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Research Article

Determinants of export of Nigerian fishery products: A bounds testing cointegration approach

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Abstract: The recent downturn of the Nigerian economy occasioned by the fall in global oil price calls for economy diversification. In this regard, the Nigerian fishery resources undoubtedly stands as a potential means of diversifying foreign exchange earnings for the economy if well explored. Hence the study sought to investigate factors that influence export of Nigerian fishery products. Secondary data, covering the period of 1976-2015, sourced from Food and Agriculture Organisation, Central Bank of Nigeria and National Bureau of Statistics was used for the study. Data analysis was carried out using autoregressive distributed lag (3,2,1,0,4,1) model. Estimates revealed the existence of significant short-run and long-run relationship between the fish export volume and the explanatory macro-variables such as the price of fishery products at global market, lagged quantity of export, exchange rate of U.S. dollar to naira, quantity of domestic fish production and consumer price index with the exception of gross domestic product exhibiting only short-run relationship. The study thus suggests that policy makers should institutionalise additional policies that will support an optimum exchange rate regime and more production of fishery products for an enhanced export basket of Nigerian fisheries sector.

.**Keywords:** Determinants; export; fishery products; bounds testing; fish export

1. Introduction

Nigeria is among the developing countries endowed with adequate potential of fishery resources for export development. According to Nigerian Institute of Oceanography and Marine Research (2015), the most commonly exported fishery resources in Nigeria are shrimps, prawns, cuttlefish, various species of live ornamental fish among others, with an annual export volume of 86, 249 tons. Though the contribution of fishery sub-sector to Nigeria's foreign earnings is meagre when compared with that of oil sector, the former still stands as a potential means of economic diversification given the recent downturn of the nation's economy caused by the drastic fall in global oil price.

As Nigeria became a World Trade Organisation (WTO) member in 1994, the new challenges as well as opportunities for fish and fisheries products exporting companies arose as a result of international market openness and tougher international competition. More so, because of the collaborative efforts between the Nigerian government and fish firms, Nigeria was harmonised in 1998 by the European Union (EU) and the Federal Department of Fisheries was granted the "competent authority" status for the issuance of health certificate for all fish and fishery products being exported from Nigeria to any of the European Union member State (Federal Department of Fisheries, 2005). In 2007, the United States of America also certified Nigeria for shrimp exports to the United States and this gave Nigeria the opportunity to earn appreciable foreign exchange from the exportation of fish and fishery products. In 2008, the country earned US $45.0m from fishery product exports.

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This substantially increased to US $170.0m in 2014 due to government intervention and collaborative efforts in the production, processing and exploitation of fish and fishery products (Food and Agriculture Organization of the United Nations, 2015). In view of this, the need to conduct research on determinants of export of fishery products is very essential. Meanwhile, evidence abound that most research and discussions on Nigerian international trade performance are linked to agriculture (Nwachukwu et al., 2013; Victor & Samuel, 2017). However, these studies are observed to be one-sided in that they centre on exportation of crop commodities only. However, given the contribution of the fishery sub-sector to Nigeria's economy, a study on the export of Nigeria's fishery products becomes necessary.

2. Conceptual and empirical framework

The concept of export supply alluded to in this study has basis in the theory of supply from microeconomic point of view. Given the fact that the total sum of an individual firm's export supply constitutes the aggregate export supply of an economy, it may be argued that factors such as level of individual firm's production of export commodity, price of exports, as well as exchange rate which determine the supply of export at firm level could also have a resultant effect on aggregate volume of export trade at the global market. Since it is expected that the volume of export increases as the export price, production level, and exchange rate increases, we may assume that aggregate export is a function of the said variables. Other factors such as gross domestic product and consumer price index, as identified by Utkulu et al. (2004) could also influence export supply.

Studies that estimate export supply of various agricultural commodities in different countries have emerged over the years, though there is lack of consensus on conceptualisation and analytical approach on the subject matter. The choice of analytical tool(s) by researchers greatly depends on the availability of data and scope of the analysis. Recently, Lutengano and Felix (2015) investigated determinants and performance of sugar export in Tanzania by applying multivariate regression model as an analytical tool. Their findings revealed that sugar export price has positive significant relationship while consumer price index has negative relationship with sugar export supply. Isaac (2010) examined the performance of Ghanaian canned tuna fish export to EU market using Armingtons trade model. The results showed that price ratio, trade policy, and level of specialisation have significant effect on export market share of Ghana. Likewise, Nwachukwu et al. (2013) made an analysis of the export performance of rubber from Nigeria from 1961 to 2010 using error correction model (ECM) and found out that the demand for rubber was significantly affected by export price of the substitute crop and income of the importing country. In a similar vein, Mndeme (2008) examined the impact of EU sugar market reforms on the Tanzania sugar export performance employing OLS technique. The result indicated that Tanzanian experienced a significant reduction in sugar export revenue as a result of the reform in EU sugar market. The present study seeks to investigate the determinant of Nigeria's fisheries export by applying autoregressive distributed lag (ARDL) model. Among other things, unlike other co-integration techniques, ARDL has advantage of non-imposition of restrictive lag selection among variables of study.

3. Methodology

The study area is Nigeria located in the tropical zone of West Africa between latitudes 4°N and 14°N and longitudes 2°2'E and 14°30'E and has a total area of 923 770 km^2 out of which 910,768 is land and 13,000 is water. The country has 30 nautical miles of marine waters and about 200 nautical miles of Exclusive Economic Zone (EEZ) which offer a great potential of fishery resources (Federal Department of Fisheries, 2014). The fisheries within the territorial waters and the EEZ broadly comprise of coastal artisanal, coastal inshore and offshore resources. The leading fish producing states in Nigeria include Lagos, Ogun, Delta, Cross River, Anambra, Rivers, Sokoto, Bornu and Yobe.

The study utilised annual time series data covering the period of 1976 - 2015, obtained from Food and Agriculture Organisation Statistics (FAOSTAT), National Bureau of Statistics (NBS) and Central Bank of Nigeria (CBN). Specifically, data on the quantity and value of aggregate fish export and production were sourced from FAOSTAT while data on macro variables such as real agricultural GDP, consumer price index, external reserve, exchange rate and per capita income were obtained from CBN and NBS. All variables were expressed in a logarithmic form in order to obtain more stationary behavior and reduce the possibility of the existence of heteroscedasticity and autocorrelation (Bekhet & Matar, 2013, Bekhet & Othman, 2014)

Autoregressive distributed lag (ARDL) bounds testing approach to cointegration was used for the analysis. Introduced by Pesaran et al. (2001), the ARDL model is a co-integration technique for exploring long- run static equilibrium and short -run dynamic relationship between the explained variable and its associated explanatory variables. Bounds testing cointegration procedure was adopted for this research due to its several advantages over other conventional cointegration techniques as elucidated by previous researchers (Pesaran & Smith, 1999; Srinivasan et al., 2012; Mahmoudinia et al., 2013). Firstly, the procedure does not mandate the unit root pre-testing to verify that all variables are integrated of the same order as required by Johansen and Juselius (1990) and Engle and Granger (1987). Therefore, the bounds testing approach to cointegration can be applied regardless of the integrated order of the studied variables i.e. whether they are I(0) or I(1), provided the order of integration is not up to I(2). However, the unit root test is only needed to ensure that variables of integrated order I(2) are not included in the model. Secondly, the procedure addresses the possible endogeneity problem that exists in most empirical studies. Thirdly, the ability of ARDL to simultaneously estimate the short and long-run components of the model helps in removing problems associated with the omitted variables(s) and autocorrelation. Fourthly, irrespective of whether the examined variables are I(0) or I(1) or fractionally integrated, the standard Wald test or F-statistics used in bounds test has a non-standard distribution under the null-hypothesis of no cointegration relationship among the underlying variables. Principally, the ARDL technique involves three steps which are enumerated as follows:

The first step is to test whether there is a long-run association among the examined variables by conducting a bounds test which involves testing for the joint significance of the coefficients of the lagged level of the examined variables using F-test. The estimated model for this stage is expressed as:

$$\Delta LnEXPQt = \Phi_0+\sum\Phi_1\Delta LnEXPQ_{t-i}+\sum\Phi_2\Delta LnEXPP_{t-i}+\sum\Phi_3\Delta LnEXCHRATE_{t-i}+\sum\Phi_4\Delta LnGDP_{t-i}+\sum\Phi_5\Delta LnPROD_{t-i}+\sum\Phi_6\Delta LnCPI_{t-i}+\sum ʆ_1 LnEXPQ_{t-i}+\sum ʆ_2 LnEXPP_{t-i}+\sum ʆ_3 LnEXCHRATE_{t-i}+\sum ʆ_4 LnGDP_{t-i}+\sum ʆ_5 LnPROD_{t-i}+\sum ʆ_6 LnCPI_{t-i}+\varepsilon_\tau \quad (1)$$

where

$LnEXPQ_t$ = log of annual export quantity of Nigerian fishery product (tons)

LnEXPP = log of annual fish export own price at the international market ($/tons)

LnEXCHRATE= log of annual exchange rate of U.S. dollar to naira

LnPROD= log of annual domestic fish production (tons)

LnCPI = log of Consumer price index (2000 = 100)

LnGDP= log of Real Agricultural GDP (2005 prices)

Δ= denotes a first difference operator

Φ_0 = intercept

$\Phi_1, \Phi_2, \Phi_3 ....\Phi_6$ and $ʆ_1, ʆ_2, ʆ_3 ....ʆ_6$ = coefficients of elasticities of the model

$e_\tau = \varepsilon t$ is the white noise error term.

The usual hypothesis testing in this step is to test for the null hypothesis of no long-run relationship among the variables against the alternative hypothesis of the existence of long-run relationship as expressed:

H_0: $ʆ_1 = ʆ_2 = ʆ_3 = ʆ_4 = ʆ_5 = ʆ_6 = 0$

H_1: $ʆ_1 \neq ʆ_2 \neq ʆ_3 \neq ʆ_4 \neq ʆ_5 \neq ʆ_6 \neq 0$

Practically, two sets of critical bounds values, i.e. the upper and the lower values, are usually given in the F-statistic developed by Pesaran et al. (2001). If the estimated F-statistic is smaller than the lower bound critical value, then the null hypothesis is accepted and hence no cointegration. Conversely, if the estimated F-statistic is greater than the upper bound critical value, the null hypothesis is rejected and this implies that there is a long-run cointegration relationship among the said variables. However, if the computed value falls between the lower critical bound and upper critical bound, the decision is inconclusive.

In the second step, once the cointegration is established among the variables, the conditional ARDL long-run model for export determinant can be estimated as:

$$LnEXPQ = ʆ_o+\sum ʆ_1 LnEXPQ_{t-\iota}+\sum ʆ_2 LnEXPP_{t-\iota}+\sum ʆ_3 LnEXCHRATE_{t-\iota}+\sum ʆ_4 LnGDP_{t-\iota}+\sum ʆ_5 LnPROD_{t-\iota}+\sum ʆ_6 LnCPI_{t-\iota}+\varepsilon_t \quad (2)$$

where all the variables are as previously defined.

In the final step, the short-run dynamic estimate is obtained by estimating an error correction model (ECM) associated with the long-run estimates. This is specifically expressed as follows:

$$\Delta LnEXPQt = \Phi_0 + \sum \Phi_1 \Delta LnEXPQ_{t-i} + \sum \Phi_2 \Delta LnEXPP_{t-1} + \sum \Phi_3 \Delta LnEXCHRATE_{t-1} + \sum \Phi_4 \Delta LnGDP_{t-1} + \sum \Phi_5 \Delta LnPROD_{t-1} + \sum \Phi_6 \Delta LnCPI_{t-1} + \varphi ECM_{t-1} + \varepsilon_t \quad (3)$$

where $\Phi_1 - \Phi_6$ are the short-run dynamic coefficients of the model, convergence to equilibrium, φ is the speed of adjustment and ECM is the error correction term obtained from the estimated equilibrium relationship of equation (1).

Finally, the diagnostic test of robustness of the model was carried out using Cumulative Sum (CUSUM) of recursive square, Ramsey RESET test, Jaque – Bera test and Breush- Pagan – Godfrey test to examine the stability, specification error, normality and heteroscedasticity of the model respectively.

4. Results and discussion

4.1. Results of the preliminary unit root test

In ARDL analysis, the computed bounds test F-statistic developed by Pesaran et al. (2001) is only valid for use when the variables are either of the order 1(0) or 1(1) but not of order 1(2). Thus to avoid inclusion of variables of order 1(2), a unit root test was performed using Augmented Dickey-Fuller (ADF) Test. Hence, result of the ADF test is presented in Table 1.

Table 1: Augmented Dickey-Fuller test of Ssationarity

VARIABLE STATUS	VARIABLE NAME	STATISTICS	INTERCEPT	TREND AND INTERCEPT	NONE	REMARK
LEVEL	LnEXPQ	ADF t-stat P-value	-1.77 0.39	-3.69 0.04	1.46 0.96	Stationary
	LnCPI	ADF t-stat P-value	-1.13 0.69	-0.78 0.96	0.007 0.67	Non-stationary
	LnEXPP	ADF t-stat P-value	-2.87 0.06	-2.99 0.15	0.06 0.69	Non-stationary
	LnEXCRATE	ADF t-stat P-value	-1.07 0.72	-0.79 0.96	1.57 0.97	Non-stationary
	LnGDP	ADF t-stat P-value	-1.97 0.29	-2.53 0.31	1.68 0.98	Non-stationary
	LnPROD	ADF t-stat P-value	0.66 0.98	-2.17 0.49	2.54 0.99	Non-stationary
FIRST DIFFERENCE	ΔLnEXPQ	ADF t-stat P-value	-10.34 0.00	-10.31 0.00	-9.92 0.00	Stationary
	ΔLnCPI	ADF t-stat P-value	-3.42 0.02	-3.56 0.05	-1.19 0.21	Stationary
	ΔLnEXPP	ADF t-stat P-value	-7.76 0.00	-7.65 0.00	-7.84 0.00	Stationary
	ΔLnEXCRATE	ADF t-stat P-value	-5.16 0.00	-5.21 0.00	-4.39 0.00	Stationary
	ΔLnEXPV	ADF t-stat P-value	-6.34 0.00	-6.25 0.00	-9.26 0.00	Stationary
	ΔLnGDP	ADF t-stat P-value	-6.13 0.00	-6.22 0.00	-5.72 0.00	Stationary
	ΔLnPROD	ADF t-stat P-value	-5.86 0.00	-6.63 0.00	-5.44 0.00	Stationary
	ΔLnEXPQ	ADF t-stat P-value	-10.34 0.00	-10.31 0.00	-9.92 0.00	Stationary

Mackinon Critical value at 1%= -3.655, 5% = -2.961, 10% = -2.613

Table 1: shows that at the original level, only export quantity (EXPQ) was found to be stationary as the estimated ADF test statistics was higher than Mackinon critical values at "trend and intercept" phase while other variables such as consumer price index (CPI), export price (EXPP), exchange rate (EXCHRATE), gross domestic product (GDP), domestic fish production (PROD) were non- stationary as their estimated ADF test statistics were lower than Mackinon critical values. However, at first difference all the variables became stationary at all the three phases (i.e. intercept, trend and intercept, none). This implies that EXPQ and its determinant were of 1(0) and 1(1) order of integration respectively. Therefore, further analysis requires the estimation of bounds testing cointegration.

Table 2 reveals the result of bounds test of the cointegration between quantity export and its determinants. The analysis indicates long-run cointegration between export quantity and its determinants as the estimated F- statistics is above upper bounds of the Pesaran critical values at all levels of significance. This implies that export and its associated exogenous variables were not drifting farther from one another in the long-run.

4.2. ARDL (3, 2, 1, 0, 4, 1) Results for the determinants of export of Nigerian fishery product

Following the establishment of cointegration between export quantity and its associated time series variables through the use of bounds test cointegration approach, a parsimonious auto-regressive distributed lag of model (3,2,1,0,4,1) based on Hannan- Quinn model selection criteria was estimated to assess the short-run dynamic among the said variables.

Table 3 reveals that the quantity of Nigerian fish export for the current year was negatively and significantly affected by the quantity exported in the previous lag two years at 10% level of significant but not significantly affected by the export quantity of the lag one year. This implies that in the short-run, a unit increase of export quantity in the previous two years led to about 1.4 unit decrease in export quantity of the current year. This result concurred with the findings of Rathnasekara et al. (2017) on their study on demand for seafood export in Sri Lanka.

The coefficient of fish export price was positively significant in the lag one of the short-run period at 1% level. This shows that the quantity of fish export supply and its own price were directly related in this period and this conformed with the theoretical a priori expectation of the law of supply. However, the long-run period revealed an unexpected result of negative impact on the export quantity. The obtained 0.63 significant value of price coefficient in the short-run indicates that the Nigerian fish export supply in the world market was relatively price inelastic. This finding is not surprising as it is believed that the supply of agricultural commodities is practically price inelastic because of their perishability.

Effect of exchange rate on fish export quantity was significant in the long-run and short-run. The estimate suggests that a unit increase in the real exchange rate increases fish export supply by 0.48 and 0.25 in the long and short-run respectively. The proponents of international trade have argued that a high exchange rate indicates lower purchasing power of domestic currencies in relation to the standard currencies of the trade partner. This eventually encourages the exporters of domestic commodities to export more of their exportable goods so as to earn more profit from foreign exchange.

Consumer Price Index (CPI) which is a measure of domestic price index had its coefficient to be negatively significant both in the long-run and shot-run with the value of -0.23 and -0.27 respectively. This implies that a higher domestic price index of Nigerian fishery products will automatically encourage the sales of the product in the domestic market and thereby reducing the export to international market.

Coefficient of real agricultural GDP was insignificant in the long-run and 1st and 2nd lag of short-run period but significant in the 3rd lag period. This implies that the agricultural GDP had no profound impact on the volume of fish export in most of the years within the study period. This is contrary to expectation as it is expected that in an open economy, an increased level of output will automatically result to surplus which will be consequently consumed in the foreign market. The disparity may probably be attributed to inadequate attention of the Nigerian government on export of fishery products as most of her policy directions towards revamping agriculture usually focus on crop production. However, the result is consistent with a number of previous studies on export performance of various agricultural products (Agasha, 2009 & Fungazza, 2004).

The quantity of domestic fish production had positive effect on fish export volume in the long- and short-run. This indicates that there was direct relationship between the volume of export and domestic production of fish. By implication, an additional unit increase in fish production boosts the export quantity by 2.03 and 1.62 units in the long- and short-run respectively. This result is in line with the findings of Lutengano et al. (2015) whose study also revealed a positive significant relationship between the volume of sugar export and the level of domestic production in Tanzania.

Table 2: Bounds Test of Cointegration of Export and its Determinants

Computed F-Statistics: 8.6572	Critical Bounds Value	
	Lower Bound	Upper Bound
10% Significance level	2.26	3.35
5% Significance level	2.62	3.79
1% Significance level	3.41	4.68

Source: Computed from CBN, FAO and NBS, 2016

Table 3: ARDL (3, 2, 1, 0, 4, 1) Determinants of Nigerian fish export.

Dependent Variable : DLOG(EXPQ)				
Short –run dynamic independent variables				
Independent Variables	Coefficient	Std. Error	t – statistics	Probability
C	-6.74**	2.46	-2.74	0.01
ΔLn(EXPQ-1)	0.18	0.14	1.27	0.22
ΔLn(EXPQ-2)	-0.14*	0.08	-1.67	0.10
ΔLn(EXPP-1)	0.63***	0.16	3.91	0.00
ΔLn(EXRATE)	0.25*	0.14	1.76	0.09
ΔLn(CPI)	-0.27*	0.13	-2.03	0.06
ΔLn(GDP)	0.53***	0.14	3.88	0.00
ΔLn(GDP-1)	-0.13	0.16	-0.83	0.42
ΔLn(GDP-2)	0.12	0.15	0.77	0.45
ΔLn(GDP-3)	0.22*	0.12	1.83	0.08
ΔLn(PROD)	1.62***	0.45	3.62	0.00
Long -run static independent variables				
Ln(EXPP)	-1.27***	0.09	-15.06	0.00
Ln(EXRATE)	0.48***	0.09	5.22	0.00
Ln(CPI)	-0.23*	0.12	-1.94	0.07
Ln(GDP)	-0.09	0.10	-0.83	0.42
Ln(PROD)	2.03***	0.24	8.51	0.00
ECT(-1)	-1.18***	0.18	-6.59	0.00
R-squared	0.97			
F-statistic	81.55			
Prob (F-statistic)	0.00			
Durbin-Watson stat	2.06			

(***)(**)(*) indicates significance at 1%, 5% and 10% level respectively

The coefficient of ECM was -1.18 and significant at 1% level of probability, implying that the speed of adjustment at which the quantity of fish export respond to changes in its determinants was about 118%. Though the obtained ECM values is greater than the conventional bench mark of 0 to -1, however some protagonists (Narayan & Narayan, 2006) maintains that ECM values of -1 to -2 is still acceptable provided the lag selection criteria give a robust estimate of the model. The 0.97 value of estimated R^2also indicates that about 97 % variation in quantity of Nigerian fishery products export was explained by the exogenous variables. The higher percentage of R^2 realised in this study is not surprising as similar values were recorded in the study earlier carried on export of various agricultural commodities (Isaac, 2010; Utkulu et al., 2004; Rathnasekara et al., 2017).

Other diagnostic statistics such as Breusch-Godfrey serial correlation LM test, the Jarque Bera test of normality, Breusch-Pagan-Godfrey test of Heteroskedasticity and Ramsey RESET test of specification error are presented in Table 4:.

From the analysis, the diagnostic parameters indicate that the residuals are serially uncorrelated, normally distributed and homosskedastic based on the outcome of Breusch-Godfrey serial correlation LM test, Jarque-Bera test of normality and Breusch-Pagan-Godfrey test respectively. Likewise, the model is well specified on the basis of the Ramsey RESET test value which implies that the model is robust and valid and as such can be adopted for policy recommendations without specification error.

Table 4: ARDL (3, 2, 1, 0, 4, 1) Diagnostic Test of Determinants of Export

Diagnostic Parameter	F-Statistics	P-value
Breusch-Godfrey serial correlation LM test	0.89	0.51
Breusch-Pagan-Godfrey Heteroskedasticity Test	0.68	0.78
Jarque-Bera test Normality Test	1.79	0.41
Ramsey RESET test of Specification Error:	0.50	0.62

Optimal lag selection is based on Hannan- Quinn selection criterion

Further diagnostic analysis also investigates the existence of stable and predictable relationship among the modelled variables using cumulative sum (CUSUM) of recursive test as graphically depicted in Figure 1.

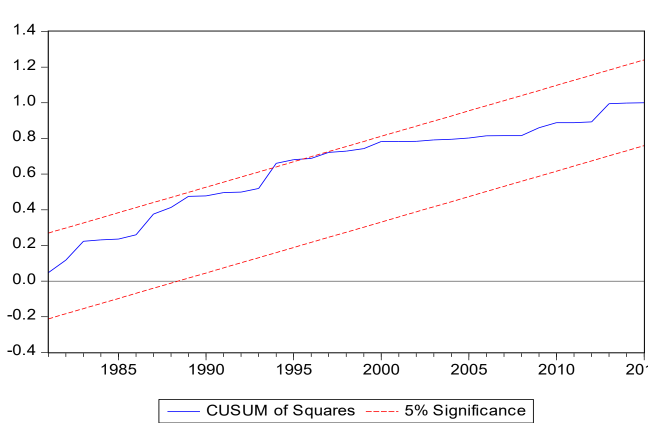

Figure 1: Cumulative Sum (CUSUM) of recursive residuals plot for export model

The plotted CUSUM of recursive residuals statistic falls within 5% significance except for the period of 1994-1996 where the plot spikes out of the acceptance region. Thus the estimated coefficients can be said to be stable and it can therefore be concluded that ARDL export function is stable and export quantity can be used as target endogenous variable.

5. Conclusion and recommendation

This study has examined factors that determine export of Nigerian fishery products using bound's testing approach to cointegration. Based on the findings of the study, fish export has been positively affected by lagged export quantity, own price, the current exchange rate, lagged GDP and lagged domestic fish production in the short-run while in the long-run only exchange rate and quantity of domestic fish production positively influenced the export quantity. The study suggests the need for government to put in place policies that will ensure more production of domestic fishery products for export. Exchange rate regime should be maintained at levels that will encourage more export of fishery products for enhanced foreign exchange earnings.

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