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Exploring the impact of blue economy, financial development and technological innovation on economic growth: Case of Nigeria

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Promoting a blue economy focused on «conservation and sustainable use of the oceans, seas and marine resources» represents the 14th goal of the UN Sustainable Development Agenda. This objective holds particular relevance for developing countries like Nigeria where the use of marine resources plays an important role in the progress of the most promising sectors of the economy. The study explores how the blue economy, financial development, and technological innovation influence economic growth in Nigeria, using time series data between 1981 and 2022 and the novel Dynamic Autoregressive Distributed Lag simulations approach. The outcomes of the study demonstrate that economic growth is positively impacted by both aquaculture production and total fisheries production in the long run, whereas, in the short run, the total fisheries production is negatively related to economic growth, and aquaculture has no impact on short-term economic progress. Financial development also supports economic growth favorably in the long run but in the short run the reverse is the case, which is consistent with the structural transformation theory. Furthermore, electricity production from hydroelectric sources and technological innovation makes positive contributions to economic progress both in the short run and in the long run. Our findings suggest that other developing countries could use Nigeria's experience in establishing a Ministry of Marine and Blue Economy to implement strategy of integrating abundant marine resources into their national economic structure, and the ministry should incorporate advanced technologies into its governance, coordination, and operational processes using data analytics, Internet of Things (IoT), and digital communication tools to improve transparency, efficiency, and responsiveness in policy implementation. These technological tools can facilitate better collaboration among governmental agencies and private sector participants.

Keywords: *sustainable development; blue economy; financial development; technological innovations; dynamic ARDL model; Nigeria*

JEL codes: *C53, N57, Q22, Q27*

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Исследование влияния голубой экономики, финансового развития и технологических инноваций на экономический рост (на примере Нигерии)

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Развитие голубой экономики, нацеленной на «сохранение и рациональное использование океанов, морей и морских ресурсов», является 14-ой целью повестки устойчивого развития ООН. Эта цель особенно актуальна для тех развивающихся стран, где использование морских ресурсов играет важную роль в развитии наиболее перспективных отраслей экономики. В статье исследуется влияние голубой экономики, финансового развития и технологических инноваций на экономический рост с использованием данных временных рядов Нигерии за период с 1981 по 2022 гг. и нового подхода – динамического авторегрессионного моделирования с распределенным лагом. Результаты исследования показали, что производство аквакультуры и рыболовство значимо положительно влияют на экономический рост в стране в долгосрочной перспективе, при том что в краткосрочной перспективе рыболовство отрицательно связано с экономическим ростом, а производство аквакультуры не оказывает никакого влияния на краткосрочный экономический рост. Финансовое развитие также положительно влияет на экономический рост в долгосрочной перспективе, но отрицательно влияет в краткосрочной перспективе, что согласуется с теорией структурной трансформации. Кроме того, производство электроэнергии на гидроэлектростанциях и технологические инновации вносят положительный вклад в экономический рост как в краткосрочной, так и в долгосрочной перспективе. Результаты нашего исследования позволяют рекомендовать другим развивающимся странам использовать опыт Нигерии по созданию Министерства морской и голубой экономики для реализации стратегии интеграции богатых морских ресурсов в национальную экономическую структуру, а министерству следует внедрять передовые технологии, такие как аналитика данных, Интернет вещей (IoT) и цифровые коммуникационные инструменты, для повышения прозрачности, эффективности и оперативности проводимой политики. Эти технологические инструменты могут благотворно повлиять на сотрудничество между государственными учреждениями и участниками частного сектора.

Ключевые слова: *устойчивое развитие; голубая экономика; финансовое развитие; технологические инновации; динамическая модель ARDL; Нигерия*

Introduction

In recent years, economists have increasingly quantified the diverse economic activities linked to the ocean, collectively known as the blue economy as a vital driver of sustainable development. Arising from the brainstorming during the 2012 Rio+20 conference, the blue economy was acknowledged by the shoreline countries as one of the exceptional elements of the global economy. The World Bank defined this sector as the sustainable use of ocean resources to promote economic growth, improve livelihoods, generate employment, and safeguard marine ecosystems (Vierros, De Fontaubert, 2017). Food and Agricultural Organization[1] asserts that fisheries production, marine tourism, maritime transportation, aquaculture, seabed mining, marine biotechnology, and bioprospecting are the major industries in the blue economy that significantly contribute in developing a strong and resilient economic framework. Technological innovation now plays a pivotal role in advancing this agenda. Cutting-edge digital technologies such as advanced data analytics, robotics, the Internet of Things (IoT), and remote sensing are transforming traditional marine sectors by optimizing resource management, enhancing operational efficiency, and supporting environmental monitoring. These innovations facilitate sustainable practices in renewable energy, aquaculture, and marine biotechnology, ensuring that economic growth driven by ocean resources remains both robust and ecologically responsible.

The global significance of the ocean as an engine of economic growth is underscored by compelling statistics. Around 40 percent of the world's population lives resides within 100 kilometers of a coastline[2], while significant portion (about 99%) of the worldwide electronic communication is dependent up on the underwater cables, making them the "backbone of global communications"[3]. In addition, fossil fuels, primarily crude oil and natural gas, continue to play a significant role in global energy, with oil alone accounting for nearly 30% of the world's total energy demand in 2024, a significant increase from around 20% in 1980[4]. The global production of aquatic animals reached an estimated 178 million tons in 2020, with capture fisheries and aquaculture contributing nearly equally; 63 percent of this production was harvested from marine waters, while 37 percent came from inland waters. The overall sale value of global aquatic production was estimated at US$ 406 billion in 2020[5]. Additionally, recent estimates from the Marine Biodiversity for 2025 indicate the formal documentation of approximately 242,000 marine species, with yearly discovery of around 2,000 new species by the researchers, ranging from microscopic plankton to deep-sea organisms, and the scientists believe that the total species range from 700,000 to over 2 million[6].

At the continental level, African Union has approved 2050 African Integrated Maritime Strategy in 2012, which stressed the compelling need to promote responsible and sustainable blue economy efforts, framing them as the New Frontier of African Renaissance. Nigeria has embraced this vision by establishing a Ministry of Marine and Blue Economy, a strategic initiative aimed at leveraging its abundant marine resources to foster economic growth[7]. With a coastline extending 420 nautical miles and an exclusive economic zone of 200 nautical miles covering maritime interests along the Gulf of Guinea, Nigeria is poised to capitalize on fisheries, aquaculture, tourism, shipping, and renewable energy sectors[8]. Integrating technological innovations into these areas is central to diversifying

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[2] United Nations (2018). UN-Habitat background paper on Blue Economy and Cities. United Nations Human Settlements Programme, p. 12. https://unhabitat.org/sites/default/files/2020/04/un-habitat-background-paper-on-blue-economy-and-cities.pdf (accessed on May 15, 2025)

[3] Submarine cable resilience. International Telecommunication Union, February 8, 2024. https://www.itu.int/en/mediacentre/backgrounders/Pages/submarine-cable-resilience.aspx (accessed on May 15, 2025)

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[8] Ibid.

the economy away from oil dependency, enhancing operational efficiencies, and promoting sustainable environmental practices[9]. Exploiting marine resources offers the potential to create employment and generate income through fisheries, aquaculture, tourism, shipping, and renewable energy sectors. This endeavor aims to position Nigeria as a leader in sustainable marine activities such as promoting marine tourism, addressing environmental challenges through the restoration of marine ecosystems, thereby supporting the effort of diversifying the economy to reduce its reliance on oil and gas[10].

This research contributes to the current body of literature in several ways. First, by investigating the link among the blue economy, technological innovation, and economic growth in Nigeria using a novel Dynamic Autoregressive Distributed Lag (D-ARDL) simulation technique to provide robust probabilistic adjustment forecasts that isolate the impact of changes in key variables on economic performance (Udeagha, Ngepah, 2022). This is the first study to examine the relationship between the blue economy, technological innovation, and economic growth in Nigeria using the novel dynamic ARDL simulation technique. The advantage of this method lies in its ability to predict, simulate, and instantly visualize probabilistic adjustment forecasts for the dependent variable when one explanatory variable change, keeping other regressors constant (Inuwa et al., 2024). The UN Sustainable Development Goal (SDG) 14 is to conserve and promote responsible and sustainable use of marine and ocean resources.

This study aims to contribute in realizing this goal by exploring how technological advancements in the blue economy can drive long lasting economic progress for Nigeria and other developing coastal nations. The findings of this study are important not only for Nigeria but also for other coastal African nations such as Benin Republic, Ghana, Kenya, South Africa, Senegal, Mozambique etc. These countries, blessed with vast ocean resources, can benefit from innovative approaches that promote environmental and economic sustainability, and inclusive growth. Therefore, the findings of this research can play a critical role in making regional policy decisions and advancing a collaborative, digitized marine economy across Africa.

Literature review

Blue economy and economic growth nexus

The notion of the blue economy and its relationship with economic growth has only been recently exploited, posing deficiencies in data availability (Alharthi, Hanif, 2020), where most of the previous studies adopted a qualitative approach. However, a preliminary investigation has underscored the significance of the blue economy in economic advancement (Agunsoye et al., 2025). Thus, this section appraises the prior literature regarding the links among the blue economy, technological innovation, financial development, and economic growth. Regarding the blue economy indices and economic growth, Alharthi and Hanif (2020) found that the blue economy factors play a statistically significant role in the economic growth of SAARC (South Asian Association for Regional Cooperation) countries. The impact of financial development on the sustainable blue economy in Europe was examined by Nham and Ha (2023). Using the panel-corrected standard error (PCSE) model and the Feasible Generalized Least Squares (FGLS) model, they confirmed the significance of financial development in improving the sustainability of the blue economy.

Other studies explored the role of the blue economy in economic growth. Mahardianingtyas et al. (2019) analyzed the impact of the blue economy on the Indonesia's economic development using literature review and interview. The results showed that blue economy significantly contributes to economic development. Bhattacharya and Dash (2021) explored the factors influencing blue economy resources by constructing a model based on panel data for 21 Asia and Pacific Island countries over the period 1996–2016. They found that the gross fixed capital formation and access to electricity have a positive impact on the blue economy.

Some scientists explored how various factors affect the sustainability of the blue economy. Hossain et al. (2024) used a panel dataset of 25 selected countries surrounding the Indian Ocean and applied the cross-sectional autoregressive distributed lag (CS-ARDL) approach to explore how greenhouse gas emissions, trade intensity, and economic growth influence blue economy. The study revealed that trade has a positive effect on the blue economy, while greenhouse gas emissions and

[9] Ibid.
[10] Ibid.

economic growth have a negative impact. Yulisti et al. (2024) examined the benefits of using Eco-Friendly Fishing Gears (EFFGs) of blue swimming crab (BSC) on fishermen's welfare and sustainable fisheries in Indonesia using the Endogenous Switching Regression model. They found that the welfare of fishermen is better off with the preservation and regeneration of resources by using the EFFGs compared to the non-EFFGs. Whisnant and Vandeweerd (2019) explored the role of blue economy investment using a transformative approach to private investment in the blue economy. The study concluded that the international development community, with support from the United Nations and the Global Environment Facility, has made significant contributions to preparing countries for the blue economy through standards, assessments and action programs.

The impact of greenhouse gas emissions and blue economy resources on economic growth was investigated by Bădîrcea et al. (2021) using a panel of annual data from the 28 European Union (EU) countries over the 2009–2018 period. By employing a Fully Modified Ordinary Least Squares (FMOLS) estimator and Granger causality estimation, the results demonstrated that blue economy and greenhouse gas emissions have significant long run impact on economic growth. In a related paper, Martınez-Vazquez et al. (2023) investigated the causal relationships between blue economic factors and per capita income in European countries using the multivariate Granger causality test and correlation analysis, and discovered that per capita income is positively impacted by coastal tourism, maritime transport, nonliving resources, and ports activities.

Michael (2023) again estimated the impact of the blue economy on the growth of the Nigerian economy by constructing an Autoregressive Distributed Lags (ARDL) model. The author found that while fisheries exhibited a positive relationship, waste management, water sanitation, and water transportation exhibited a negative relationship with the economic growth rate in Nigeria. Geng et al. (2024) investigated the impact of blue economy on inclusive growth in 19 member countries of the Asian Cooperation Dialogue using the Westerlund cointegration test. The findings revealed that fisheries and aquaculture production foster inclusive growth in the Asian countries. Elisha (2019) explored how the blue economy influences economic growth of the Niger Delta region and the Nigerian state. The study findings showed that blue economy has positive impact on job creation, poverty eradication, improvement in physiological conditions, sustainable fisheries production, eco-friendly energy and natural resources use, innovative industrial innovation, communities and cultural preservation, and society as a whole.

Technological innovation and economic growth

Technological progress plays an important role in promoting sustainable economic growth by offering innovative solutions to complex global problems (Islam, 2025). These advancements support various sustainable development goals by enhancing operational efficiency and addressing critical issues in these sectors. For instance, Islam (2025) investigated the impact of technological advancements on SDGs in G7 countries by employing the IV-GMM model, and found that technological advancements contribute to achievement of SDGs. In another similar study, Olunuga and Ashoghon (2024) evaluated the influence of financial technological innovation on economic growth in Nigeria, and found its positive and significant impact on both economic growth and sustainable development of the country's economy. Muktar et al. (2024) used structural equation model (SEM) to study the influence of Artificial Intelligence (AI), innovation, and employment on SMEs growth in Nigeria. The results showed that AI innovation indicators have positive relationship with SMEs growth. Nwani et al. (2025) used the autoregressive distributed lag technique in Turkey to demonstrate that both domestically created and foreign (transferred) innovations significantly enhance economic efficiency in Turkey.

The relationship between technological innovation, economic development, and environmental sustainability was explored by Adebanjo and Akintunde (2024). They discovered that higher levels of technical innovation and economic development promote environmental sustainability in the US. Another study by Fasanmi et al. (2025) established that the technological innovation has a significant impact on the revenue growth of manufacturing firms in Southwestern Nigeria after using descriptive and inferential statistics. Zhang et al. (2024) in their study on the emerging Asian economies after applying Second-Generation Augmented Mean Group and Common Correlated Effects Mean Group Panel Techniques confirmed that technological progress, institutional efficiency, green and fossil fuels energy utilization stimulate economic advancements. After utilizing Dynamic Ordinary Least Square and Non-Linear Autoregressive Distributed Lag models, Philip et al. (2022) discovered the positive contributions of green energy policy, technological advancements, and financial innovation on business successes and environmental sustainability. Olofin et al. (2023) examined the connection between science education and the socio-economic development by exploring the transformative potential of science education as a catalyst for socio-economic development in Nigeria. They concluded that Nigeria can navigate challenges and seize opportunities in a rapidly changing global landscape through the promotion of science and technology education.

After careful analysis of previous research, it can be concluded that the studies have used different methodologies to express the relationship between blue economy and economic growth or blue economy and environmental sustainability in various countries. However, no previous study has examined the cumulative impact of blue economy and technological innovation on economic growth in Nigeria. According to Inuwa et al. (2022), incorporating financial development into economic growth-related studies is crucial for understanding the multifaceted nexus between finance and the economy. It plays a significant role in explaining the channel through which financial systems can support sustainable development. Additionally, previous studies have not employed the novel dynamic ARDL, which is helpful in visualizing the impact of positive and negative changes to the explanatory variables on the explained variable. This study provides a novel contribution to the field of blue economy by examining the simultaneous impacts of technological breakthrough, financial development and innovation, and ocean economy resources on economic growth in Nigeria by employing additional techniques of Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) methods for robustness check, which are known for their unbiased nature, efficient handling of normalization asymptotics, and effectiveness as optimal estimators in cointegration regressions.

Methodology

Type and sources of data

This study used annual time series data for Nigeria from 1981 to 2022 on aquaculture production, electricity production from hydroelectric sources, total fisheries production, domestic credit to private sector GDP per capita sourced from the World Bank's World Development indicators (WDI), and technological innovation sourced from the Organisation for Economic Co-operation and Development (OECD). These variables are presented in Table 1.

Table 1

Description of the variables

Variables	Code	Source
Aquaculture production (metric tons)	ACP	WDI
Total fisheries production (metric tons)	TFP	WDI
Electricity production from hydroelectric sources (% of total)	EPH	WDI
GDP per capita (constant 2015 US$).	RGDP	WDI
Domestic credit to the private sector (% of GDP) (a proxy for financial development)	FD	WDI
Technological Innovation expressed as the number of patents (residents)	TI	OECD

Source: authors' compilation from World Bank Development Indicators (https://databank.worldbank.org/source/world-development-indicators) and Organisation for Economic Co-operation and Development data (https://www.oecd.org/)

Model specification

In line with the reviewed literature, the study adapted with slight modifications the model of Alharthi and Hanif's (2020) which analyzed the impact of blue economy on SAARC countries. Thus, the functional model is specified as follows:

$$GDPP_t = \beta_0 + \beta_1 ACP_t + \beta_2 TFP_t + \beta_3 FD_t + \beta_4 EPH_t + \beta_5 TI_t + \varepsilon_t, \quad (1)$$

where $\beta_1 - \beta_5$ are the estimated coefficients of the explanatory variables; GDPP is the gross domestic products per capita, a proxy for the level of economic development; ACP is the Aquaculture Production; TFP is the total fisheries production; FD is the level of financial development; EPH is the electricity production from hydroelectric sources; TI represents technological innovations; and ε is the error term, which is assumed to be normally distributed.

Estimation procedure

This study employs the innovative dynamic Autoregressive Distribution Lag (DYARDL) Model to examine the dynamic simulation effects of blue economy, technological innovation, and financial development on economic growth in Nigeria. Addressing the shortcomings of the conventional ARDL methodology, Jordan and Philips (2018) devised an upgraded dynamic ARDL modeling procedure. The visualization and graphical representation of positive and negative shocks to the regressors are generated by this upgraded procedure, while simultaneously capturing the intricate short-run and long-term relationships among the variables under study. Additionally, the DYARDL framework not only addresses the complexities linked to the orthodox ARDL model but also facilitates rapid simulation and visualization of probabilistic forecasts of changes in the dependent variable with a change in one explanatory variable, holding others constant (Udeagha, Ngepah, 2022).

Unit root test

Augmented Dickey-Fuller (ADF) and Philips-Perron (1988), as well as the Lee and Strazicich (2003) LM unit root test with two structural breaks were employed by this study to find out the stationarity qualities and the structural breaks in the employed variables. This is because most conventional stationary tests are biased due to the presence of structural breaks (Inuwa et al., 2022).

Dynamic autoregressive distributed lag (dynamic ARDL) simulations model

Using equation (1) as the baseline model for this study, and following the work of Jordan and Philips (2018), we introduce a new dynamic ARDL (further DYARDL) model as follows:

$$\begin{gathered} \Delta lnGDPP_t = \alpha_0 + \alpha_0 lnGDPP_{t-1} + \rho_1 \Delta lnACP_t + \phi_1 lnACP_{t-1} + \rho_2 \Delta lnTFP_t + \\ + \phi_2 lnTFP_{t-1} + \rho_3 \Delta FD_t + \phi_3 FD_{t-1} + \rho_4 \Delta EPH_t + \phi_4 EPH_{t-1} + \rho_5 \Delta TI_t + \quad (2) \\ + \phi_5 TI_{t-1} + \mu_t. \end{gathered}$$

Robust analysis

To confirm the robustness of the DYARDL outcomes, this investigation make use of FMOLS model to explore the long-run interrelation between dependent and independent variables. This model is characterized by the absence of bias, full efficiency, and optimal estimation of cointegration regressions that modifies OLS to correct serial correlation and endogeneity in the regressor as a result of the existence of long-run relationships (Inuwa et al., 2022). The study also employed the Canonical Cointegrating Regression (CCR) model as a robust checking technique developed by Park (1992) following the works of Inuwa et al. (2022) and Adeoye and Alenoghena (2019). In addition to correcting the asymptotic bias, it can eliminate both the endogeneity caused by the long-run correlations of cointegration equation errors and stochastic regressor innovations, and the long-run dependence between cointegration equation and stochastic variable.

Results and discussion

Summary statistics

Before discussing the results, this study examines the summary statistics of the variables. Standard deviations analysis shows higher volatility in EPH followed by TI and FD, while lnGDPP, lnTFP, and lnACP record lower volatility. The pairwise correlation matrix indicates the presence or otherwise of multicollinearity in the model. A high correlation coefficient ($r \geq 0.8$) shows strong multicollinearity between the variables. The outcomes of the pairwise correlation matrix statistics presented in Table 2 depict that the explanatory variables are weakly correlated except for TFP and EPH.

Table 2

Summary statistics and correlation matrix

Statistics / Variables	GDPP	ACP	TFP	FD	EPH	TI
Mean	7.612	11.017	12.996	10.942	22.922	9.826
Median	7.683	11.351	13.364	10.605	27.100	7.657
Maximum	7.893	12.666	14.008	19.626	38.218	32.610
Minimum	7.265	1.000	1.000	6.174	1.000	0.602
Standard Deviation	0.236	2.236	2.344	3.386	14.193	8.425
Skewness	–0.401	–3.164	–4.849	0.780	–0.565	1.285
Kurtosis	1.523	15.002	25.380	3.194	1.854	4.008
Correlation Matrix						
GDPP	1.000					
ACP	0.360	1.000				
TFP	0.011	0.935	1.000			
FD	0.695	0.192	–0.066	1.000		
EPH	–0.819	–0.164	0.144	–0.529	1.000	
TI	0.031	0.100	0.100	0.182	0.164	1.000

Source: author's computation using Eviews 12.

Unit root tests

Table 3 presents the results of various unit root assessment to analyze the stationarity qualities of the variables.

Table 3

Unit root tests results

Variables	Augmented Dickey-Fuller test	Phillips-Perron test	Lee-Strazicich test	
	Test Statistics		Break Year	Test Statistics
Level				
lnGDDP	–1.939	–3.102	1995 2011	–5.616
lnACP	–3.367	–2.820	1997 2002	–9.334***
lnTFP	–2.865	–2.813	1991 2011	–6.272**
FD	–4.252***	–2.303	2005 2012	–8.046***
EPH	–1.405	–1.222	1991 1998	–5.936
TI	–3.484	–3.492	1991 2002	–7.502***
First Difference				
ΔlnGDDP	–3.996**	–3.996**	2001 2011	–6.586**
ΔlnACP	–5.867***	–9.197***	1995 2007	–9.629***
ΔlnTFP	–7.932***	–7.906***	1991 2006	–6.328**
ΔFD	–5.910***	–8.017***	2003 2010	–7.333**
ΔEPH	–6.801***	–8.516***	1991 2001	–6.941**
ΔTI	–6.749***	–12.578***		

Note: ***, ** and * denote the level of significance at 1%, 5% and 10% respectively.
Source: authors' computations using Eviews 12.

The results of the ADF, and PP unit root tests as presented in Table 3 divulge that while some variables are not stationary at their level values, they become stationary after first differencing. However, these conventional tests ignore the structural breaks in the data. In contrast, the Lee and Strazicich (2013) test takes into account two structural breaks in the variables. The outcome of Lee-Strazicich tests displayed in the right-hand side of Table 3 confirm that the variables are integrate, when two structural breaks are taking into account, making them suitable for the application of the dynamic ARDL approach.

Lag length selection criteria for F-bound cointegration test

Table 4 presents the results of choosing the optimal lag order based on five different criteria. All the lag selection criteria except LR and SC, suggest that a lag length of three (3) is optimal for the F-bound cointegration test. Therefore, this study used a lag length of three for the cointegration test.

Table 4

Selection of optimal lag length for the F-bound co-integration test

Lag	LogL	L.R.	F.P.E.	A.I.C	S.C.	H.Q.
0	45.0889	NA	0.004792	−2.505558	−2.276536	−2.429643
1	65.7396	33.55727*	0.001406	−3.733722	−3.458896	−3.642625
2	67.7414	3.127865	0.001324	−3.796337	−3.475707*	−3.690057
3	69.3032	2.342725	0.001283*	−3.831450*	−3.465016	−3.709988*

Note: * indicates lag order selected by the respective criterion. L.R.: Sequential Modified LR test statistic (each test at 5%); F.P.E: Final Prediction Error; A.I.C: Akaike Information Criterion; S.C: Schwarz Information Criterion; H.Q: Hannan-Quinn information criterion.
Source: authors' computation using Eviews 12.

Bound testing approach for cointegration

The results of the cointegration test using the ARDL bound testing approach was illustrated by Table 5. The null hypothesis (H0) states the absence of cointegration.

The results in Table 5 confirm the rejection of the null hypothesis that states the absence of cointegration, as the calculated F-statistics is above the upper-bound critical values at all the levels of significance, empirically confirming the existence of cointegrating relationship among the variables under study.

Table 5

Bound Test for Cointegration

F-Statistic	Significance level, %	Bound critical values	
		I(0) Bound	I(1) Bound
5.351746	1	3.29	4.37
	2.5	2.88	3.87
	5	2.56	3.49
	10	2.2	3.09

Source: authors' compilation using Eviews 12.

Dynamic ARDL model results

Table 6 displays the estimated results of the dynamic ARDL simulation model.

From Table 6 it can be deduced that aquaculture production (ACP) positively stimulates economic growth (GDPP) both in the short run and long run, while total fisheries production (LTFP) is positive in the long run, but unfavorable in the short run. More specifically, a 1% increase in ACP and TFP promotes economic growth of 0.036% and 0.028% respectively in the long run, while a 1% increase in TFP reduces economic growth by 0.0005% in the short run. This negative relationship between total fisheries production and economic growth in Nigeria can be theoretically justified through the structural transformation theory propounded by Lewis (1954). The theory, also known as the Dual-Sector Model, and later became widely known as the structural transformation theory in development Economics, states that as economies grow and develop, they tend to shift labor and resources from the primary sector (fisheries and agriculture) to the growing industrial and service sectors. In Nigeria, economic growth is majorly driven by oil and gas, telecommunications, and services sectors, while agriculture and marine economy sectors remain relatively informal and underdeveloped. As a result, even if fisheries production volumes increase, its share in the overall GDP decreases, which can be perceived as a sign of economic backwardness rather than progress.

Table 6

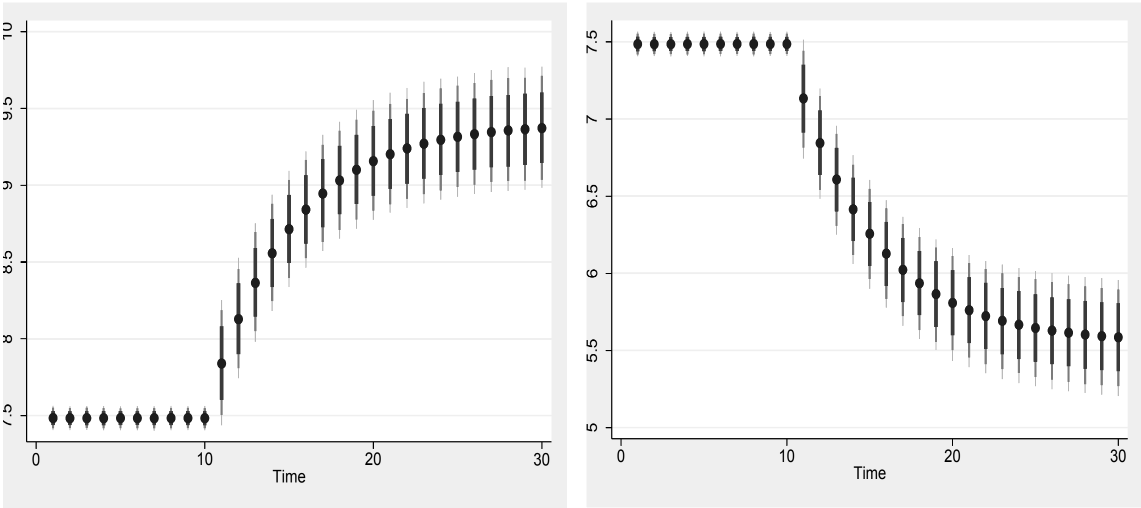
Dynamic ARDL simulation model

Variables	Coefficient	Std. error	t-value	P>t	[95% conf. interval]	
Cons	0.5643	0.6874	0.82	0.418	–0.8358	10.9644
$lnACP_{t-1}$	0.0356**	0.01980	20.80	0.032	–0.0047	0.0759
$lnTFP_{t-1}$	0.0282***	0.0468	–30.6	0.001	–0.0670	0.1235
$\Delta lnTFP_t$	–0.0005	0.0031	–0.16	0.871	–0.0069	0.0060
FD_{t-1}	0.0026**	0.0031	20.04	0.027	–0.0040	0.0089
ΔFD_t	–0.0002	0.0034	–0.05	0.959	–0.0072	0.0068
EPH_{t-1}	0.0022**	0.0009	20.36	0.025	0.0003	0.0040
ΔEPH_t	0.0035**	0.0017	20.04	0.050	–20.6800	0.0069
TI_{t-1}	0.0006	0.0012	0.50	0.622	–0.0018	0.0030
ΔTI_t	0.0003	0.0009	0.37	0.716	–0.0016	0.0023
R-squared	*0.7837*					
Adjusted R-squared	*0.6546*					
N	*41*					
Prob > F	*0.0034****					
Simulations	*1000*					
Root MSE	*0.0369*					

Note: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.
Source: authors' computation using Stata 17.

Electricity production from hydroelectric sources (EPH) is positive and statistically significant in both the short run and long run. 1% increase in EPH boosts to economic growth by 0.0035% and 0.002% respectively, both in the short run and long run. This result is consistent with findings of Alharthi and Hanif (2020), Yulisti et al. (2024), and Bădîrcea et al. (2021). Furthermore, financial development (FD) is positive and statistically significant in the long run, but insignificantly negative in the short run. 1% increase in FD increases economic growth by 0.003% in the long run, whereas in the short run a 1% increase in FD reduces economic growth by 0.0002%. This could be linked to the structural and institutional weaknesses in the Nigerian financial system as pointed out by Osuji and Ekeagwu (2024), who emphasized that limited access to credit, high interest rates, corruption, weak regulation and poor financial inclusion hinder productive investment in Nigeria. This is also supported by rent-seeking concept developed by Gordon Tullock in 1967 as presented in the work of Tollison (2012). This theory suggests that in weak institutional environments, financial systems may be captured by elites for rent-seeking, diverting resources from productive sectors to non-productive sectors like real estate in form of buying land or property and holding them idle or involved in speculative activities. Finally, technological innovation (TI) has significant positive short run and long run impact, stimulating economic growth positively. 1% increase in TI raises economic growth by 0.0006% and 0.0003% respectively. These findings are consistent with the results of Islam (2025), Olunuga and Ashoghon (2024), Nwani et al. (2025), and Fasanmi et al. (2025).

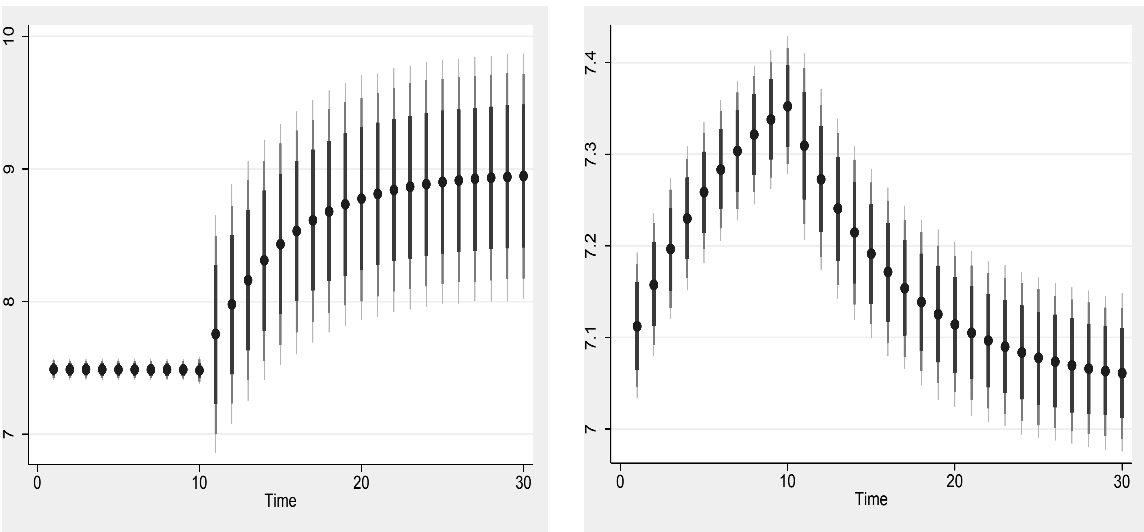
The impulse response plot in Figure 1 displays the relationship between aquaculture production and economic growth in Nigeria. The figure showcases that 10% upsurge in aquaculture production is significantly and positively correlated with economic growth in both the long and short term. Conversely, a 10% fall in aquaculture production exert negative impact on economic growth over both time horizons. These results suggest that an increase in aquaculture production has a sustainable positive impact on economic growth in Nigeria.



a) 10% increase in aquaculture production a) 10% decrease in aquaculture production

Figure 1. The impact of change in aquaculture production on economic growth in Nigeria, %
Note: In Figures 1-5, the dots indicate the average prediction value, while the dark grey to light grey lines represent 75%, 90% and 95% confidence intervals, respectively.
Source: authors' computation.

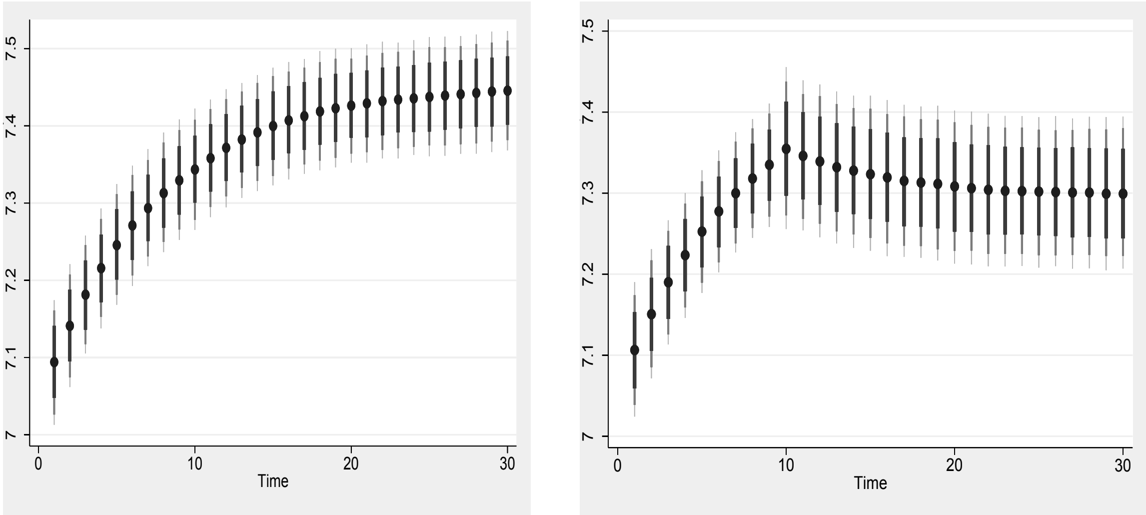
Figure 2 illustrates the relationship between TFP and economic growth using impulse response graph. The plot reveals that a 10% rise in total fisheries production has a long-term and short-term positive impact on economic growth, while a 10% fall in total fisheries production has long term negative influence on economic growth.



a) 10% increase in total fisheries production b) 10% decrease in total fisheries production

Figure 2. The impact of adjustment in total fisheries production on economic growth in Nigeria, %
Source: authors' computation.

Figure 3 plots the link between FD and economic growth, exhibiting that a rise in FD by 10% stimulates the economy favorably. On the contrary, a corresponding 10% fall in FD showcases a short-term positive but a long-term negative impact on economic growth, suggesting that while short term fluctuation may occur, sustained financial development is critical for long term economic growth in Nigeria.

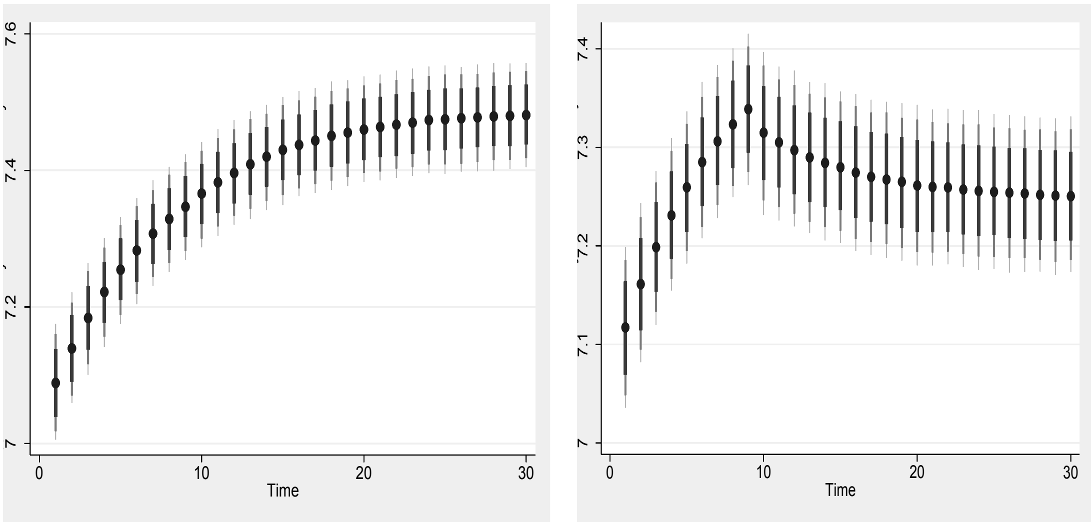


a) 10% increase in financial development

b) 10% decrease in financial development

Figure 3. The impact of change in financial development on economic growth in Nigeria, %.
Source: authors' computation.

Figure 4 illustrates the nexus between electricity production from hydroelectric sources and economic growth.



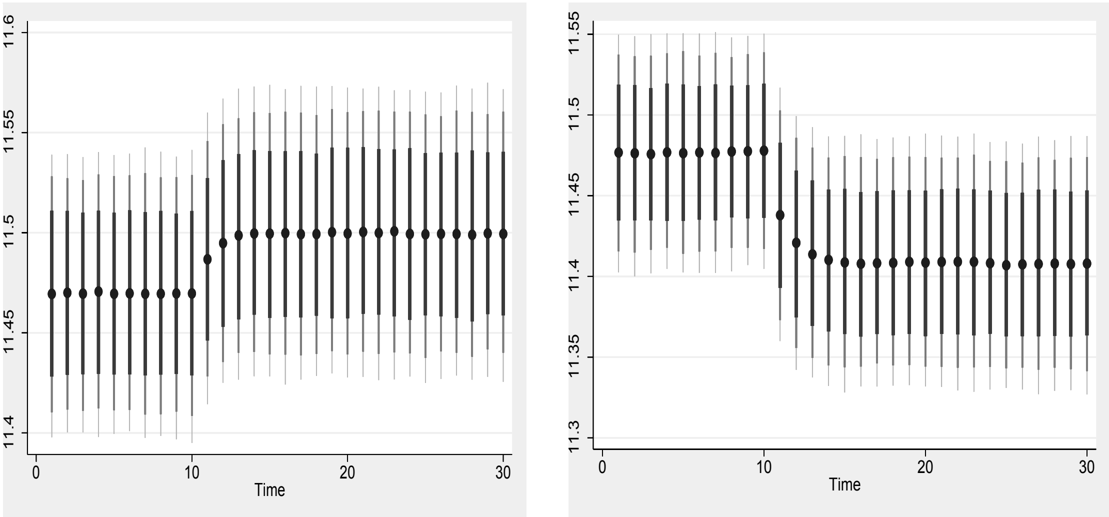
a) 10% increase in electricity production from hydroelectric sources

b) 10% decrease in electricity production from hydroelectric sources

Figure 4. The impact of change in electricity production from hydroelectric sources on economic growth in Nigeria, %
Source: authors' computation.

The plot shows that a 10% rise in electricity production from hydroelectric sources contribute a long-term positive impact on economic growth. In contrast, a 10% decline in electricity production from hydroelectric sources has a short-term positive impact on economic growth but a long-term negative impact. This suggests that a decline in electricity production from hydroelectric sources does not immediately affect Nigeria's economic growth. This is associated with the fact that businesses and households typically lean on diesel and petrol generators as alternative energy sources to satisfy their immediate energy demands to prevent disruption on economic activities. However, persistently relying on this costly and suboptimal energy translates into dwindling revenue by escalating the costs of production, reduced competitive spirit, low investment, and limit industrial expansion, thereby obstructing economic growth.

Figure 5 illustrates the link between technological innovation and economic growth in Nigeria. The plot depicts that 10% rise in technological innovation results in sustained long term positive impact on economic growth. In contrast, 10% decline in TI gradually slow down economic growth.



a) 10% increase in technological innovation b) 10% decrease in technological innovation

Figure 5. The impact of change in technological innovation on economic growth in Nigeria, %
Source: authors' computation.

Diagnostic tests for statistical analysis

A variety of diagnostic statistical tests was employed to evaluate the reliability of the estimated model. Table 7 reports the corresponding empirical findings.

Table 7

Diagnostic statistics tests

Diagnostic statistical tests	Null hypotheses	X^2 (p Values)	Remarks
Breusch-Godfrey LM test	The residuals exhibit serial correlation	0.1461	The model does not exhibit serial correlations
Breusch-Pagan-Godfrey test	The model exhibits heteroscedasticity	0.9329	There is no evidence of heteroscedasticity
Ramsey RESET test	The model exhibit specification error	0.2272	Model is specified correctly
Jarque-Bera Normality Test	The data does not follow a normal distribution	0.4884	Estimated residuals are normally distributed

Source: authors' computations using Eviews 12.

It can be deduced from Table 7 that the model has successfully passed all the diagnostic statistical assessments, indicating its reliability and overall adequacy. The results from Breusch-Godfrey LM test, Ramsey RESET, and Breusch-Pagan-Godfrey tests reveal that the model is free from serial correlation, correctly specified, and shows no evidence of heteroscedasticity, respectively. Furthermore, the Jarque-Bera normality test confirm that the residuals of the model are normally distributed.

Robustness check

To check for the robustness and reliability of the DYARDL result, this research applied Fully Modified Ordinary Least Squares (FMOLS) and Canonical Cointegrating Regression (CCR) model as robust estimators to examine the long-term impact of blue economy on the Nigerian economic growth. Tables 8 and 9 present the results of using these techniques.

Table 8

Fully Modified Ordinary Least Squares (FMOLS) result

Variable	Coefficient	Standard error	T-statistic	Probability
lnACP	0.3188	0.0274	11.643	0.0000
lnTFP	–0.2842	0.0258	–11.030	0.0000
FD	–0.0033	0.0040	–0.846	0.4068
EPH	0.0007	0.0013	0.576	0.5701
TI	0.0004	0.0011	0.337	0.7395
Const	7.8036	0.0736	106.053	0.0000

Source: authors' computation using Eviews 12.

Table 9

Canonical Cointegrating Regression (CCR) model result

Variable	Coefficient	Standard error	T-statistic	Probability
lnACP	0.2603	0.0232	11.236	0.0000
lnTFP	-0.2802	0.0733	-3.823	0.0010
FD	-0.0037	0.0027	-1.446	0.1631
EPH	0.0044	0.0011	3.938	0.0008
TI	0.0009	0.0010	0.877	0.3902
Const	7.9650	0.7616	10.459	0.0000

Source: author's computation using Eviews 12.

The results of the FMOLS and CCR models in this study are consistent with the previous findings from the Dynamic ARDL model, although the coefficient values are slightly different.

Conclusions and policy recommendations

Conclusions

By utilizing the innovative dynamic ARDL simulations model, this study explored the dynamic impact of aquaculture production, total fisheries production, financial development, electricity production from hydroelectric sources, and technological progress on Nigeria's economic growth throughout 1981 to 2022. From the findings, economic growth is positively supported by both aquaculture production and total fisheries production in the long run, whereas, in the short run, TFP is negatively related to economic advancement. Long term economic progress is also promoted by financial development. Furthermore, electricity production from hydroelectric sources and technological progress has positive effect in both the short run and long run. The robustness of the findings obtained from the Dynamic ARDL model is confirmed by the estimates of the Canonical Cointegrating Regression and Fully Modified Least Squares models.

Recommendations

Based on the study's empirical findings, the following policy recommendations can be proposed.

Firstly, boosting economic growth and environmental sustainability within a blue economy framework requires robust, sustainable financial support. This can be achieved through public donations and private investments, utilizing blue bonds and other innovative financing schemes. The use of modern technologies, such as blockchain, remote sensing, and artificial intelligence can enhance the efficiency and accountability of these financial mechanisms by creating an enabling environment for transparent transactions, real-time monitoring, and advanced data analytics. Such technological integration is crucial to address the challenges posed by climate change and the deteriorating ocean environment.

Secondly, other developing countries that have ocean resources should follow the example of implementing blue bonds at national and regional levels. Supported by digital platforms, this can significantly enhance market growth and investor confidence. By integrating technology into the financial framework, stakeholders can more effectively monitor, manage, and report on marine resource usage, ensuring economic growth and environmental sustainability.

Thirdly, African nations should emulate Nigeria's initiative in creating a Ministry of Marine and Blue Economy as a strategic move to integrate their nations' rich marine resources into national economic framework. This ministry should incorporate advanced technologies into its governance, coordination, and operational processes using data analytics, Internet of Things (IoT), and digital communication tools to improve transparency, efficiency, and responsiveness in policy implementation. These technological tools can facilitate better collaboration among governmental agencies and private sector participants.

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