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COINTEGRATION AND ERROR CORRECTION MODELS IN FISH EXPORT AND ECONOMIC GROWTH IN NIGERIA

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Abstract

The study uses cointegration and error-correction models to examine the causal link between Nigerian fishery exports and economic growth. The study established evidence of a long-term association as well as a bi-directional causality between fishery exports and economic growth in Nigeria's fishing sector using annual data from 1980 to 2021. The results support the idea that there is no immediate cause-and-effect connection between the variables. The study recommended that the government should concentrate its efforts in this area in order to increase the productivity of the fishing sector and consequently, its potentials for output, which would ultimately encourage economic growth.

Keywords: Economic Growth, Fish Exports, Cointegration, Error-Correction Models.

JEL Classification: Q57, Q58

1. Introduction

The demand for fish continues to expand rapidly, making fish the most highly traded food commodity in the world. Some emerging nations have a comparative advantage due to a mix of low-cost labor and seas that are abundant for highly sought-after fish kinds (Fox et al 2013).

Natural resource management is a distinguishing aspect of farming and fishing. This is especially important for fishing since a lack of property rights encourages overexploitation, which is known as the tragedy of the commons. The world's fisheries are gravely threatened by overfishing (FAO, 2020). It is challenging to prevent overfishing by restricting access to the resource in any situation, but Nigeria presents unique difficulties due to its lack of administrative resources and funding for monitoring efforts. Nigeria must balance maintaining its fish stocks with simultaneous increase in production and competitiveness.

Fish is a significant source of protein in Nigeria and fishing helps to increase food security, in addition to diversifying exports, generating jobs, and earning more money abroad.

The contrast between formal and informal activities in fishing is made between industrial and artisanal fishing. Industrial fishing is dominated by foreign vessels that use cutting-edge technology to catch highly valuable demersal species. Through fishing agreements, industrial fishing operations generates income for the Nigerian government, but the operators frequently land only a small portion of their catch in the host nation and occasionally cause stock depletion FAOSTAT (2017).

Artisanal fishing is a subsistence endeavor, much like the informal sector more generally. Although a significant employer and earner, it is constrained by inadequate infrastructure and unsanitary conditions. Policy for the fishing industry is made more difficult by the significance of artisanal fishing since there may be

trade-offs between resource management and employment (FAO 2018).

In contrast to the global average of 20.3 kg/capita/year, household fish consumption in Nigeria is low at 13.3 kg/capita/year (FAO 2018). According to FAOSTAT (2017) estimates, 14.3 million individuals in Nigeria were considered undernourished in 2016. Over 800 km of coastline and other large inland waterways make up Nigeria's coast line and fishing provides living for approximately 1.5 million people (WorldFish 2017b). Around 1 million metric tons of fish is produced in Nigeria annually, with over 750,000 tons coming from catch fisheries and about 310,000 tons from aquaculture (WorldFish 2017b).

In 2020, the fisheries sector contributed 1.09% of the nation's total GDP, while in the third quarter of 2021, it contributed 0.9% (NBS, 2022). According to the World Fish (2022) study on Nigeria, 1,477,651 people were said to be employed in the nation's fisheries and aquaculture sector in 2021. Currently, the industrial fisheries which uses trawlers for both shrimping and fishing, employs over 9000 Nigerians. However, due to the dearth of thorough data in this area, it is impossible to determine the precise number of individuals employed in Nigeria's fishing sector. Without include fish fillets and other fish meat, the county imported frozen fish worth about $876,081,485.00 million in 2020 but only made $106,964.00 thousand in exports (TrendEconomy, 2021).

Theoretically, it has been contended that variations in export rates could result in variations in economic growth (Ramos, 2001). In an economy's GDP growth rate, export growth is acknowledged as the main driver of productivity and employment growth (Ramos, 2001). For instance, crops and cattle may be produced in SSA nations due to the favorable climatic conditions and good vegetation (Osabuohien et al., 2018). Nigeria has benefited enormously from the increase in agricultural exports, as a result, the importance of exports to Nigeria's financial success and development cannot be overstated because they speed up that progress overall (Abou-Stait, 2015).

Exports can serve as a source of foreign exchange gains because trade settlements between nations are conducted in foreign currency (Matthew et al., 2018). Usman and Salami (2018) argued that an emerging nation's economic growth will be boosted by the drive to promote exports due to the multiplier effects of exports on the country's income level. This is because income from exports helps to increase the aggregate demand in the country. The objective of this study is to investigate the causality between fishery's exports and its economic growth in Nigeria using the cointegration and error-correction models.

2. Literature Review

How exports and GDP are related

Here, we investigate three potential links between exports and GDP: export-led growth, growth-driven exports, and the feedback relationship, which is a two-way causal relationship.

Export-led growth

Countries that export a significant portion of their produce appear to grow more quickly than others, according to research by Michaely 1977, Feder 1982, Marin 1992, and Thornton 1996. The expansion of exports has a stimulating effect on the economy as a whole in the form of externalities and technology spillovers. Models by Grossman and Helpman (1991), Rivera-Batiz and Romer (1991), and Romer (1990) postulate that as economies become more open to international commerce, the number of specialist inputs grows, boosting growth rates. Buffie (1992) examines the possibility of export-led development as a result of export shocks. Using Portuguese data from 1865 to 1985, Oxley 1993 finds no evidence in favor of the ELG hypothesis—quite the opposite, igniting the debate over growth-oriented programs.

Growth-driven exports

Scholars such as Bhagwati 1988 have emphasized that, contrary to the export-led growth hypothesis, an increase in GDP typically results in a proportional expansion of trade, unless the pattern of growth-induced supply and corresponding demand results in an anti-trade bias. Neoclassical trade theory frequently emphasizes the causal relationship between home-factor productivity and endowments and the supply of exports, as in Findlay, (1984). International trade theorists have recently paid a great deal of attention to the Vernon (1996) hypothesis on the product life cycle. For instance, Segerstrom et al. (1990) employed the product life cycle theory as a starting point for their analysis of North-South trade, finding that the rate of product innovation in the North was influenced by company competition in research and development.

Feedback

The most intriguing economic hypotheses propose a reciprocal causal relationship between trade and growth. Bhagwati (1988) claims that greater trade creates more income and leads to a growth in GDP, which in turn facilitated more commerce, creating a "vicious circle." Grossman and Helpman (1991) have recognized this kind of feedback in their models of North-South trade.

3. Methodology

The researchers investigated the causality between fishery exports and its economic growth in Nigeria using the cointegration and error-correction models. To examine the cointegration and error-correction models between those two variables, this paper follows the standard steps proposed by Engle and Granger (1987). First, pretesting the variables for their stationarity employing the augmented Dickey-Fuller (ADF) test, used the Likelihood Ratio (LR) test, Akaike Information Criterion (AIC), and Schwarz Information Criterion (SIC) for confirmation. The second step examined if the two series the natural logarithms of economic growth (LPCIt) and real fishery exports (LEXPt) are co-integrated. T1his step verifies if there exists a long run equilibrium relationship between them over time. The cointegration can be examined by using the Engle-Granger cointegration test or Johansen and Juselius procedures, both of which were employed to check robustness of the results in cointegration. Lastly, error-correction model was applied to examine the short run relationship.

The VECM specifications employed in this study are presented in two endogenous variables as stated below in two equations labelled equation 1 to 2.

$_t = \beta_0 + \beta_{t-1} + {}_{1i\,t-i} + {}_{1t}$ *(1)*

$_t = {}_0 + {}_{t-1} + {}_{3i\,t-i} + {}_{2t}$ *(2)*

The researchers employed annual data on exports and PCI of Nigeria's fishing sub-sector. They were obtained from the federal department of Fisheries, the Bureau of Statistics Nigeria, and the Central Bank of Nigeria for a period from 1980 to 2021.

4. Results and Discussion

4.1 Unit Root Test

The results of the Augmented Dickey-Fuller (ADF) test-based unit root tests for LPCIt and LEXPt are shown in Table 1. The series are stationary in order one, I(1), and the null hypothesis is rejected under the first difference of all variables, but it is not rejected at any level of significance.

Table 1: Unit Test

Variables	Level	ADF @5%	Ist Difference	Decision	
	ΔPCIt	-0.827965	-2.936942	-6.774474	1(1)
	ΔEXPt	-1.814656	-2. 936942	-9.409205	1(1)

Source: Author's computations using E-view 9

Table 2: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-31.78430	NA	0.020290	1.778121	1.864310	1.808786
1	-24.48131	13.45288*	0.017063*	1.604279*	1.862846*	1.696275*
2	-22.96916	2.626368	0.019498	1.735219	2.166163	1.888545
3	-22.11656	1.391081	0.023136	1.900872	2.504193	2.115529
* indicates lag order selected by the criterion **Source: Author's computations using E-view 9**						

The FPE criterion, which recommends a lag length of one, is used to choose the ideal lag length. Utilizing the LR test, AIC, and SIC criteria—all of which suggest the same lag duration, or Lag 1 confirms this FPE criterion.

4.2 Results of cointegration test

The cointegration test investigates the equilibrium relationship between LPCIt and LEXPt over the long run.

Table 3: Results of Johansen cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.329814	25.39777	15.49471	0.0012
At most 1 *	0.235217	10.19019	3.841466	0.0014
Source: Author's computations using E-view 9 Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

The results indicate that there is cointegration between the two variables based on the ADF test conducted on the residuals of the cointegration equations. At 1% level of significance, the null hypothesis, which contends that the residual series have a unit root, is rejected. The findings suggest a long-term equilibrium relationship between the exports of the fishing industry and its economic expansion.

Table 4: Results of Johansen cointegration test

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.329814	15.20759	14.26460	0.0354
At most 1 *	0.235217	10.19019	3.841466	0.0014
Source: Author's computations using E-view 9 Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				

A trace test indicates two cointegrating equations at the 5% level. The max-eigen value test identified 2 cointegrating equations at the 1% level. It cannot yet be concluded that there is a causal relationship between the variables, despite the fact that the results show that the variables are cointegrated. An error-correction model is used to determine the causal relationship between the real fishery exports and its economic growth.

Longrun Relationship Equation

LPCIt =-1.220849LEXPt + 3.411642
(3)

(-4.25216)

Equation 3 shows the coefficient of the normalized long-run co-integration equation after the VECM model was computed. According to the normalized co-integration equation in (3), LEXPt has a significant and long-term positive relationship to LPCIt. This suggests that increasing fish exports in Nigeria will have a favorable impact on economic growth. This is not unexpected because, a priori, it is anticipated that a well-targeted government fiscal policy will increase output through subsidies for agricultural inputs and the provision of extension services to farmers. This might have something to do with the country's ongoing transformation program as well as several government initiatives to restructure the fishing sector, such the Anchor Borrower's Programme.

4.3 Error-Correction Models

On the basis of the ideal lag length and the outcomes of the cointegration test, estimation for an error-correction model is created to investigate the short-run dynamic relationship between exports and economic growth.

Table : 5 Vector Error Correction Estimates, Dependent Variable: D(PCI)

	Coefficient	Std. Error	t-Statistic	Prob.
CointEq1	-0.063993	0.024150	-2.649844	0.0119
D(PCI(-1))	0.077067	0.118883	0.648261	0.5209
D(FXPT(-1))	0.026930	0.039068	0.689309	0.4950
C	-0.004335	0.027675	-0.156654	0.8764
R-squared	0.235594	Mean dependent var		-0.001436
Adjusted R-squared	0.171893	Durbin-Watson stat		1.747401
F-statistic	3.698455	Akaike info criterion		-0.563889

Source: Author's computations using E-view 9

The error correction model, ECM (-.0640), is negative and statistically significant at the 5% level, according to the VECM result in Table 5. This shows that the relationship between the variables in the long run is stable. It also means that, in the current time, the shock-induced disequilibrium of 6.4% converges back to the long-run equilibrium. In other words, there is a long-run, unidirectional causal relationship between PCI and EXP.

The VECM results for other, on the other hand, demonstrated the absence of a long-run equilibrium relationship between PCI and economic growth in EXP. The model's value for ECM insignificance serves as proof of this.

Table 6: The result of Wald Tests to Short-run Causality

Variable	ΔPCI_{t-1}	ΔEXP_{t-1}	Inference (Short run causality)
ΔPCI		1.073147	
		(0.7838)	No short-run causality
ΔEXP	3.35573		
	(0.2685)		No short-run causality

Source: Author's computations using E-view 9

4.4 Causality Test Result

With the aid of the Wald statistical test, the short-run causal relationship between the dependent and historical values of the independent variable was jointly examined, as shown in table 6. The short-run causality test is null if fish export (EXP), the independent variable, has no historical lags that may have affected the value of economic growth (PCI), the dependent variable. The Null Hypothesis is rejected or vice versa if the probability value of Chi-square in the Wald Statistics is less than 0.05.

It is proven that there is no short-run causal relationship between economic development (PCI) and fish export (EXP) after examining the Wald statistics as given in Table 6. Additionally, there is no immediate link between fish exports (EXP) and economic expansion (PCI).

Table 7 : Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
L EXPt does not Granger Cause LPCI	40	4.48123	0.0185
PCI does not Granger Cause LEXPt		0.07520	0.9277

Source: Author's computations using E-view 9

The combined significance tests of the coefficients of the lagged-differences of the explanatory variables reflect the direction of Granger causality flow. The empirical data strongly suggests that, in the short run, fish export contributes significantly to economic growth. In particular, the null hypothesis that fish export does not ' Granger-cause' economic development could be disproved at 1% level for this study.

This outcome is in line with Tiffin and Irz's (2006) and Ogunbadejo et al, (2019) earlier research for developing nations, which found that agricultural value-added development, is a "Granger cause" of GDP growth.

4.5 Diagnostic Tests

Table 8: VECM Model Diagnostic Test

LM Test Statistics		Prob
Serial Correlation	Obs*R-squared = 1.190986	0.2751
Normality	Obs*R-squared = 2.67331	0.2167
Heteroscedasticity	Obs*R-squared = 2.964548	0.5638

Source: Author's computations using E-view 9

Table 8 displays the results of the Heteroscedasticity test, Jarque-Bera normalcy test, and Lagrange multiplier test of residual serial correlation. According to the results, the model appears to have passed every test, which means that it has a valid functional form. Its residuals are serially uncorrelated, normally distributed, and homoscedastic.

5. Conclusion and Recommendations

The cointegrating equations show that the exports of fisheries and Nigeria's economic growth are cointegrated, indicating a long-run equilibrium link between those variables. Also, there is a long-term bi-directional correlation between exports and economic growth in Nigeria's fishing sector based on the significance of the coefficients of the error-correction elements from both the economic growth and export equations.

In conclusion, this feedback relationship between the export of fisheries and their economic growth suggests that the expansion of the agricultural sector (via higher exports) benefits the whole economy. These findings illuminate the contribution of the agricultural sector to economic development in emerging nations. Additionally, the findings suggest that a national strategy

adopted for increasing seafood and fish-related exports has been successful in terms of public investment on enhancing technology. Fish product quality, fish supply chain and the Nigerian fishery sector have been adjusted to a change in the global trade liberalization. The findings have significant implications for Nigerian agriculture policy. According to the findings, policymakers should make a concentrated effort to focus on increasing the fishing agricultural sector's productivity in order to increase its output capacity, which would then spur economic growth.

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