ASSESSMENT OF FISH PRICE VOLATILITY IN NIGERIA

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ABSTRACT

Based on monthly pricing data from 1995 to 2015, this study analyzes price volatility in the Nigerian fish market. The exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model was used to analyze the univariate volatility of the market. The fish supply market's long-term persistence of price volatility is an indication of a fundamental level of volatility over the course of the research period. The first-order autoregressive term's value was considerable for the fresh, frozen, and smoked fish markets, according to empirical findings. In comparison to fresh fish prices (-0.37) and smoke prices (-2.09), frozen fish prices (0.72) showed a greater persistence parameter. The three fish price variance models all contained large asymmetric terms. According to the study, increased strategic intervention is required for increased agricultural output and adequate fish stocks, particularly to balance out seasonal variations and time lags in the fish trade.

Key words: Fresh, frozen,smoked price volatility,EGARCH model,

JEL Codes C22 Q21, Q22.

1.INTRODUCTION

The importance of price volatility as an economic phenomenon has long been acknowledged by economists (Engle, 1982). It makes price discovery more difficult and puts economic agents at risk. The Federal Agriculture Improvement and Reform (FAIR) Act debate in 1996 saw a significant increase in discussion about volatility (Ray et al. 2000). The initial assumption was that the decoupling of agricultural program payments would increase market volatility; however, this forecast has turned out to be inaccurate for various commodities (Yang et al., 2001). According to a wealth of research (Hudson and Coble, 1999; Kinnucan, 1986; Goodwin and Schnepf, 2000), volatility is significant in agricultural commodities.

Volatility in prices has negative effects throughout the entire food supply chain. According to several studies (Seal and Shonkwiler, 1987; Rezitis and Stavropoulos, 2009; Sckokai and Moro, 2009; Piot-Lepetit, 2011; Tangermann, 2011; Taya, 2012), farmers may reduce their output supply and their investments in productive inputs in response to price volatility. Additionally, the upstream portion of food supply chains is exposed to sourcing concerns due to the volatility of agricultural input prices, requiring food and agricultural enterprises to change their sourcing strategies as a coping mechanism (Rabobank, 2011). Unexpected price hikes might also jeopardize a consumer's ability to access food, especially if they spend a significant portion of their income on food (Hernandez et al., 2013).

Price volatility serves as a gauge of price uncertainty and affects income, fishing costs, pressure on fish stocks, and food security (Pincinato et al., 2020),it is crucial to analyze price volatility. Welfare is significantly impacted by the volatility of seafood prices (Dahl and Yahya, 2019). Fishing and aquaculture industries include risk; therefore, there may be some price fluctuation, as Dahl and Oglend (2014) point out. Furthermore, price volatility has a significant effect on the aquaculture and seafood markets, claim Asche et al. (2015).They claimed that differences in supply and demand might be to blame for these pricing swings. Seasonality and output shocks could be to blame for the former.

Given that over 40% of the world's fish production is traded globally, the latter could be caused by variations in the availability of nearby alternatives as well as in trade restrictions and currency exchange rates. Additionally, as stated by the OECD/FAO (2022), the volatility of the markets for energy, management strategies, environmental regulations, stock conditions, and domestic fishing regulations are some risks and uncertainties that could significantly affect the fishery sector for the years 2022–2031. Given the risks associated with the market and production, price changes have a substantial impact on enterprises that produce seafood and those who are involved in the supply chain. The seafood business therefore confronts uncertainty as a result of this price volatility, which eventually leads to changing profitability over time. Due to the involvement of armed militia groups in Nigeria, farmers have been less active in farming activities recently. Due to the activity of the bandits, some raw materials necessary to produce fish feeds such corn and groundnut cake meal are presently exceedingly expensive and rare. The end product (fish feed) and fish are now quite expensive as a result of this (Ladan and Matawalli, 2020, Abubakar et.al 2023).

Additionally, the pandemic (COVID-19) caused a variety of significant uncertainties in both developed and developing nations, including stock market volatility, uncertainty regarding economic policy, uncertainty regarding employment, and the future of GDP growth Erdoan et al., (2020), Kabiru, H. (2020), and it caused a global economic recession in many countries (Brianca et al., 2020). The pandemic, which struck Nigeria at the beginning of 2020, has made poverty and inequality worse.

Previous studies on fish pricing have generally concentrated about the price ranges and the price process's drift term since they are primarily interested in issues like price forecasting and market integration. As far as we are aware, not much research has been done on the characteristics of fish price volatility. As a result, through analysis and formally investigating the price process' volatility term this research adds to the study of fish prices. Essentially, we are looking for signs that the term "volatility" cannot be adequately characterized by a normally distributed random variable with a zero mean that is commonly thought to be independent. By using the GARCH model on our price time series, we do this econometrically (Bollerslev, 1986).

As far as the researcher is aware, there have been no studies on the volatility of fish prices in Nigeria could be discovered, despite studies on the assessment of fish price volatility in the literature. The lack of existing literature in this field served as the inspiration for this investigation. The study finds that the general level of volatility in the fish subsector across the research period is indicated by the long-term persistence of price volatility in the fish supply market utilizing the GARCH (Generalized Autoregressive Conditional Heteroscedastic) method estimate technique.

The goal of this research is to evaluate how much market price volatility there is for fresh, frozen, and smoked fish in Nigeria. We will also examine potential asymmetries in market-level volatility. Additionally, we look at the error term's distributional characteristics, to find non-normality traits like leptokurtosis and skewness in the price structure.

There are five sections in this research study. The introduction is in Section 1, and the literature review is in Section 2. The research methodology is covered in Section 3 and the data analysis and discussion of the empirical results are covered in Section 4. In Section 5, which closes the research investigation, it is described how to summarize, draw conclusions, and advocate policies.

2. LITERATURE REVIEW

2.1 Theoretical

The Storage of Theory, According to Williams and Wright (1991), the storage theory explains how investors will buy and sell commodities depending on their predictions of future price fluctuations. Speculators will store the commodity whenever the price is lower than the level they anticipate will succeed in the subsequent period in order to sell it at a greater price then. However, the route of the underlying supply shocks is simply followed by price dynamics when there are no incentives to store. Furthermore, loss aversion is further heightened since nominal price increases make individuals feel as though real price increases are occurring.

In the Cobweb Theory, Ezekiel (1938) first proposed this concept, which views price swings as endogenous (volatility is caused by market activity) as opposed to exogenous (as in the storage theory). Even though they are aware that the price will probably diverge in the following period, the agents' production decisions will be based on the market pricing. As a result, agents' expectations might cause price variations: when prices are high (low), they'll increase (reduce) production, resulting in the opposite low (high) prices in the subsequent period (Williams and Wright, 1991).

2.2 Empirical Literature Review

Since price volatility is a gauge of price uncertainty and affects income, fishing costs, pressure on fish populations, and food security, it is crucial to study (Pincinato et al., 2020). For risk managers and policymakers, Assefa et al. (2015) stress the significance of comprehending the scope and direction of price volatility transmission in food supply chains.

Several studies, including Ankamah et al. (2017), Gizaw et al. (2021), Guillen and Franquesa (2015), Jaffry (2004), and Simioni et al. (2013), confirm asymmetric price transmission.

Dahl and Oglend (2014), Asche et al. (2015), and Dahl (2017) conclude that aquaculture product prices are less variable than wild product prices in their analysis of price volatility. A number of noteworthy studies, including those by Oglend (2013), Solibakke (2012), Bloznelis (2016), Asche et al. (2019), and Dahl and Yahya (2019) look at the short-, medium-, and long-term patterns of price volatility dependency on markets for other species. Interconnected dynamics and volatility are a source of concern.

Dahl and Jonsson (2018) investigate the price fluctuation repercussions for seafood sourced from fisheries and aquaculture and conclude that there is less volatility in aquaculture production. Fish and crustacean imports from the EU, Japan, and the USA are the three largest regional import markets. Dahl and Jonsson (2018) analyze the price volatility spillover among these markets and find that there is a significant and unpredictable spillover of volatility from net exporting economies to net importing markets. According to past studies, Dahl and Jonsson (2018) evaluated the difference in price between seafood produced by aquaculture and fisheries and came to the conclusion that there is less volatility in aquaculture output.

Zheng et al. (2008) looked into the asymmetric news effect on US food markets. For 45 retail food items, they examined monthly data spanning 25 years. Their research revealed that a third of the marketplaces had asymmetric impacts, with surprise price rises being more unstable.

Buguk et al. (2003) discovered that substantial volatility (i.e., feed, farm, and wholesale prices) is transferred from the prices of menhaden, corn, and soybeans to the pricing of catfish by using an exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model to analyze price volatility transmission along the US catfish value chain. Also, in the study of price volatility transmission along the value chain for fresh wild hake in Spain, Ferrer-P'erez and Gracia-de-Rentera (2020) used first-hand sale, wholesale, and retail prices as well as an asymmetric MGARCH model and vector autoregressive (VAR) model. They came to the conclusion that the value chain exhibits time-varying volatility and asymmetric effects.

Risk will vary from region to region, as expected given the diverse backgrounds of each market. In this paper, symmetric and asymmetric models are employed to analyze fish price fluctuation on the market.

3. METODOLOGY

Monthly market prices for fresh, frozen, and smoked fish from 1995 to 2015 are included in the time series data used in this analysis. The data are derived from secondary source data collected from the Federal Department of Fisheries (2015). All prices are in Nigerian naira per kilogram.The Ordinary Least Squares approach can be used to estimate GARCH models. The OLS method should not be used frequently on small samples since error terms are not uniformly and independently distributed (iid(0,1).The maximum likelihood approach is preferable in this situation (Greene, 2012). The log likelihood function is maximized by the GARCH model's parameters.

Volatility model types

The ARCH Models (Family of Autoregressive Conditional Heteroskedasticity)

Every ARCH or GARCH family model requires two different specifications, the mean and variance equations. According to Engel, the ARCH model, which expresses the mean equation in the following way, can be used to model conditional heteroskedasticity in a return series:

$$y_t = E_{t-1}(y_t) + \varepsilon t \qquad (1)$$

such that $q_t = \varphi_t \delta t$

The mean equation, which also applies to other GARCH family models, is equation 1. E_{t-1} [.] is an expectation that depends on the knowledge present at time t-1, εt an error resulting from the mean equation at time t, and φt a series of independently distributed random variables (iid) with a mean of 0 and a variance of 1. $E\{ E_{t-1}/ \varnothing_{t-1}\}=0$; and $\delta^2 t = E\{ E^2_{t-1}/ \varnothing_{t-1}\}$ a nontrivial positive valued parametric function of $\O_{t-1}$. The following is the variance equation for an ARCH model of order q:

$$\delta^2 t = C_0 + \sum_{i=1}^{q} \alpha 1 \varepsilon 2t - I \qquad (2)$$

Where Co ≥0 and $\alpha_i \geq 0$ for i = 0, 1, 2,....q indicate the conditional variance at time t, Co is a constant, α_i = the parameters of the ARCH terms of order q, and ε^2_{t-i} = denote the lagged values of the squared prediction error for i = 1, 2, 3,..., q.

In order to address the question of how many lags of the squared innovations should be included in the ARCH model; Bollerslev (1986) introduced a generalized version of the ARCH model by modeling the conditional variance as a function of both its own lagged values and the lagged values of the squared innovations:

$$\delta^2 t = C_0 + \alpha\varepsilon^2_{t-I} + \beta\varepsilon^2_{t-I} \qquad (3)$$

Where $\delta^2 t$, $C_{0,}$, α and ε^2_{t-i} are as previously described in equation (2), δ^2_{t-1} denotes the one-period lag of the fitted variance from the model, and β is the GARCH coefficient. $\alpha \geq 0$ and $\beta \geq 0$,are necessary to ensure a well-defined GARCH (1,1) model, whereas $\alpha + \beta < 1$ is sufficient to ensure covariance stationarity.

Asymmetric effects in volatility modeling are possible with the TGARCH model, which Glosten et al. presented in 1993. They added an extra term to the GARCH model to account for any potential asymmetries in the data. The following is the TGARCH specification:

$$\delta^2 t = C_0 + \alpha\varepsilon^2_{t-I} + \gamma h_{t-1}\varepsilon^2_{t-I} + \beta\varepsilon^2_{t-I} \qquad (4)$$

where h_{t-1} is an indicator function that evaluates to 1 if $\varepsilon_{t-I} < 0$ and to 0 otherwise. C0, α and β and are as defined in equation (3), and γ is the asymmetry parameter. When $\mathcal{E}t\text{-}1$ is greater than 0, a positive shock is obtained, and when $\mathcal{E}t\text{-}1$ is less than 0, a negative shock is obtained. On the conditional variance, good news has an effect of $\boldsymbol{\alpha}$ and bad news has an effect of $\alpha + \gamma$. If $\boldsymbol{\gamma} > 0$, there is a leverage effect as negative shocks raise volatility more than an equivalent amount of positive shocks, and if γ = 0, news impact is asymmetric. If the asymmetry term (γ) is zero, the TGARCH model becomes the fundamental GARCH model.

Nelson (1991) expands the GARCH model to more accurately describe volatility clustering and the asymmetric effect. The EGARCH model is described as follows:

$$log\,(\delta^2 t) = C_0 + \alpha.(|\frac{\varepsilon t-1}{\delta t-1} - \sqrt{\frac{2}{\Pi}}|) + \gamma\,(\frac{\varepsilon t-1}{\delta t-1}) + \beta\, log(\delta^2_{t-1}) \qquad (5)$$

Where C_0, α, β and γ possess the definitions provided in equation (4). Given that the log of the conditional variance is on the left-hand side of equation (5), the leverage effect is probably exponential rather than quadratic. The conditional variance estimations should be optimistic as a result. The accurately depicts the asymmetric impact of earlier shocks via the $\boldsymbol{\gamma}$. News impact is asymmetric if the asymmetric term is γ < 0; otherwise, there is leverage effect. The effect of conditional shocks on the conditional variance is measured by α. A period shock that is positive has α + γ influence on the conditional variance, whereas a period shock that is negative has α – γ effect. The conditional distribution of the error term is typically assumed when estimating ARCH/GARCH models.

Stationarity Tests

Time series econometrics only functions when the underlying series is stationary. The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests' test statistics were used, the stationarity of the fish price series under examination was examined. The serial correlation in the error terms is taken into consideration by the PP test using nonparametric statistical methods, whereas the ADF test relies on parametric transformation of the model. Using the Schwarz criteria for information, the ideal number of delays was identified. For price series, at the 5% level of significance, the ADF and PP tests were not significant. (Table 1), confirming the level series' non-stationarity.

4. RESULTS AND DISCUSSIONS OF FINDINGS

This empirical analysis, which covers the years 2005 to 2015, uses the monthly average prices of fresh, frozen, and smoked fish. The Federal Department of Fisheries database is the source of the data.

Table 1: Test the unit root

	LEVEL			1st Diff.			
Variable(s)	ADF	@5%	PP	ADF	@5%	PP	Decision
Fresh	-0.36743	-3.02069	-0.47142	-3.80111	-3.02997	-3.80111	1(1)
Frozen	0.295486	-3.02069	0.244905	-3.4154	-3.02997	-3.3137	1(1)
Smoked	-0.73134	-3.02069	-0.69246	-4.79934	-3.02997	-4.79525	1(1)

Source: Authors' compilation (2023)

To confirm stationarity, both tests were determined at the 1% level, highly significant after differencing the series once. In order to properly model the fish price series, it was felt that the series needed to be first differentiated.

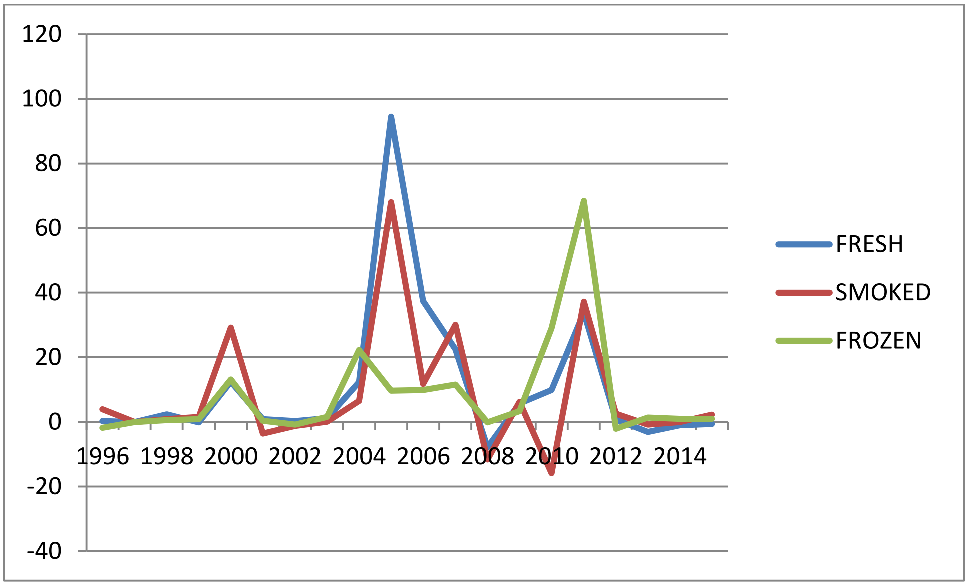
Table 2: Descriptive statistics

	FRE	FRO	SMO
Mean	380.6117	337.8947	686.5708
Median	317.8108	251.2838	704.4595
Maximum	770.8108	697.4324	1150.946
Minimum	123.4759	161.9189	300.7514
Std. Dev.	263.2356	210.5549	342.5898
Skewness	0.34619	0.939536	0.169146
Kurtosis	1.463246	2.186476	1.319181
Jarque-Bera	2.485877	3.668644	2.572146
Probability	0.288535	0.159722	0.276354

Source: Author's compilation (2023)

Both the price series for fresh, frozen, and smoked fish have a slight rightward skew, which means that the data's right and left tails are both longer than average. Less extreme outliers are produced by the series distribution than the normal distribution, as seen by the fact that the kurtosis values are below 3. The fish price series has seen large volatility, as evidenced by the high standard deviation in the mean price.

Figure 1: Price Movement in Fresh, Smoked, and Frozen Fish in Nigeria, 1995–2015



Source: Federal Department of Fisheries, (2020)

In figure 1, the yearly fish price series appears to have a mean, variance, and trend that fluctuate with time, proving that the series is not stationary with respect to covariance. A graphical study of the dataset revealed that volatility appeared at various points in time (Figure 1). Between 2004 and 2006, fresh fish prices were less predictable, while frozen fish prices were steadier between 1996 and 2003.

Volatility Model for the Price of Fresh Fish (PFR)

The prices of fish were calculated using the GARCH, TGARCH, and EGARCH volatility models, which are described in equations (3), (4), and (5). The TGARCH (1,1) was found to have the best volatility model for the price of fresh fish based on the model selection criterion since it had the lowest AIC value.

$$log\ (\delta^2 t) = -3.36900 - 0.78819\left(\left|\frac{\varepsilon t-1}{\delta t-1} - \sqrt{\frac{2}{\Pi}}\right|\right) - 0.97743\ \left(\frac{\varepsilon t-1}{\delta t-1}\right) + 0.41407 log(\delta^2_{t-1})$$

Table3: The summary of the volatility models for fresh fish pricing and the features

	GARCH	TGARCH	EGARCH
ω (cons)	0.0016 (0.0669)	0.0017 (0.0198	-3.36900 (0.000)
α (ARCH)	-0.0088 (0.1611)	0.1257 (0.2360)	-0.78819 (0.000)
β (GARCH)	0.5833 (0.5457)	0.5939 (0.0015)	0.41407 (0.000)

γ (Asymmetry)	-	-0.6347 (0.0738)	-0.97743 (0.00)
Positive shocks	-	-0.506	-1.76562
Negative shocks	-	0.7604	0.18924
Persistence	0.5745	0.7196	-0.3741
AIC	-3.008505	-2.875853	-3.448847*

Source: Author's compilation (2023)

The findings of the EGARCH model-based ARCH-LM test are shown in Table 6. The p-values possess all more than 0.05 demonstrating the EGARCH model's effectiveness in removing heteroscedasticity. The asymmetric coefficient is -0.97743, and the coefficients in an equation for variance are -0.78819. The overall leverage impact of -1.55859 implies that the market's volatility is more impacted by fish prices is more affected by bad news than by good news.

The parameters of the EGARCH model are assessed. The PFR's parameter εt-1 > 0 has a -0.78819+ (-0.97743) = -1.76562 times greater impact on the conditional variance when good news spreads in the market. On the other hand, when there is bad news in the market, the parameter εt-1< 0 has an influence that is multiplied by 0.18924, i.e., -0.78819 + (-0.97743). In Nigeria's fresh fish market, bad news has a stronger influence than favorable news.

The relationship between price value and volatility is negatively correlated, as shown by the overall leverage impact of -1.558590. According to a general theory put forward by Black (1976) and Christie (1982), negative shocks and news tend to enhance volatility more than positive shocks and news of the same magnitude. This implies that unfavorable surprises or news that could result in price hikes increase the volatility of fresh fish prices. The volatility of the price of fresh fish, for instance, is reduced by positive price shocks by (-1.76562), but negative price shocks of the same size increase volatility by (-0.1924).

In general, a negative shock results in higher volatility than a positive one. The observed degree of persistence in the two supply chains was used to determine the volatility shock's half-life, [log(0.5)/log(α +β)], which measures the time it takes for a shock to shrink to half of its initial magnitude.

The findings (Table 3) indicate that the fresh fish supply's half-life is estimated to be 0.705 months.

Volatility Model for the Price of Frozen Fish (PFRO)

According to Table 4's evaluations of the volatility models for frozen fish (PFRO), the model with the lowest AIC value, EGARCH (1,1), is better suited for predicting the price of frozen fish (PFRO) compared to the other two rival models.

Table4: An overview of the volatility models and their features

	GARCH	TGARCH	EGARCH
ω (cons)	0.0009 (0.6838)	5.3560 (0.0000)	-6.39513 (0.000)
α (ARCH)	-0,0089 (0.2320)	-0.0077 (0.5767)	0.70471 (0.4940)
β (GARCH)	0.5888 (0.5622)	0.5794 (0.0000)	0.01918 (0.8760)
γ (Asymmetry)	-	0.0162 (0.9962)	-1.03825 (0.3055)

Positive shocks	-	0.0085	-0.33354
Negative shocks	-	-0.0239	1.74296
Persistence	0.5799	0.5717	0.72389
AIC	-3.516747	-3.533847	-3.776762*

Source: Author's compilation (2023)

The outcomes of the EGARCH model-based ARCH-LM test are displayed in Table 7. The p-values are higher than 0.05, demonstrating the EGARCH model's effectiveness in removing heteroscedasticity. The asymmetric coefficients for the variance equations are -1.03825, while the coefficients of alpha are 0.70471. There is -0.02696 leverage effect overall shows that the volatility of fish market prices is more affected by bad news than by good news.

We assess the parameters of the EGARCH model. The FRO's parameter $\varepsilon t\text{-}1 > 0$ increases whenever positive news spreads in the market has an effect on the conditional variance that is 0.70471+ (-1.03825) = -0.33354 times greater. On the other hand, the parameter $\varepsilon t\text{-}1 < 0$ has 0.70471- (-1.03825) = 1.74296 when there is negative news in the market. In Nigeria's market for frozen fish, negative news has a stronger impact than favorable news. According to the frozen fish volatility model (PFRO), both positive and negative price shocks will have differing effects on the product's volatility. Though to a lesser extent, there is considerable evidence of persistence, which suggests that volatility shocks will still exist in the future.

Volatility Model for the Price of Smoked Fish (SMO)

The volatility models calculated for the price of smoke fish (SMO) and displayed in Table 5 demonstrates that the EGARCH (1,1) is the most effective model for the price of smoke fish.

$$log\ (\delta^2 t) = -1.9223\text{-}2.19583(|\frac{\varepsilon t-1}{\delta t-1} - \sqrt{\frac{2}{\Pi}}\,|) + 0.81950\ (\frac{\varepsilon t-1}{\delta t-1}) + 0.10101 log(\delta^2_{t-1})$$

Table5: An overview of the volatility models and their features

	GARCH	TGARCH	EGARCH
ω (cons)	0.0012 (0.5980)	2.2605 (0.0238)	-5.40804 (0.0000)
α (ARCH)	-0.0111 (0.0724)	0.0617 (0.2961)	-2.19583 (0.0000)
β (GARCH)	0.5789 (0.4694)	0.5846 (0.0015)	0.10101 (0.0000)
γ (Asymmetry)	-	-0.1639 (0.0001)	0.81950 (0.0000)
Positive shocks	-	-0.1022	-1.378334
Negative shocks	-	0.2256	-3.015326
Persistence	1.9704	0.6463	-2.09482
AIC	-3.239299	-3.143359	-3.562039*

Source: Author's compilation (2023)

It is established that the price of smoke fish (SMO) volatility demonstrates an asymmetric response to price shocks since the asymmetric factor is large and positive in the model provided in Table 5. The positive coefficient of the asymmetric term also demonstrates that the pricing effects of good technologies are less significant volatility than negative innovations do on absolute value, which indicates the presence of the leverage effect, which is shown by a value of -0.39635. The high significance of the ARCH and GARCH variables further argues in favor of including them in the design process. With regard to the other price ranges, the low persistence parameter for the price of smoke fish volatility (-2.09482) indicates that shock effects are more transient than previously thought.

In summary, the outcomes of the EGARCH model-based ARCH-LM test are displayed in the appendix. The p-values are higher than 0.05, demonstrating the EGARCH model's effectiveness in removing heteroscedasticity.

It was found out that the market price volatility of fresh, frozen, and smoked fish is asymmetrically affected by negative and positive shocks, favoring price declines (0.98, -1.04, and 0.2, respectively). This means that unexpected price rises cause certain commodities' prices to fluctuate more than unexpected price decreases of the same magnitude. The outcome was consistent with Zheng et al.'s (2008) and Cermak's (2017) findings on asymmetric results in the prices of food commodities.

The leverage effect is demonstrated by these models' asymmetries in their parameters (-1.56, -0.027, and -0.396) in fish prices, indicating that the magnitude of neither positive nor negative shocks have an equal influence the seafood market's price volatility in Nigeria. The results corroborate Assefa et al. (2015).

5. CONCLUSION AND POLICY RECOMMENDATIONS

The large value of the standard deviation in the mean price suggests that fish price levels during 2005–2015 experienced wide fluctuations. The squared residuals of the conditional mean models revealed a strong autoregressive conditional heteroscedastic (ARCH) effect, despite the absence of any indication of serial correlation. The three different fish price types were modeled as zero-mean, serially uncorrelated processes with conditionally non-constant variances for series with large ARCH effects.

In this regard, a symmetric GARCH model and two asymmetric GARCH models were fitted to each of the three fish price types with a view to coming up with the best model for obtaining reliable estimates of their conditional variances. In order to determine the optimal model for generating accurate estimates of their conditional variances, three different fish price types were fitted to symmetric and two asymmetric GARCH models. The EGARCH (1,1) model was determined to be suitable for the three fish prices based on the AIC model selection process.

The rather significant difference in the GARCH term's value from the ARCH term's value suggested that over the study period, fresh, frozen, and smoked fish supply chains in Nigeria have seen a rise in average prices.

Frozen fish prices (0.72) had a higher persistence parameter compared to fresh fish prices (-0.37) and smoked prices (-2.09). The asymmetric terms in the three fish price variance models were likewise significant, showing that their volatilities reacted asymmetrically to changes in fish prices. Asymmetry in these model' specifications demonstrates the leverage effect in fish prices, indicating that negative shocks do not have the same magnitude as positive shocks and have an equal impact on the volatility of fish prices in the Nigerian fish market.

High and persistent fish price volatility and the ensuing uncertainty pose a threat to a sustainable way of life in Nigeria because they will make proper agricultural and economic planning challenging, impede household decisions regarding sustainable and long-term fish consumption, reduce demand for affected fish commodities, and increase the risk of chronic low nutrient intake because the majority of volatility is brought on by price increases. Given that the asymmetry effect demonstrates that price rises have a bigger impact on price volatility, the findings imply that the government should concentrate more of its attention at the level of fish prices, particularly high fish prices, than on price volatility generally.

Also, for the sake of national food security and self-sufficiency in fish production, and in particular to the elimination of time delays and seasonal variations in the Nigerian fish sector, the federal government should ensure sustainable development of the nation's fisheries.

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Appendix

Table 6.Results of the ARCH-LM test for the EGARCH model.

	F-statistics	Probability	Obs R^2 Statistics	Probability
PFR	0.2875853 .	0.5925	0.289250	0.5907

Source: statistical results.

Table 7. Results of the ARCH-LM test for the EGARCH model.

	F-statistics	Probability	Obs R^2 Statistics	Probability
PFRO	0.002702.	0.9586	0.002724	0.9584

Source: statistical results.

Table 8. Results of the ARCH-LM test for the EGARCH model.

	F-statistics	Probability	Obs R^2 Statistics	Probability
PSM	0.433166.	0.51100	0.435898	0.5091

Source: statistical results.