εt is a white noise disturbance, k is the number of lags and Mt is an indicator function such that:

$\boldsymbol{Mt}$= {1 $if\ \varepsilon t-1 \geq 0$ 0 $if\ \varepsilon t-1 < 0$ .... (6)

Hence, model consisting of equation 3, 5 and 6 is called threshold autoregressive (TAR) cointegration model. In the modified version, Enders and Granger (1998) and Enders and Siklos (2001) suggested an alternative threshold based on the change in $\varepsilon t-1$ in the previous period. They proposed a new indicator function Zt such that;

$\boldsymbol{Zt}$= {1 $if\ \Delta\varepsilon t-1 \geq 0$ 0 $if\ \Delta\varepsilon t-1 < 0$ ....(7)

Also, model consisting of equation 3, 5 and 7 is called momentum-threshold autoregressive (M-TAR) cointegration model. The asymmetric cointegration between (fishermen price of captured fish) Prt and (urban retailed price of captured fish) Put using TAR and M-TAR models is determined by testing the null hypothesis of no cointegration.

$H0: \rho 1=\rho 2=0$

Enders and Siklos (2001) referred to the F-statistic of this null hypothesis as Φ and Φ* in TAR and M-TAR respectively because it has non-standard distribution. They also described Monte Carlo experiments that can be used to test the null hypothesis of no cointegration against the alternative cointegration with threshold (i.e. TAR and M-TAR) adjustment. The asymmetric adjustment in the error term is suspected when the null hypothesis is rejected. Secondly, in the presence of asymmetric cointegration, the null hypothesis of symmetric adjustment can be examined using a standard F-statistics.

$H0: \rho 1=\rho 2$

The confirmatory test of asymmetric adjustment of the error correction is indicated when both hypotheses are rejected ($i.e.\ H0{:}\rho 1=\rho 2=0$ *and* $H0{:}\rho 1=\rho 2$). when the threshold cointegration is found, the transmission are tested using the threshold error correction model.

$\Delta Prt=\delta 0+\theta 11 Mt\varepsilon t-1+\theta 12(1-Mt)\varepsilon t-1+\Sigma\delta 1iki=1\Delta Prt-i+\Sigma\delta 2iki=1\Delta Put-i+\xi 1t\ldots$ ………………………(8)

and,

$\Delta Put=\beta 0+\theta 21 Mt\varepsilon t-1+\theta 22(1-Mt)\varepsilon t-1+\Sigma\beta 1iki=1\Delta Prt-i+\Sigma\beta 2iki=1\Delta Put-i+\xi 2t\ldots$ ……………………………………………………………………….(9)

Where $\theta 11$ and $\theta 12$ represent the speed of adjustment coefficient of ΔPrt if $Prt\text{-}1$ is above and below its long run equilibrium respectively. Also, $\theta 21$ and $\theta 22$ represent the speed of adjustment coefficients of ΔPut of the two regimes respectively. Note, the entire processes were performed for the nine different categories of fishes in the study area.

Results and Discussion

To ascertain the stationarity of variables specified in the model, the standard Augmented Dickey Fuller test was performed. Test statistics for each price variable at level and first difference are presented in Table 2. The result of the ADF unit root test showed that, price series were non-stationary at levels but stationary at first difference for ADF equation without constant and trend. However, the result was mixed for ADF equation that contains constant only. For certainty and high precision of estimates, it was considered that, price variables specified were non stationary at level but stationary at first difference.

Following the result of the unit root tests, equations specified in the study cannot be analyzed at the level of variables without the risk of obtaining spurious regression. Hence, the result implies that, series should be tested for co-integration and possible error correction mechanism.

Descriptive Analysis of Prices used in the Study

The descriptive statistics of fish prices used in the analysis is shown in Table 3 to Table 5. For instance, the average price of low and high quality fresh fish in the rural and urban markets was N34.47/kg and N400.61/kg respectively. The data provided evidence that, price differential existed between the producer price and the retailed price of fishery products in the study area. The coefficients of variability and standard deviation also varied across categories of fishes. This means that, variation between the rural and urban prices of fishes are conspicuous in the study area.

Engle Granger Co-Integration results for producer Price of Fish

The co-integration test result using Engle and Granger two-step technique is presented in the lower portion of Table 6 and Table 7. The order of integration of the residuals generated from the long run equation as specified in equation 3 for each of the nine category of fishes were evaluated and were found significant at 1% probability level. Following the Engle–Granger two-step co-integration tests, the null hypothesis of no co-integration was rejected for the nine categories of fish equations. The result implies that, there is a long run symmetric equilibrium relationship between the rural/producer price of fish and its respective urban/retailed price in the study area. The upper part of Table 6 and Table 7 also contain the long run estimates of the rural/producer price equations defined in equation 2.

Engle Granger (Symmetric) Error Correction Models for the producer Price of captured Fish

The presence of the co-integration relationship between the producer price of fish and its corresponding retailed price demanded the specification of the Error Correction Model. Table 8 and Table 9 contain estimates of ECM generated from equation 4 for all categories of fish. The essence was to determine the speed of adjustment of the producer price to exogenous shock generated by the retailed price in urban market with underlying assumption of symmetric adjustment in the error term.

The result presented in Table 9 validates the existence of the long-run symmetric equilibrium relationship between the producer price of fish category specified and its respective urban price. The slope coefficient of the error correction term is correctly signed and significant for all fish categories. This represents the speed of adjustment of the respective producer price in the long run. In other words, the slope coefficient is consistent with the hypothesis of convergence towards the long-run equilibrium once the producer price equation is shocked. The result showed that, disequilibrium in the producer price of fishes in the short run; would be corrected in the long run. The significant nature of the Engle –Granger error implies that the urban price of fish will always react to bring stability in the producer price whenever it experienced significant variation.

The value of the coefficient of the Engle -Granger error correction term in the low quality fresh fish price equation implies that, about 72.30% of the symmetric adjustment in the producer price takes place in a month due to exogenous shock induced by its retailed price in urban market. Similarly, 91.60% 39.90%, 48.20%, 91.40%, 47.0%, 30.50%, 85.90% and 93.10% of symmetric long run adjustments occur monthly in the producer price of high quality fresh fish, low quality dry fish, high quality dry fish, imported fish, dry Bonga fish, periwinkle, cockle and dried Cray fish respectively. These results confirmed the long and short runs market integration between the producer price of fish and its respective urban price with assumption that, the error adjustment is linear and symmetric in nature. In summary, it is obvious that, the cointegrated character of the producer price of captured fishes is evident, so they are linked by a relationship of long-term equilibrium. This means that a deviation of the producer markets from a steady state triggers a process of self-balancing for a return to equilibrium in the long run. This connotes interdependence of the two markets.

Several authors (Chung-Hua *et al.,* 2007 and Duasa, 2009) have criticized the Engle Granger methodology on the assumption that, the adjustment of the error term in the long run might not follow the fundamental hypothesis embedded in the methodology.

Enders and Siklos (Asymmetric) Cointegration and Error Correction Models for Producer price of Fish

By implication, the Engle Granger results discussed above might be wrongly specified if the error terms have underlying asymmetric adjustment. To confirm the true nature of error adjustment, Enders-Siklos asymmetric cointegration test was conducted. The result as presented in Table 10 revealed that the null hypotheses of no asymmetric cointegration and symmetric relationship between the producer and retailed prices of periwinkle and cockle were rejected respectively (i.e. model 7 and 8). This result suggests that, the Engle Granger cointegration wrongly specified the long run relationship showed in model 7 and 8 respectively. The result connotes that, the long run relationship between the producer and urban prices of periwinkle and cockle can be described as asymmetric. This means that the long run relationship in the price of these categories of fish assumed a non-linear relation. However, the results of model 1, 2, 3, 4, 5, 6 and 9 were in agreement with the Engle –Granger adjustment procedure in the long run previously discussed. The null hypothesis of symmetric relationships in these models was not rejected. Following the presence of asymmetric cointegration between the producer and retailed prices of periwinkle and Cockle, the threshold autoregressive error correction models (TAR-ECM) were generated to assess their short run dynamics. The result of the asymmetric error correction model is shown in Table 11.

The TAR error correction model for the producer price of periwinkle and Cockle revealed that, there are significant long run asymmetric relationships with their respective urban prices. This means that, the error term adjustment process is highly asymmetric. For the Periwinkle equation, the estimated adjustment speed coefficients are -0.3234 and -0.9225 for the positive and negative values of $\Delta\varepsilon t$-1 respectively. Hence, the speed of adjustment coefficient represents how quickly long run disequilibria were corrected. These coefficients imply that, when the producer and retailed prices of periwinkle temporarily departed from equilibrium relationship, adjustment back to equilibrium in the long run is more rapid following relative decrease in the producer price (below long run value) compared to increase in price. Therefore, producer prices of periwinkle significantly responded to both negative and positive discrepancies in the long run price equilibrium arising from fluctuation in the corresponding urban prices. This result connotes the existence of a bi-directional long run causality relationship between the producer and urban price of periwinkle with underlying asymmetric feedback between the two markets, hence, following the long run adjustment coefficients; the adjustment is faster (almost instantaneous) when $\Delta\varepsilon t$-1 is negative than when positive. For the negative adjustment, this mechanism is illustrated as thus:

$$\Delta \boldsymbol{RPWt} = \boldsymbol{K} - \mathbf{0.9225}[\boldsymbol{RPWt}-\mathbf{1}+\mathbf{1.54}+\mathbf{0.69}\boldsymbol{UPWt}-\mathbf{1}]\ \boldsymbol{\varepsilon t}-\mathbf{1}<\mathbf{0}$$

Similarly, for the positive adjustment, this mechanism is illustrated as thus:

$$\Delta \boldsymbol{RPWt}=\boldsymbol{K}-\mathbf{0.3234}[\boldsymbol{RPWt}-\mathbf{1}+\mathbf{1.54}+\mathbf{0.69}\boldsymbol{UPWt}-\mathbf{1}]\ \boldsymbol{\varepsilon t}-\mathbf{1}>\mathbf{0}$$

Where "K" represents the constant and lagged changes in the producer and urban prices as indicated in equation 8. The result means that, adjustment back to equilibrium relationship in the long run is faster (about 92.25% speed adjustment) when temporary departures from equilibrium are caused by relative decrease in the producer price, or increase in urban price. Similarly, the producer price of periwinkle will adjust to eliminate about 32.34% of positive shock from the equilibrium in the long run as a result of changes in urban price. Hence, in RPW – UPW market flow, there are faster adjustment to negative deviations from the equilibrium compared with positive deviations. This means that asymmetric relationship is more on the positive side.

By implication, the result suggests that, when the urban price of periwinkle declines from the equilibrium position in the long run, the speed of adjustment back to the equilibrium is about 92.25% compared to 32.34% when the price increase.

Similarly, the TAR error correction mechanism between the producer price of cockle and it corresponding urban price suggests quick and significant adjustment of the producer price once it falls short of equilibrium position. The model suggests that, about 98.82% of the negative deviation of the producer price from its equilibrium is corrected every month. This mechanism is shown below:

$$\Delta \boldsymbol{RCOt}=\boldsymbol{K}-\mathbf{0.9882}[\boldsymbol{RCOt}-\mathbf{1}+\mathbf{0.09}+\mathbf{0.980}\boldsymbol{UCOt}-\mathbf{1}]\ \boldsymbol{\varepsilon t}-\mathbf{1}<\mathbf{0}$$

"K" is as defined previously. The result implies that, the RCO – UCO market, will adjusted and eliminate 98.82% of negative deviations from the equilibrium relationship for changes created by UCO. However, the model did not provide significant evidence for producer price adjustment relative to urban price fluctuation when it is above the long run equilibrium value. The result showed that, the producer price has only 24.07% speed of adjustment back to equilibrium relationship if the temporary departure is positively induced. The implication of the result is that fishery industry is largely underdeveloped implying that several issues need to be address in the study area. Issues such as: seasonality, perishability, poor processing/value addition, and short shelf life due to poor storage are worth mentioning.

Discussion of the Long and Short Run Results and its Implication to Policy Makers and Fisher Folks

The estimated results revealed that, the producer price of captured fish and its urban or retailed price have a long run relationship with varying degrees of error adjustment. The cointegration coefficient in the low quality fresh fish (0.93), high quality fresh fish (0.96), low quality dry fish (0.67), high quality dry fish (0.88), imported fish (0.96), dry Bonga fish (0.89), periwinkle (0.69), cockle (0.98) and dried cray fish (0.97) were significant but did not perfectly converged to the law of one price.

These results suggest that, in the long run some fish markets have weak interdependency while some have strong interdependency. For instance, the result has shown that the producer price of periwinkle and cockle have asymmetric long run relationship, whereas the price relationship in the low quality fresh fish; high quality fresh fish; low quality dry fish; high quality dry fish; imported fish; dry Bonga fish; and dried cray fish followed symmetric adjustment in the long run. The differences in the long run behaviour could be attributed to several issues blurring the fishery sub sector in the study area. As reported by Peltzman (2000); asymmetry price relationship between the producer and consumer prices occurred as the result of many small intermediaries present in the distribution channel. Zachariasse and Bunte (2003) also noted that market power may explain why prices are not fully transmitted while oligopolistic and oligopsonistic interdependence may give rise to lags in price adjustment. One of the phenomenon that could contributes to the nonlinear price transmission in periwinkle and cockle is the contract fishing arrangement prevalence in the study area. It is noticed that this has resulted in a near monopsony market structure and promoted accumulation of intermediaries at the further stage in the marketing chain of fishery products in Akwa Ibom State.

Other pertinent issues include; the seasonality, perishability, short shelf life due to poor storage as well as inefficient processing methods. The magnitude of these problems cause distortion in the producer – retailed price relationship in the long run. The implication of asymmetric price relationship suggest that policies or programmes designed to promote productivity of the artisanal fishery sub sector might not be transmitted smoothly to the consumers due to inconsistent feedback. Economics theory held that, any external shock to the demand or supply side of a market, whatever the number of stages between producers and consumers, should not result in a different speed (or length) of adjustment to the long-run equilibrium according to the sign of the variation. Any significant difference would reveal a case of market failure as long as the output price is expected to respond symmetrically to variations of input prices (Simioni et al., 2013).

Although several fishery products (low quality fresh fish; high quality fresh fish; low quality dry fish; high quality dry fish; imported fish; dry Bonga fish; and dried cray fish) showed symmetric relationship in the long run, but the adjustment back to equilibrium relationsip was not instantaneous. This also suggests the presence of externality forces and market power among others that still need to be address adequately. The combined results of the short and long run models indicated that the retailed price of captured fishery do not have perfect deterministic characteristic on its producer price in the study area.

Conclusion and Recommendations

The findings have shown that the producer price of capture fish followed symmetric adjustment for low quality fresh fish; high quality fresh fish; low quality dry fish; high quality dry fish; imported fish; dry Bonga fish; and dried cray fish and asymmetric adjustment for cockle and periwinkle in the long run with respect to its urban or retailed price. This result portrays the significant influence of externality costs or arbitrage activities in the marketing system of fishery products in Akwa Ibom State. This result calls for a broad policy package that should focus on improving the marketing system and streamlining as well as developing the value addition chain of fishery products in the region. As a way to boost captured fish productivity and increase the quality of animal protein of citizenry, externality such as contract fishing should be replaced with incentives and subsidies to the fisher folks. Potentials in the sub sector can also be harnessed by streamlining the marketing procedures/channels of fishes through provision of regulated central market.

It is also recommended that, governments of the region should bring up programmes to promote value addition and competitiveness among fisher folks in the region. The region authority should provide processing and marketing infrastructures (processing facilities, storage facilities, communication facilities among others) to help reduce externality costs (transportation costs, security levies) associated with fish marketing. The region governments should establish market information centers and awareness programmes on mass media (such as radio, television and newspaper), to facilitate efficient communication among markets and between distributors and consumers.

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APPENDICES

Table 1: Category of Fish in the study area

Fish category	Producer price (Kg/Naira)	Retailed/Urban price(Kg/Naira)
Fresh Fish (High quality)	RHQ	UHQ
Fresh Fish (Low quality)	RLQ	ULQ
Dried Fish (High quality)	RDH	UDH
Dried Fish (Low quality)	RDL	UDL
Imported Fish	RIM	UIM
Dried Bonga Fish *(Ethmalosa fimbriata)*	RBF	UBF
Periwinkle	RPW	UPW
Cockle	RCO	UCO
Dried Cray Fish	RDC	UDC

Source: Field Survey, 2015.

Table 2: Result of ADF unit root test for price variables used in the analysis

Logged Variables	ADF Test No Constant and Trend				ADF Test Constant only			
	Lag	Level	1st diff.	OT	Lag	Level	1st diff.	OT
RLQ	0	0.1467	-19.451**	1(1)	0	-3.8322**	–	1(0)
ULQ	0	0.1527	-20.181**	1(1)	0	-4.0297**	–	1(0)
RHQ	0	-0.2374	-17.240**	1(1)	0	-5.2592**	–	1(0)
UHQ	0	-0.1099	-18.013**	1(1)	0	-4.9811**	–	1(0)
RDL	0	-0.0926	-21.063**	1(1)	0	-4.1293**	–	1(0)
UDL	0	-0.2121	-22.133**	1(1)	0	-6.4209**	–	1(0)
RDH	0	0.0633	-20.897**	1(1)	0	-4.7631**	–	1(0)
UDH	0	0.0392	-20.541**	1(1)	0	-5.6852**	–	1(0)
RIM	0	0.1625	-18.381**	1(1)	0	-3.0482	-18.3428**	1(1)
UIM	0	0.3008	-17.610**	1(1)	0	-2.6654	-17.5850**	1(1)
RBF	0	0.4983	-16.159**	1(1)	0	-2.2680	-16.1681**	1(1)
UBF	0	0.2879	-16.807**	1(1)	0	-3.1819	-16.7866**	1(1)
RPW	0	-0.3316	-15.809**	1(1)	0	-5.6989**	–	1(0)
UPW	0	-0.2270	-16.483**	1(1)	0	-5.6895**	–	1(0)
RCO	0	-0.4371	-17.829**	1(1)	0	-6.1912**	–	1(0)
UCO	0	-0.4475	-18.687**	1(1)	0	-6.5663**	–	1(0)
RDC	0	-0.1528	-20.372**	1(1)	0	-5.8470**	–	1(0)
UDC	0	-0.0239	-19.825**	1(1)	0	-5.0332**	–	1(0)
1% critical value		**-2.5827**	**-2.5829**			**-3.4808**		

Note: OT means order of integration. Critical value (CV) is defined at 1% significant level for ADF. Asterisks ** represents 1% significance level. Variables are as defined previously in equation 2.

Table 3: Descriptive statistic of price variables used in the Study

Parameters	Summary of Descriptive Statistics					
	Rural price of Fresh Fish (LQ) (₦/Kg)	Urban price of Fresh Fish (LQ) (₦/Kg)	Rural Price of Fresh Fish (HQ) (₦/Kg)	Urban price of Fresh Fish (HQ) (₦/Kg)	Rural Price of Dry Fish (LQ) (₦/Kg)	Urban price of Dry Fish (LQ) (₦/Kg)
Mean	343.47	400.61	584.76	638.40	667.65	758.23
Median	350.86	384.01	637.68	660.24	593.51	652.91
Minimum	89.84	113.10	104.72	118.27	169.50	183.46
Maximum	664.29	857.64	1185.6	1182.5	1500	7923
Std. deviation	147.00	176.58	268.94	256.17	280.06	706.18
Coeff. of Variation	0.428	0.441	0.459	0.401	0.419	0.931
Skewness	0.189	0.459	0.079	0.111	0.496	8.114
Kurtosis	-0.894	-0.667	-1.159	-1.005	-0.644	78.88

Note: Computed by authors, and prices are expressed in nominal terms. Also, 1dollar = ₦199.00 as of 25/05/015.

Table 4: Descriptive statistic of price variables used in the Study

Parameters	Summary of Descriptive Statistics					
	Rural price of Dry Fish (HQ) (₦/Kg)	Urban price of Dry Fish (HQ) (₦/Kg)	Rural Price of Imported Fish (₦/Kg)	Urban price of Imported Fish (₦/Kg)	Rural Price of Dry Bonga Fish (₦/Kg)	Urban price of Dry Bonga Fish (₦/Kg)
Mean	1106.4	1062.70	311.20	315.68	461.35	473.32
Median	993.63	1040.10	275.94	282.18	383.94	392.44
Minimum	285.2	123.42	126.39	126.55	196.17	162.95
Maximum	15481.0	6139.2	833.33	666.67	1037.7	1920.0
Std. deviation	1330.9	602.66	145.13	140.31	235.07	260.45
Coeff. of Variation	1.203	0.567	0.466	0.444	0.509	0.550
Skewness	9.644	4.602	0.740	0.499	1.096	1.940
Kurtosis	101.71	36.34	-0.107	-1.001	0.070	6.050

Note: Computed by authors, and prices are expressed in nominal terms. Also, 1dollar = ₦199.05 as of 25/05

Table 5: Descriptive statistic of price variables used in the Study

Parameters	Summary of Descriptive Statistics					
	Rural price of Periwinkle (₦/Kg)	Urban price of Periwinkle (₦/Kg)	Rural Price of Cockle (₦/Kg)	Urban price of Cockle (₦/Kg)	Rural Price of Dried Crayfish (₦/Kg)	Urban price of Dried Crayfish (₦/Kg)
Mean	144.93	129.94	207.66	199.53	1497.4	1509.2
Median	128.49	115.23	206.07	197.72	1473.6	1464.1
Minimum	50.00	50.00	30.30	31.83	102.00	103.30
Maximum	856.34	493.95	906.25	906.29	3333.3	3333.3
Std. deviation	116.15	67.46	121.16	111.63	668.17	664.34
Coeff. of Variation	0.801	0.519	0.583	0.559	0.446	0.440
Skewness	3.707	2.836	1.904	2.287	0.232	0.321
Kurtosis	15.622	11.451	7.856	11.584	-0.543	-0.538

Note: Computed by authors, and prices are expressed in nominal terms. Also, 1dollar = ₦199.05 as of 25/05

Table 6: Long run Relationships between Rural and Urban Prices of Fisheries

Variable	**Fresh Fish (LQ)**	**Fresh Fish (HQ**	**Dry Fish (LQ)**	**Dry Fish (HQ)**	**Imported Fish**
Constant	0.28(1.19)	0.16(0.41)	2.07(6.22)***	0.79(2.09)**	0.19(1.15)
Urban Prices	0.93(23.45)***	0.96(15.72)***	0.67(13.07)***	0.88(15.89)***	0.96(31.72)***
Diagnostic statistics					
R^2	0.808	0.655	0.568	0.660	0.886
F-cal	549.76***	247.00***	170.74***	252.52***	1006.03***
DW-Test	1.803	1.908	1.429	1.843	2.050
Normality test	0.828	53.313***	100.87***	377.11***	79.486***
RESET test	7.06***	7.224***	244.52***	45.44***	1.996
ADF unit root test for residuals of above equations					
Without const.	-10.333***	-10.889***	-8.524***	-10.545***	-11.724***
With const.	-10.293***	-10.848***	-8.490***	-10.504***	-11.679***

Note: Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are expressed in logarithm.

Table 7: Long run Relationships between Rural and Urban Prices of Fisheries

Variable	Dry Bonga	Periwinkle	Cockle	Dried Cray Fish
Constant	0.61(2.83)***	1.54(3.61)***	0.09(0.51)	0.199(0.64)
Urban Prices	0.89(25.37)***	0.69(7.69)***	0.98(26.20)***	0.969(22.55)***
Diagnostic statistics				
R^2	0.832	0.313	0.841	0.796
F-cal	643.854***	59.131	686.26***	508.315***
DW-Test	1.477	0.727	1.749	2.053
Normality test	78.513***	450.769***	109.22***	170.32***
RESET test	20.762***	0.096	0.759	0.540
ADF unit root test for residuals of above equations				
Without const.	-8.718***	-5.424***	-10.109***	-11.710***
With const.	-8.684***	-5.403***	-10.071***	-11.665***

Note: Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are expressed in logarithm.

Table 8: Engle Granger adjustment mechanism (ECM) for Rural Price of Fisheries

Variable	Fresh Fish (LQ) RLQ	Fresh Fish (HQ) RHQ	Dry Fish (LQ) RDL	Dry Fish (HQ) RDH	Imported RIM
Constant	0.004(0.24)	0.002(0.08)	0.009(0.51)	0.02(0.73)	0.002(0.12)
$LnRural_{rt-1}$	-0.13(-1.53)	-0.001(-0.02)	-0.30(-3.57)***	-0.39(-3.09)***	-0.07(-0.76)
$\Delta \text{Ln} ULQ_t$	0.59(8.35)***	–	–	–	–
$\Delta \text{Ln} UHQ_t$	–	0.64(7.79)***	–	–	–
$\Delta \text{Ln} UDL_t$	–	–	0.20(3.88)***	–	–
$\Delta \text{Ln} UDH_t$	–	–	–	0.42(5.82)***	–
$\Delta \text{Ln} UIM_t$	–	–	–	–	0.73(10.15)***
$\Delta \text{Ln} ULQ_{t-1}$	0.01(0.14)	–	–	–	–
$\Delta \text{Ln} UHQ_{t-1}$	–	-0.08(-0.72)	–	–	–
$\Delta \text{Ln} UDL_{t-1}$	–	–	-0.05(-0.88)	–	–
$\Delta \text{Ln} UDH_{t-1}$	–	–	–	0.07(0.71)	–
$\Delta \text{Ln} UIM_{t-1}$	–	–	–	–	0.02(0.19)
ECM_{t-1}	**-0.723(-6.37)*** **	**-0.916(-7.81)*** **	**-0.399(-4.66)*** **	**-0.482(-3.59)*** **	**-0.914(-7.36)*** **
Diagnostic Statistics					
R^2	0.570	0.565	0.437	0.523	0.630
F-Cal	41.454***	40.556***	24.259***	34.339***	53.259***
Normality	2.048	104.99***	34.627***	438.022***	66.268***
RESET test	0.573	2.734*	2.295	0.628	0.283

Note: Values in bracket represent t-values. The asterisks *, ** and *** represent 10%, 5% and 1% significance levels respectively. Variables are as defined previously in Table 1.

Table 9: Engle Granger adjustment mechanism (ECM) for Rural Price of Fisheries

Variable	**Dry Bonga RBF**	**Periwinkle RPW**	**Cockle RCO**	**Dried Cray Fish RDC**
Constant	0.007(0.52)	0.005(0.18)	0.004(0.19)	0.004(0.189)
$LnRural_{rt-1}$	-0.15(-1.70)*	-0.17(-1.96)*	-0.006(-0.07)	-0.093(-1.062)
$\Delta \text{Ln}UBF_t$	0.44(7.62)***	–	–	–
$\Delta \text{Ln}UPW_t$	–	0.72(8.62)***	–	–
$\Delta \text{Ln}UCO_t$	–	–	0.885(20.84)***	–
$\Delta \text{Ln}UDC_t$	–	–	–	0.877(13.76)***
$\Delta \text{Ln}ULQ_{t-1}$	0.02(0.30)	–	–	–
$\Delta \text{Ln}UBF_{t-1}$	–	0.14(1.29)	–	–
$\Delta \text{Ln}UPW_{t-1}$	–	–	-0.057(-0.621)	–
$\Delta \text{Ln}UCO_{t-1}$	–	–	–	0.081(0.783)
$\Delta \text{Ln}UDC_{t-1}$	–	–	–	–
ECM_{t-1}	**-0.470(-5.09)*** **	**-0.305(-4.06)*** **	**-0.859(-7.44)*** **	**-0.931(-7.390)*** **
Diagnostic Statistics				
R^2	0.432	0.494	0.832	0.756
F-Cal	23.766***	30.545***	154.453***	97.011
Normality	33.323***	148.07***	113.609***	206.094***
RESET test	10.389***	0.204	1.704	1.544

Note: Values in bracket represent t-values. The asterisks *, ** and *** represent 10%, 5% and 1% significance levels respectively. Variables are as defined previously.

Table 10: Enders-Siklos asymmetric Cointegration test for the Producer Price of Fish and its corresponding urban Price

Variables	**H_0: $\rho_1 = \rho_2 = 0$**						**H_0: $\rho_1 = \rho_2$**	
	$t_{Max.}$	**TAR Φ**	**K**	**M-TAR Φ***	**$t_{Max.}$**	K	**TAR: F-test**	M-TAR: F-test
Model 1 — FF (LQ)	--3.069*	8.451*	5	8.689*	-3.084*	5	0.474	0.891
Model 2 — FF (HQ)	-3.864*	14.003*	4	13.933*	-3.963*	4	0.601	0.486
Model 3 — DF (LQ)	-1.544	2.453	6	2.5449	-1.610	6	0.051	0.236
Model 4 — DF (HQ)	-1.351	1.445	8	1.461	-1.279	8	0.145	0.176
Model 5 — IMF	-3.846*	9.415*	6	9.319*	--3.930*	6	0.394	0.227
Model 6— Bonga	-3.203*	6.513*	7	6.608*	-2.978*	7	0.115	0.285
Model 7 — Periwinkle	-3.503*	10.457*	5	8.583*	-2.145	5	4.159*	0.859
Model 8 — Cockle	-3.733*	15.389*	2	14.376*	-3.593*	2	2.646*	0.985
Model 9 — Cray F	-3.681*	8.547*	5	8.599*	-3.684*	5	0.305	0.394

Note: Monte Carlos stimulated critical values at 10% wwas used. Asterisk * means significant at 10% level. Threshold value (tau) = 0. K was determined by AIC.

Table 11: Threshold Autoregressive (TAR) Asymmetric Error Correction Mechanism in model 7 and 8

Periwinkle		Cockle	
Variables	**TAR ECM**	**Variables**	**TAR ECM**
Constant	-0.0405	Constant	-0.0321
$Z_t\varepsilon_{t-1}$	-0.3234**	$M_t\varepsilon_{t-1}$	-0.2407
$(1 - M)\varepsilon_{t-1}$	-0.9225***	$(1 - M)\varepsilon_{t-1}$	-0.9882**
ΔRPW_{t-1}	-0.5389***	ΔRCO_{t-1}	-0.5183
ΔRPW_{t-2}	-0.5092***	ΔRCO_{t-2}	0.0181
ΔRPW_{t-3}	-0.3295*	ΔRCO_{t-3}	-0.2431
ΔRPW_{t-4}	-0.06145	ΔRCO_{t-4}	0.0623
ΔRPW_{t-5}	0.1228	ΔRCO_{t-5}	0.2117
ΔUPW_{t-1}	0.0655	ΔUCO_{t-1}	0.0348
ΔUPW_{t-2}	0.2225*	ΔUCO_{t-2}	-0.2193
ΔUPW_{t-3}	0.0135	ΔUCO_{t-3}	-0.0222
ΔUPW_{t-4}	0.0926	ΔUCO_{t-4}	-0.1073
ΔUPW_{t-5}	-0.1106	ΔUCO_{t-5}	-0.3235*
R^2	0.3164	R^2	0.3533
Normality	45.512***	Normality	7.191**
F-cal	4.358***	F-cal	5.146***
RESET test	11.585***	RESET test	2.906*
DW test	1.9741	DW test	2.104

Note: Asterisk ** and *** represent significant level at 10% and 1% level respectively. EView was used to generate the error correction mechanism.