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Fish Price and Volatility Trends: An Assessment of Nigeria's Fishery Subsector

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Abstract
In recent years, there has been an increase in the general price of fish thereby reducing access by the poor. Hence, the factors driving the price increase were examined. Secondary data from the Nigerian Bureau of Statistics and the Central Bank of Nigeria were used. A monthly data on real fish prices, real meat prices, crude oil price, exchange rate, real transport cost and food inflation rate over a period of 86 months was obtained. Descriptive analysis and pictorial representation of the trends were presented. Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests were carried out. The GARCH model was adopted in identifying factors responsible for the volatility observed. Results revealed that the variables were stationary at first difference. The graphical representation of the prices showed that variables such as fish prices and meat prices had upward trends while crude oil price and food inflation rate had unpredictable fluctuations until late 2014 when it began the sudden and continuous upward trend. The Johansen test of co-integration was performed on the integrated variables, they were found to be co-integrated and so the normalized coefficient was reported. The exchange rate variable was found to have a long run relationship with fish prices. The GARCH results revealed that variables such as meat prices, transport prices, crude oil price and food inflation rate have significant impact on the fish price. The policy recommends aquaculture development in order to reduce Nigeria's dependence on fish imports and to stabilize fish prices.

Keywords: Fish, price volatility, GARCH model and ADF.

1.0 Introduction

The fisheries sector has maintained a steady contribution to total GDP within 2000-2004 according to CBN published figures, translating to about 5% of agricultural GDP. In terms of trade, Nigeria remains the highest importer of fish and fishery products in Africa. The Nigeria fisheries sub-sector contributes about 3% to 4% to the country's annual GDP and is an important contributor to the population's nutritional requirements, constituting about 50 percent of animal protein intake. In addition, the sub-sector generates employment and income for a significant number of artisanal fishermen and small traders. Although captured fisheries have now been declining, Nigeria has a big potential in both marine and fresh water fisheries including aquaculture. In spite of this high potential, domestic fish production still falls far below the total demand, which was estimated at 2.2 million metric tons per year in 2008. As a result, the country imports about 60 percent of the fish consumed.

The United States Development Agency (USDA) report in 2012 showed that Nigeria produces about 600,000 tons of fish annually from aquaculture and capture fisheries but the country fish supply shortfall is about 900,000 million tons. The market gap is met through imports of mainly mackerel, herring, horse mackerel, croaker and blue whiting from Europe, Latin America and Asian countries. Worth more than 850 million dollars in addition to more than 180,000 tons of stock fish (whole and parts) are supplied by Scandinavian exporters and valued at more than 450 million dollars per year. According to the United Nations, Nigeria's population of 170 million people may exceed 210 million by 2020 and the demand for fish protein is expected to grow by another 700,000 metric tons over the same period. The implication of a price fluctuation in this regard might mean harm or good for the nation depending on the direction of change. Volatility is the fluctuation in the value of a variable especially price (Routledge, 2002) i.e. the statistical measure of the variability (dispersion) of a variable or index. Englama *et al* (2010) defined volatility as the rate of change in price over a given period. The fluctuations in price may create uncertainty about the future path of the commodity in question. Issues centering on fish price volatility and the effects of such on economic units and food security forms the thrust of the research work and remains the drive for a critical study of price volatility in the Nigerian fish subsector.

Taking a critical look at the problem of poverty traps caused by price volatility, it could have harmful effect on health and nutritional well-being of consumers, increased susceptibility to diseases, reduced school enrolment, result in loss of human capital, and all these episodes can result in poverty traps whereby a one-time shock has permanent effects. Taking a deep look at the problem of reduced investment in a market situation where credit markets do not function well and income is highly volatile, volatile prices could exacerbate this effect. Fish importers might be afraid that an adverse price shock might lead them into poverty traps, they may be reluctant to adopt technologies that provide greater long run returns, looking at the macroeconomic implication, a country like ours with a larger share of consumer spending on food with the poor having fewer assets than the rich which makes them less able to cope with volatility. The fact that the cost of unstable prices is greater than the benefits does not imply that instability should be reduced. Before making this assertion, the cost of price volatility must be compared to the cost of mitigating its impacts and this should propel policy makers to take firm steps.

Akegbejo-Samsons (1997) posited that with the population growth rate of Nigeria at 4-5% and livestock production at 2-3% growth rate, there pose a problem of protein consumption deficit, the consequence which might be soaring cost of animal protein which will have a greater impact on the poor segment of the populace. This large deficit is augmented by massive importation of frozen fish with the country spending huge amounts on these importations, with 2000-2007 foreign exchange figures on fish importation at $594,373.69 million with much more alarming figures in recent times. It is necessary to look at the factors which could keep these figures getting higher. To know if such is determined by factors from the local market or factors from the international market such as volatility of crude oil price. In volatility studies, policy makers must place more focus on its determinants since the solutions depends largely on the nature and types of causes. Therefore, an analysis to understand why prices evolve as they do and mainly what explains the variations in prices is a central question for our economy (Deaton, 1999). Tight market conditions for essential agricultural commodities pose policy challenges for national governments as well as for international organizations. There have been efforts by countries through policies to curb volatility issues but these come at high economic and fiscal cost and there is no guarantee that market interventions reduce domestic price volatility. In order to take the right policy decisions, we need to understand what caused the current price spike, what the implications may be for prices and price volatility in the future, and how various countries and members of society may be affected. Evidence from OECD, 2008 report shows that the impact of high agricultural commodity prices on developed countries is relatively modest but for the urban poor and the major food importing developing countries, the impacts will be strongly negative as an even higher share of their limited income will be required for food also these populations derive a large proportion of their income from trade in basic food products. The main objective of this study is to assess price volatility in the Nigerian fish subsector and examine the factors causing it.

A major reason for volatility has been argued to be low elasticities of the short run supply and demand, if this holds however, one should see a change in the degree of volatility as production and consumption evolve (Balcombe, 2015). Empirical evidence has shown that volatility of many time series does not stay constant, however changes in volatility are evident in simple plots of the absolute changes in prices from period to period and this shows that there is a shift in the average volatility of many agricultural prices. The Autoregressive Conditional Heteroscedasticity (ARCH) and its generalized forms (GARCH) posited in its principles that while there are periods of relatively high and low volatility, the underlying unconditional volatility remains unchanged. This evidence of ARCH and GARCH is widespread in series that are partly driven by speculative forces and may also be present in the behavior of agricultural prices. There may be long run increases or decreases in the volatility of the series, this could be accounted for by including a trend variable among the explanatory variables in the analysis. Another alternative is that volatility has a stochastic trend. This trend can be explained by the dynamics of agricultural investment. High prices trigger a rush of investment and technological development that succeeds in raising production and lowering prices. In contrast, persistent low prices lead to a reduction of public interest and waning investment. This situation persists until supply is so low that prices begin to spike which again triggers a new round of investment.

According to Gilbert, 2010 there are three types of agricultural policies that affect commodity price behavior: Firstly, policies related to production can have indirect impacts on market prices. Production subsidies, for example, can set suboptimal incentives to farmers, distort input allocation, and may lead to inefficient supply levels for different crops. Secondly, trade policies can directly affect commodity prices in the form of taxes. Eugenio 2010 claimed that trade policies may lead to lower or higher volatility in production, stocks and prices at the world and/or national levels for different commodities and markets. There is a possibility that trade and trade policies may help or harm stability of food availability, food prices and household incomes. Export bans could

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stabilize domestic prices and help preventing supply shortages. Lastly, price stabilization policies affect market prices. Among the direct price stabilization polices are buffer stocks, emergency reserves, price controls, and most rigorously prohibition of private trade. Apart from that, marketing boards have been provided monopoly power for grains in a number of countries throughout the 20th century. However, their influence was reduced during the liberalization process within the last 30 years. Most commonly used are buffer stocks and emergency reserves. Both imply the public participation in commodity storage. The latter involves market intervention through stock releases only when food prices spike. Unlike, buffer stocks schemes are always involved in buying and selling grain to guarantee that market prices only move within a price band. The bandwidth is restricted by publicly announced floor and ceiling prices. This intervention can stabilize commodity prices. Yet, stabilizing effects depend on the choice of bandwidth, institutional design of the organization, and its fraction of the total volume traded. However, a thorough policy assessment of actual stabilization programs is difficult since without comparison is not possible.

Theoretical Framework.

The cobweb theory explains the movement of agricultural prices. The cobweb model is an economic model that explains periodic fluctuation in prices of agricultural goods. It describes cyclical supply and demand where the amount produced must be chosen before the prices are observed. Producers' explanations about prices are assumed to be based on observations of previous prices. The model was coined 'cobweb theorem' in 1934 by Nicolas Kaldor. The cobweb model is based on time-lag between supply and demand decisions by farmers. For instance, if there is high price of maize and farmers expects this high price to continue, they would raise their production of maize relative to other crops. Therefore, when they go to the market, the supply will be high, resulting in low prices. If on the other hand, they anticipate low price to continue, they would decrease their production of maize for the next year, resulting in high prices again. Thus, the circle continues in a cobweb manner. Cobweb model is used to describe the dynamics of demand, supply and price over long period of time. There are many perishable agricultural commodities whose price and output are determined over long periods and they show cyclical movement. As prices move up and down the circle, quantities produce also seem to move up and down in a counter-cyclical manner. The cobweb model is an over-simplification of the real price determination process. The cobweb model is not merely an adjustment process of the market equilibrium but it also predicts on observable events. Its significance lies in the demand, supply and price behaviour of agricultural commodities. The theoretical framework of this study is based on Generalized Autoregressive Conditional Heteroskedasticity modeled by Tim Bolerslev (1986) and Exponential General Autoregressive Conditional heteroskedasticity modeled by Daniel Nelson (1991). Bolerslev introduced the GARCH model by extending the work of Robert Engle (1982) framework and has been popular since the early 1990s.

2.0 Materials and Methods

Nigeria covers a land area of 923,768 km^2 with 1.4% covered by water. It is located in West Africa and shares border with Republic of Benin in the West, Chad and Cameroon in the East and Niger in the North. Its coast in the south lies on the Gulf of Guinea on the Atlantic Ocean. It has a population of about 206139589 (World Population Prospects (2019 Revision), 155,215,573 (2010 estimate). Secondary data from Nigerian bureau of statistics and Central Bank of Nigeria was used. It comprised of monthly data collected over variables such as fish prices, Agricultural GDP, Meat price, Oil price, transportation index from January 2009-December 2016. The variables were tested for stationarity using the ADF test. The analytical technique used are descriptive statistics. The Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) tests were used to find out if the variables were stationary and to what degree. Johansen co-integration technique seeks the number of co-integrating relations or rank while the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Model was used to identify factors responsible for the volatility in fish price series.

General Autoregressive Conditional Heteroskedasticity Model (Garch)

The Generalized Autoregressive Conditional Heteroskedasticity was modeled by Bolerslev (1986) and Exponential General Autoregressive Conditional heteroskedasticity modeled by Nelson (1991). Bolerslev introduced the GARCH model by extending the work of Robert Engle (1982) framework and has been popular since the early 1990s.

$$h_t = \propto_0 + \propto_1 \mu_{t-1}^2 + \beta h_{t-1}$$

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The equation of the mean is a function of a constant, one regressor and an error term, the error term μ_t μ_t is called white noise $(0, \sigma_t^2)$. The variance equation for GARCH (1, 1) is written as a function of a constant term, the ARCH term which means autoregressive conditional heteroskedasticity captures reports about volatility from the earlier period measured as the lag of squared residuals from the mean equation and the last forecast period. The coefficients α and β are positive to make sure the conditional variance is always positive (Roman, 2010). The non-negativity restrictions are considered necessary to guarantee that ht> 0 in all periods and the upper bound α + β<1 is required in order to make the ht stationary and consequently the unconditional variance finite. The condition α + β <1 may not be met due to 35 persistent instability of many financial time series but a unity sum of both and leading to the integrated GARCH (IGARCH). It is used by several professionals in several areas including, trading, investing, hedging and dealing. The process for GARCH model involves three steps: estimate the best fitting autoregressive model, compute autocorrelations of the error term and lastly test for significance. GARCH method presumably captures risk in each period more sensibly than simply rolling standard deviations which gives equal weights to correlated shocks and single outliners. The model is premised on two different specifications. There is one for the conditional mean and another for the conditional variance (Onwusor, 2007).

$$\sigma_t^2 = w + \sum_{i=1}^{p} \alpha_t \varepsilon_{t-1}^2 + \sum_{t=1}^{q} \beta_i \, \sigma_{t-1}^2$$

The innovation here is that GARCH allows past conditional variances into the equation, the intention of GARCH is that it can parsimoniously represent higher order ARCH process, GARCH models explain variance by two distributed lags, one on past squared residuals to capture frequency effects and the second on lagged values of the variance itself to capture longer term influences. The GARCH (1, 1) model embodies a very intuitive forecasting strategy: the variance expected at any given date is a combination of a long run variance and the variance expected for the last period, adjusted to take into account the size of last period's observed shock. In the GARCH (1, 1) model, the effect of a return shock on current volatility declines geometrically over time. Despite the success of both ARCH and GARCH models (Bolerslev *et al*, 1992)) these models cannot capture some important features of financial and economic data. The most interesting feature not addressed by these models is the leverage or asymmetric effect also the GARCH (p, q) model has the unconditional distribution of the Et having fatter tails than the normal distribution but in a GARCH (1, 1) model for the conditional variance, the failure to model the fat-tailed properties lead to spurious results in terms of the estimated risk-return tradeoff.

Unit Root Test or the Test for Stationarity

The unit root test is carried out before the GARCH analysis can be carried out; this is because it is necessary to test for the presence of a unit root in a variable. A unit root test tests whether time series variable is non-stationary using autoregressive model. A test that is very popular and valid for large samples is the Augmented dickey fuller (ADF) and another test that can be used is Phillips Perron test. They are used to determine the order of integration of a variable.

The ADF test for unit roots requires the following regression:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \sum \Delta Y_{t-1} 1 + e_t$$

Where:
ΔYt = the first difference of Yt
β = test coefficient
et = white noise
A unit root test implies testing the significance of b against the null that b = 0.

The decision rule states that the t-statistics on the coefficient of the variable (β) which is expected to be negative, must be significantly different from the critical values for a given sample size if the null hypothesis is to be rejected. The null hypothesis is that the variable of interest is non-stationary. That is, integrated of order one. If this is accepted, the series is non-stationary. The test states that if a particular series say Y has to be differenced n times (number of times, 1, 2, 3… n) before it becomes stationary then Y is said to be integrated of order n (it is written as I(n)). If the series is stationary at level it is said to be integrated to order 0 (I(0)), that is there is no unit root. If a variable is differentiated once in order for it to be stationary it is said to be integrated to order 1 that is I(1). The test statistics of the estimated coefficient of Yt is then used to test the null hypothesis that the series is

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non-stationary (has unit root). If the absolute value of the test statistics is higher than the absolute value of the critical T value (which could be at 1, 5, or 10 percent) then the series is said to be stationary, therefore we reject the null hypothesis, otherwise it has to be differentiated until the series is stationary.

Johansen Co-Integration Technique

This technique is solely based on the premise that long run co movement exists between trended economic time series so that there is a common equilibrium relation which the time series have a tendency to revert to, in the eventuality of a time series not stationary, a linear combination of them may exists that is stationary. Oyetunji, 2013 further stated that a lot of economic series behave like I(1) processes that is they seem to drift all over the place, but another thing to notice is that they seem to drift in such a way that they do not drift away from each other. Formulating it statistically you will come up with a co integration model.

The choice of the use of this technique in this study is based on the fact that most time series data are not stationary, meaning they have no constant mean, variance and auto variance for every successive lag, so the use of the conventional OLS method of estimation would only yield invalid results. The technique is also a convenient approach for the estimation of long run parameters with unit root and provides a direct test of the economic theory and enables utilization of the estimated long run parameters into the estimation of the short run disequilibrium relationships. The technique is a procedure for testing co-integration of many I(1) time series, it permits more than one co-integrating relationships and this makes it more applicable than the Engle-Granger test which is OLS based. There are two types of Johansen test, Trace and Maximal Eigen value which are used to test for co integration and they are also used to determine the number of co integrating vectors. Both tests do not always indicate the same number of co integrating vectors.

A Priori Expectation

The A priori expectation provides expected signs and significance of the value of the coefficient of the model parameters to be estimated in light of economic theory and empirical evidence.

There are sound reasons for believing strong positive links exist between fish price and factors such as exchange rate, oil price, transport price and meat price.

$\beta1>0$, $\beta2 > 0$

The coefficient of exchange rate is said to be positive, that is fish prices will move in its direction.

The coefficient of oil price is also expected to be positive, that is upward movement in oil prices will also mean upward movement in fish prices.

The coefficient of transport price is also expected to be positive, that is upward movement in oil prices will also mean upward movement in fish prices.

The coefficient of meat price is also expected to be positive, that is upward movement in oil prices will also mean upward movement in fish prices.

The coefficient of food inflation rate is also expected to be positive, that is upward movement in oil prices will also mean upward movement in fish prices.

3.0 Results

Price Trends: Graphical representation

The pattern of the real price of composite fish in the Nigerian fish sector which included real prices of both locally produced and imported fish is shown in figure 1. The graph also depicts a uniform upward trend in the price. Further analysis was used to know what factors account for this price movement and proper policy recommendations made as to how farmers can position themselves rightly under such price regime. The use of the real prices of fish was out of a need to put in account the effect of inflation while studying the price fluctuations.

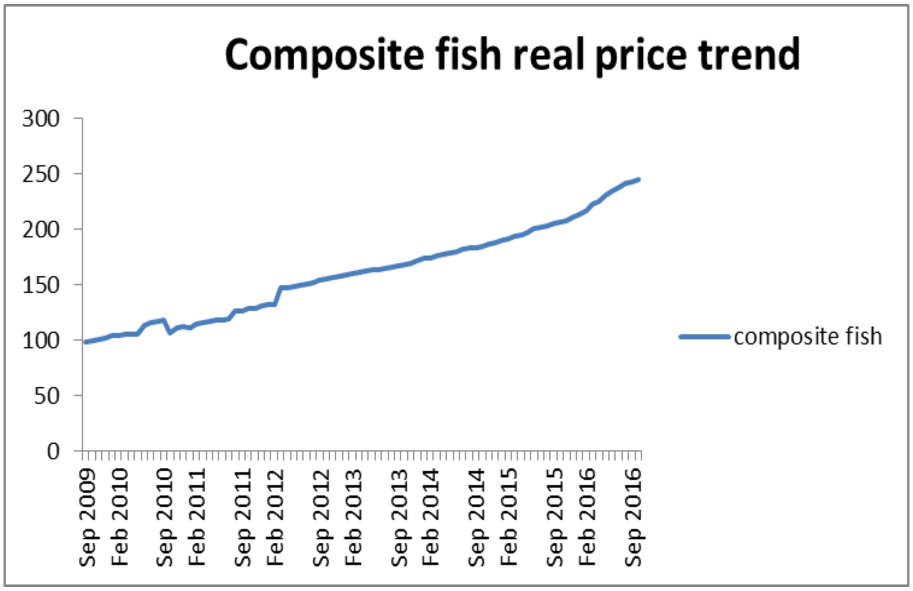

Figure 1. Composite fish real price trend.
Source; NBS data, January 2009-December 2016.

Figure 2 shows the composite meat price trend and this was meant to depict diagrammatically the relationship between fish prices and meat prices as such could be a predicting tool for investors that would like to forecast the price of fish. The graph showed an upward trend that is very similar to the trend in the real prices of fish, to ascertain this perceived relationship, a more valid econometric analysis such as co-integration test was carried out to validate this claim. Similar to fish prices, there was a slight fluctuation in the prices between the year 2010 and 2012 which could further indicate a very close relationship between the two variables. The use of the real price of meat was also to account for inflationary effect in the examination of the price trend.

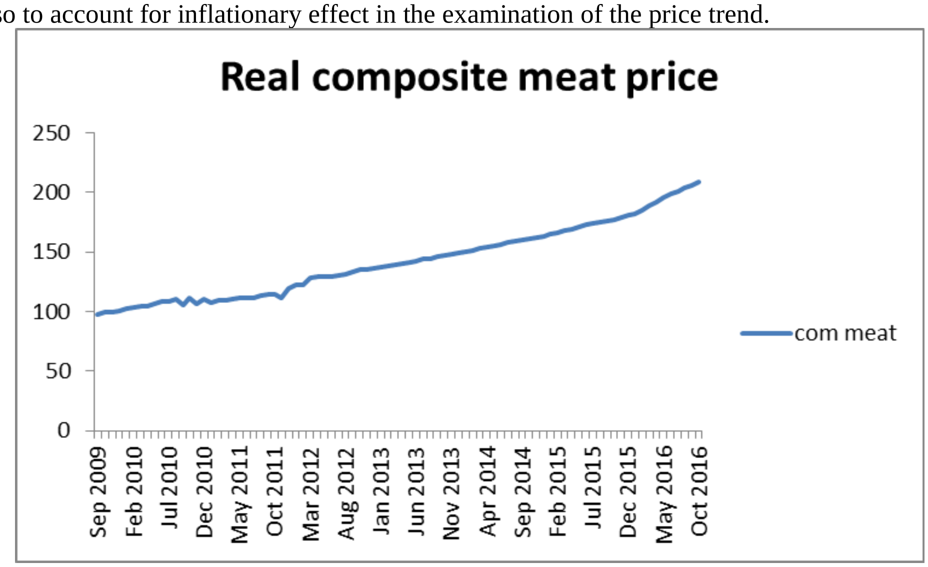

Figure 2: Composite meat real price trend.
Source; NBS data, January 2009-December 2016.

From September 2009 to May 2011, figure 3 revealed a fluctuating but upward growth in Nigerian crude oil price in the export market, remained stable for some months and got to its trend peak in 2012 but with the excessive supply in the world global oil market in 2014, there was a significant drop in oil price which could have affected a major import commodity like fish. In late 2015 there was more further decline in crude oil price with resultant effect on other variables had been revealed in the econometrics analysis in the next section.

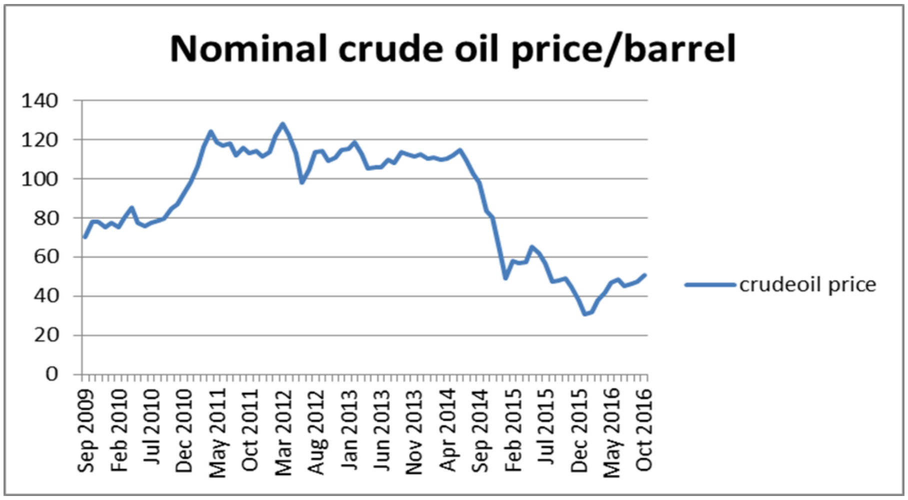

Figure 3. Nominal crude oil price trend.
Source; CBN statistics, January 2009-December 2016.

The food inflation rate trend revealed a very unbalanced state of food prices in Nigeria. Figure 4. The factors showed from literature that could be responsible for a wavy trend include global price volatility transmission, climate issues, exchange rate fluctuations, pest and disease outbreak etc. however, from late 2015 the curve showed an upward trend in food inflation rate which could be a pointer to the fact that prices of fish would predictably be on the increase in a short while.

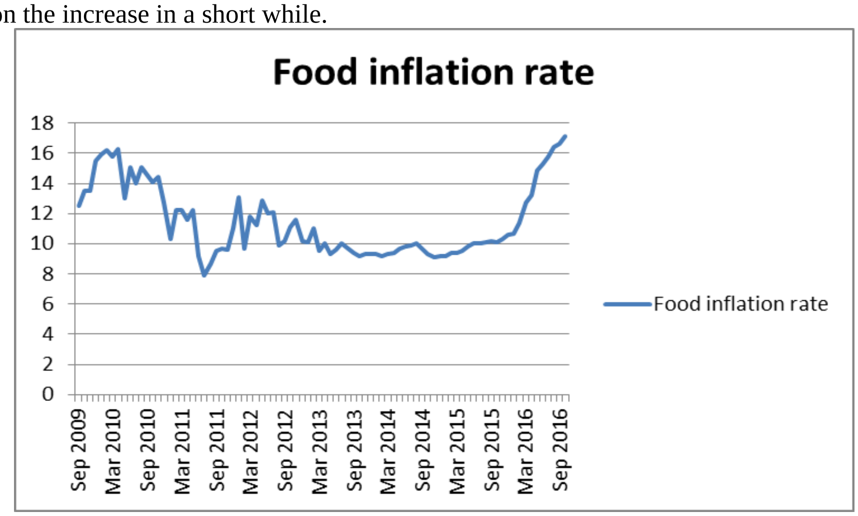

Figure 4: Food inflation rate trend.
Source; CBN statistics, January 2009-December 2016.

The exchange rate trend over the seven years period revealed a balanced trend from 2009 to early 2015 when the upward trend began which could be literarily attributed to the global fall in oil price but a further downward trend as seen in the crude oil price trend might have led to the exchange rate jump in early 2016 coupled with the devaluation of the naira by the government, however the major focus of this study is to see how all these trends in all this variables affect the fish subsector with the major reflector being fish prices.

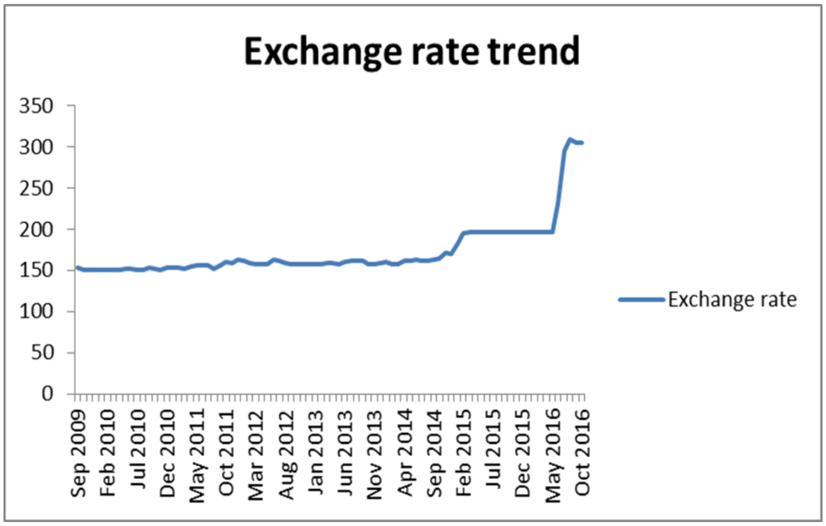

Figure 5: Exchange rate trend
Source; CBN statistics, January 2009-December 2016.

Figure 6 also showed a very similar trend with meat and fish price trend which could tentatively point at an association of transport, fish and meat prices. Although, concrete assertions cannot be made on graphical results, further probe was done to establish if there be any cause and effect between the variables.

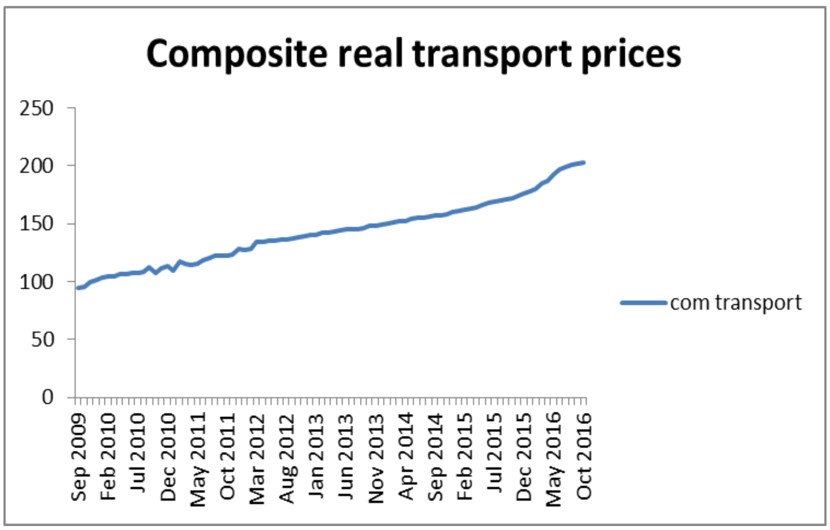

Figure 6: Composite real transport price trend
Source: NBS data, January 2009-December 2016.

Descriptive Statistics of Data Used

Tables 1 and 2 show a description of the data set with respect to the mean, standard deviation, minimum, maximum values, the skewness, kurtosis and total number of valid data points. From table 1, it can be deduced that there is a huge deviation 40.97 from the average real price of fish at ₦160.63 which could point at the presence of volatility in the series, the maximum value of the constant fish price could also help investors have a feel of the highest historical real price of fish. The skewness-standard error coefficients showed that the composite fish price is drawn from a normally distributed population. The kurtosis-standard error coefficient also showed a normally distributed population from which the sample is drawn as both coefficients lie within the +/-1.96 range. Examining the deviation in the real transport prices, it is also clear that there is a wide deviation 27.91 from the mean 142.81. The skewness and kurtosis coefficients however showed that the sample was drawn from a normally distributed

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population although with smaller base when compared with the composite fish price series. The composite meat price series shows a strong deviation of 30.69 from its mean value of 142.17 with minimum and maximum values of 97.41 and 208.79 which is very close to the minimum and maximum real price values of composite fish 98.15 and 244.84, this could mean a co-movement between fish and meat prices. However, the kurtosis and skewness coefficients reveal that the sample was drawn from a normally distributed population as the skewness/standard error and kurtosis/standard error figure fell between +/- 1.96.

Table 1: Summary of descriptive statistics

Descriptive	Composite fish price		Composite transport price		Composite meat price	
	Statistic	Std. Error	Statistic	Std. error	Statistic	Std. error
Mean	160.63		142.81		142.17	
Std. Dev	40.97		27.91		30.69	
Minimum	98.15		94.93		97.41	
Maximum	244.84		203.39		208.79	
Skewness	0.222	0.260	0.281	0.260	0.379	0.260
Kurtosis	-0.930	0.514	-0.637	0.514	-0.892	0.514
Valid (N)	86		86		86	

Source: NBS and CBN data, January 2009-December 2016.

The information from the food inflation rate series showed the series has a very low level of fluctuation with its standard deviation at 2.37 from a mean value of 11.45. The results also revealed a peak value of 17.09 which raises questions on the impact of such value on fish prices, the skewness and kurtosis. Values however revealed that the series is not normally distributed. The exchange rate series revealed a strong deviation of 34.07 from its average value of 172.47. This fluctuation could have strong implications on the prices of imported products such as fish. The peak value of 309.73 could be as a result of currency devaluation or fall in the price of Nigeria's major export commodity which is crude oil. The skewness and kurtosis values however revealed a series which is not normally distributed. The standard deviation coefficient of 27.99 of the crude oil price also revealed a wide movement away from the mean value of 88.35. Facts from literature has established a positive linear relationship between crude oil prices and transport prices which could have an effect on fish prices. This study will however assert claims in that regards. The skewness and kurtosis however revealed that the series is not normally distributed. Olomola and Nwafor , 2018 observed that During the period 2009-2016, overall food prices (indicated by the food price index) continued to rise steadily depicting a trend with imperceptible volatility. Moreover, there is virtually no significant divergence between the trend of general consumer prices and food prices (The persistent rise in food prices is not unexpected in view of the supply-demand imbalances, rising population and rising cost of production and marketing. Government program and policies have been targeted at reducing the cost production to stabilize price and make food affordable to consumers. However, the extent to which such policies have helped to tame food inflation varied over the years and has sometimes been influenced by some other policies (such as exchange rate, interest rate and trade policies) that are not specific to the agricultural sector).

Table 2: Summary of descriptive statistics

Descriptive	Food inflation rate		Exchange rate		Crude oil price	
	Statistic	Std. Error	Statistic	Std. error	Statistic	Std. error
Mean	11.45		172.47		88.35	
Std.Dev	2.37		34.07		27.99	
Minimum	7.90		150.00		30.66	
Maximum	17.09		309.73		128.00	
Skewness	0.867	0.260	2.81	0.260	-0.524	0.260
Kurtosis	-0.496	0.514	8.34	0.514	-1.147	0.514
Valid (N)	86		86		86	

Source: NBS and CBN Data January 2009-December 2016.

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Factors Driving Price Volatility in the Fishery Subsector

Unit root test

Unit root test is carried out to determine if the variables are stationary and if not, to dine their order of integration (i.e. number of times they are to be differenced to achieve stationarity). In standard econometric analysis of the data used in research, a stationary test was carried out; this is due to the fact that most time series data are non-stationary. The Augmented Dickey Fuller test (ADF) for unit roots and the Phillips Perron (PP) test were conducted for at the time series employed in the study. The table shows that all the variables are not stationary at level. This can be seen by comparing the observed values (in absolute terms) of the augmented dickey fuller (ADF) and Phillips Perron test statistics with the critical value (also in absolute terms) at 1%,5% and 10% level of significance. As a result of this, the variables were differenced once and from the table above. It can be seen that the variables are stationary at first difference since all the variables are integrated of the same order.

Table 3: Test for Unit Root

Variables	Augmented-dickey fuller test (ADF)				Phillips Perron test (PP)			
	Level	Order of Integration	First difference	Order of Integration	Level	OI	First Difference	OI
Composite fish	1.4885	I(0)	-10.1194*	I(1)	1.6600	I(0)	-10.0777*	I(1)
Composite meat	3.9412	I(0)	-3.5996*	I(1)	3.1055	I(0)	-12.3097*	I(1)
Composite transport	1.7327	I(0)	-3.7445*	I(1)	1.4811	I(0)	-11.2016*	I(1)
Exchange rate	2.7157	I(0)	-6.4568*	I(1)	2.5460	I(0)	-4.7076*	I(1)
Crude oil price	-0.9385	I(0)	-6.7690*	I(1)	-0.8492	I(0)	-6.7690*	I(1)
Food inflation rate	-1.4268	I(0)	-12.0756*	I(1)	-1.4268	I(0)	-12.0756*	I(1)

Source: Computed by Author using E-views 5.1 * Variable stationary at 1%, 5% and 10% critical values.
** Variables stationary at 5% and 10% critical values *** Variables stationary at 10% critical values

Johansen Maximum Likelihood Test of co-integration

The test seeks to find out if a linear combination of the independent variable becomes stationary over the long run which if it is means that co-integration exists among the variables, meaning there is a long run relationship among the variables. This test seeks out the number of co-integrating relations or rank using the Johansen's maximum Eigen value and the trace test. The results are shown in the table below. Considering the result of the trace test, it is evident that we are to reject the null hypothesis H0 that there is no co-integrating relationship between the variables as the result shows that there is one co-integrating equation at the 0.05 level of significance.

The Maximum Eigen test result also rejects the null hypothesis of no co-integration among the variables and shows that there is a co-integrating equation at 0.05 level of significance. Since both test yields same result, this shows that these variables considered have equilibrium condition which keeps them in proportion to each other in the long run. The test however proceeds to exactly identify the Johansen Maximum likelihood estimates showing the co-integrating coefficients normalized to composite fish price. This helps us better in the understanding of the long run relationships among co-integrating variables.

Table 4: Johansen Maximum Likelihood Test of co-integration

Number of co-integrating equation H0:	Trace statistic		Maximum Eigen value	
	Statistic	0.05 Critical value	Statistic	0.05 Critical value
None	99.49196	95.75366	45.99080	40.07757
At most 1	53.50116*	69.81889*	21.70940*	33.87687*
At most 2	31.79176	47.85613	17.93056	27.58434
At most 3	13.86121	29.79707	7.056711	21.13162

Source: Computed by the Author using E-views 5.0
*Reject H_0 for the co-integrating rank test (Trace and Maximum Eigen Value) Statistic
The hypotheses are stated below

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H_0: there is no co-integrating relationship among the integrated variables
H_1: there is a co-integrating relationship among the integrated variables

Normalized co-integrating coefficients

The t-statistic was used to determine the statistical significance of each variable. To determine the co-integrating relationship, the rule of thumb is that, a variable is said to be statistically significant if the absolute value of its t-statistic is approximately 2 or above. The results finally showed that a long run relationship exists between fish prices and exchange rate, this could also be stated in long run elasticity terms, meaning that exchange rate is elastic in relation to fish prices, a change in exchange rate will cause 15.2% change in fish prices in the long run.

Table 5. Summary of normalized co-integrating coefficients

Variables	Composite fish price	Composite meat price	Exchange rate	Crude oil price	Transportation price	Food inflation rate
Coefficients	1.00000	-0.117212	0.152048	0.040224	-1.551269	-1.012592
Standard error		(0.17024)	(0.03874)	(0.02963)	(0.19390)	(0.26324)
		-0.6885	3.9248	1.3575	-8.0004	-3.8466

General Autoregressive Conditional Heteroskedasticity Test Result

Method: ML-ARCH (Marquardt) – Normal distribution
Included observations: 86
Convergence achieved after 22 iterations. Pre-sample variance: backcast (parameter = 0.7)
GARCH = C (7) + C(8)*RESID(-1)^2 + C(9)* GARCH(-1)
Dependent variable; Composite fish price

The constant term shows the volatility movement if all the independent variables are not considered while the residual coefficient RESID(-1)^2 shows the impact of a magnitude of a shock (size) meaning a unit change in all the significant variables such as meat prices, transport prices, crude oil price and food inflation rate will cause a 14 % magnitude change in the dependent variable.

Table 6: GARCH Results

Variable	Coefficient	Std.error	z-statistic	Prob
@SQRT (GARCH)	-3.181521	0.575367	0.575367	0.0000
Composite meat prices	0.381363	0.067842	0.067842	0.0000
Composite transport prices	0.838662	0.069948	0.069948	0.0000
Crude oil price	-0.023094	0.011706	0.011706	0.0485
Exchange rate	0.002037	0.002749	0.002749	0.4588
Food inflation rate	-0.269707	0.104339	0.104339	0.0097
		Variance equation		
C	-0.036782	0.015387	-2.390412	0.0168
RESID(-1)^2	0.143497	0.058975	2.433178	0.0150
GARCH(-1)	0.829927	0.031986	25.94654	0.0000
R-squared	0.995569	Mean dependent var		160.6339
Adjusted R-squared	0.995292	S.D. dependent var		40.96811
S.E. of regression	2.811029	Akaike info criterion		4.191863
Sum squared residual	632.1509	Schwarz criterion		4.448713
Log likelihood	-171.2501	Hannan-Quinn criterion		4.295233
Durbin Watson stat	0.786581			

The GARCH(-1) coefficient shows the asymmetric effect, the impact a bad news and a good news of the same size in the independent variables will have on the dependent variable. With a positive coefficient of 0.8299, its shows that a good news such as a reduction in crude oil price will have a greater impact than a bad news of equal magnitude. The GARCH (1,1) Model appears to be the best fit as it yields the lowest coefficients in terms of the

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AKAIKE,SCHWARZ and HANNAN-QUINN criterion. The R-squared although too large could however mean that the independent variables best explain the dependent variable.

4.0 CONCLUSION.

It can be concluded that a long run relationship exists between exchange rate and fish prices, this is understandable as a major portion of the fish intake in Nigeria is imported, other variables may not have a direct impact on the price fluctuation in fish prices but their indirect impact was reflected in the GARCH result as most of them had significant effect on the dependent variable. Based on the conclusions above, the following recommendations are hereby made:

- Good market information, transparency and policy response; there must be in place an agency that supplies reliable and up to date information on fish supply, stocks, import and export availability, enhanced market information and early warning system would enable all market players plan ahead. This will make governments more accurately assess needs, make budgetary provision for producer and consumer safety nets and better position emergency food security reserves. Better market information analysis could reduce uncertainties and assist producers, traders and consumers to make better decisions.
- Good trade policies; the government should look at a policy direction that will help stabilize prices in favour of local production and will not in the long run increase price volatility.
- National buffer stock; the nation should in a way of controlling price ensure a mop and buffer approach during on and of seasons, this is an important policy instrument that has been effective in quite a number of emerging economies. Although the operational costs of achieving this is high, the payoff in the long run is however huge.
- International safety nets; during periods of unfavorable price fluctuations, contingent and compensatory financing facilities are important mechanisms assisting countries to avoid major financial deficits.

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