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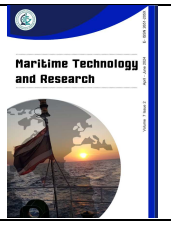

Research Article

Maritime security and blue economy development in Nigeria: A structural equation model

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Abstract

The Nigerian Niger Delta region has been described as the epicenter of piracy and kidnapping for ransom of seafarers and other maritime crimes, especially in the Gulf of Guinea region. This paper aims to evaluate maritime security and blue economy development in Nigeria using structural equation modelling. The study adopts a quantitative research methodology and expost facto research design. 33 year (1990 - 2022) time series secondary data are sourced from the International Maritime Bureau (IMB), Nigerian Ports Authority annual reports, CBN statistical bulletin, NOSDRA, and NPA annual statistics. The data obtained are transformed, cleaned, and subjected to confirmatory factor analysis, measurement modelling and structural equation modelling using AMOS (V23). From the structural equations analysis, the specified models meet the minimum/necessary conditions (Df => 0) for model identification. The findings of the study reveal that 56 % of maritime security threats in Nigeria waters can be predicted by the number of crewmen kidnapped for ransom, 55 % by pirates' attacks, and 92 % by crude oil theft in Nigerian waters. Similarly, the results reveal that maritime security threats (MST) have a significant effect on blue economy development in Nigeria. Imperatively, adequate maritime security measures stimulate confidence among local and international stakeholders, attracting investments, encouraging trade partnerships, and enhancing the country's position as a reliable maritime hub. Therefore, the study recommends that the Nigerian government should prioritize cooperation and collaboration with other regional navies to ensure adequate maritime domain awareness and security interdiction within her exclusive economic zone, as provided by the Yaoundé code of conduct security architecture.

1. Introduction

The ocean is an important finite resource for mankind, and Africa, in particular, as it is key to national security and economic growth (Ocean Beyond Piracy, 2018). Africa is enthusiastic about the possibilities of investing in the maritime industry, with the 2063 agenda of the continent envisaging the blue economy as a major contributor to transformation and development (African Union-InterAfrican Bureau for Animal Resources, 2019). Blue economic activities, growth, and sustainable development depends on security; this idea creates an evident link between blue economy and maritime security. The Red Sea maritime terrorism incidents are evidence of the strangulation of the international supply chain, with attacks on merchant shipping by Houthi rebels. This provides credence to the blue economy and maritime security nexus.

Importantly, the potential of the blue economy to drive Africa's economic growth was recognized with the adoption of the African Charter on Maritime Security, Safety and Development in Africa (the Lomé Charter) by the African Union Assembly in 2016 (African Union, 2016; Stable Seas, 2019). Also, the 2050 Africa's Integrated Maritime Strategy (AIMS) has enabled a framework for the sustainable development of her maritime frontiers for economic prosperity. This strategy is aimed at fostering more wealth creation from the oceans, seas, lakes, and inland waterways of Africa by creating a flourishing maritime economy and realizing the potentials of the ocean economy in an environmentally sustainable manner (African Union, 2012).

The African Union proclaimed that the blue economy could become the new frontier of an African renaissance (African Union, 2012; UNECA, 2016; Spamer, 2018). Therefore, the blue economy is heavily dependent on maritime security to protect the opportunities and resources inherent in it from a range of threats, such as piracy, oil theft, illegal unregulated and unreported (IUU) fishing, and a host of other transnational crimes (Voyer et al., 2018).

The Nigerian blue economy encompasses a wide array of clusters, including shipping, port operations, fishing, offshore exploration, tourism, hydrocarbon mining, and other numerous maritime services. This diverse industry contributes significantly to the Gross Domestic Product (GDP) of Nigeria, and serves as a catalyst for job creation, food security, revenue generation, and foreign exchange earnings. However, the Nigerian coastal areas comprise Lagos and the oil-rich Niger Delta states (Hamisu, 2019). Nigeria has about 800 km of coastline and an Economic Exclusive Zone (EEZ) of 200 nautical miles from her territorial waters. Nigeria is among the states that comprises the Gulf of Guinea (GoG), situated in the West of, and part of Central, Africa. The Nigerian economy is dependent on the maritime industry, which seems to be endangered by persistent security threats which, if allowed to persist, may jeopardize the economic growth of the country, affect food and energy security, lead to loss of sustainable livelihoods, and shatter peace in the coastal communities; hence, the justification for this study.

These maritime security threats are counter to the 2063 agenda of the African continent envisaging the blue economy as a major contributor to transformation and development (African Union, 2016). There are myriad factors which contribute significantly to the problem of insecurity in Nigerian waters, especially concerning coastal communities and indigenous peoples. The factors stem from pollution of the coastal areas and wetlands, illegal fishing, and non-inclusion of the welfare of the coastal communities in blue economy development. These have resulted in poverty and loss of livelihoods, which seem to be the motivation for the coastal communities and indigenous peoples to venture into low-risk high-reward criminal ventures to earn a living.

Moreso, despite the enormous investment (military expenditure) in security measures provided by the Nigerian government through the Integrated National Security and Waterways Protection Infrastructure Framework (Deep Blue Project) and Falcon Eye (which are reactive rather than proactive and do not address the root causes of maritime insecurity), the Tantita Security Services Limited (TSSL) pipeline surveillance contract, these threats persist in the Nigerian coastal zones. Also, the Nigerian Navy, though carrying out incessant security drills to rid Nigerian waters of pirates, oil thieves, illegal oil refineries, and illegal fishing, seems to be overwhelmed with effectively governing the Nigerian Exclusive Economic Zone (EEZ), as no nation can handle this alone. The Joint Task Force (JTF) commissioned to interdict maritime crimes in the Niger Delta region is allegedly perceived to be complicit in the oil crimes going on in the oil-rich region (Transparency International Defence and Security, 2019). With an estimated theft of between 6 - 10 percent of the country's crude oil production, Nigeria leads globally in oil theft (Naanen, 2019). The rate of attacks so far put the number of seafarers kidnapped in the Gulf of Guinea in 2018, 2019, and 2020 to 108, 142, and 154, respectively (CEMLAWS, 2021). Attacks remain more likely closer to the Niger Delta region of Nigeria; the threat has spread to larger parts of the Gulf of Guinea, affecting countries from Ghana to Gabon (Risk Intelligence, 2021).

Nigeria loses approximately US$6 billion annually in freight costs because of piracy in her waters (Pichon & Pietsch, 2019). As a result, import and export rates are pushed up, causing local customers to pay higher prices and governments to lose revenue at the ports. Based on this, the following objectives were formulated for the study;

1) To determine the cause and effect relationship between maritime security threats and the blue economy development in Nigeria.

2) To determine the cause and effect relationship between maritime security measures and the development of the blue economy in Nigeria.

The other parts of the study are arranged as follows; Section 2 captures a brief review of relevant literature with emphasis on the blue economy and maritime security concepts, establishing the nexus between maritime security and blue economy development in Nigeria. Section 3 highlights the data source, model specification, and method of data analysis, while section 4 presents the results of the study. Conclusions, recommendations, and suggestions for further study are highlighted in section 5.

2. Literature review

2.1 The blue economy concept

The blue economy, as a concept of sustainable development, has become mainstream in economic development policies in various countries, including Nigeria. The blue economy is a subset of the ocean economy, and the identification and valuation of the segments or sectors that constitute the ocean economy is often the first step in the process of planning blue economy development or of identifying potential blue economy opportunities (Colgan, 2016; Voyer et al., 2018). Blue economy discourse is based on the triumvirate pillars of economic growth, environmental sustainability, and social inclusion.

Similarly, the World Bank (2017) conceptualized the blue economy as the sustainable use of ocean resources for economic growth and improved livelihoods and jobs, while restoring and preserving the health of the ocean. The UN (2022) postulated that a blue economy should be economically viable (prosperous) and environmentally sustainable, but also culturally appropriate, and should foster social equity and human well-being. The blue economy is a new frontier for economic growth, food security, human security, energy security, and national security, and is a means of diversifying the economy using resources from oceans, seas, rivers, and lakes and harnessing other blue economy clusters for the well-being and security of the people. However, the protection, securitization, and sustainable utilisation of these blue spaces are key pillars for the governance of the blue economy (Pretorius & Henwood, 2020).

2.2 Maritime security concept

The concept of maritime security means different things to different people; however, the one adopted in this study is holistic, as it is not limited to piracy, but entails the protection of a state's land and maritime domain, resources, economy, environment, and community from certain harmful activities at sea. It is worthy to note that piracy alone does not constitute maritime insecurity, but it entails threats such as kidnapping of crewmen at sea, IUU fishing, crude oil theft, underwater cable sabotage, etc.

The definition of piracy, provided under Article 101 of the United Nations Convention on the Law of the Sea (UNCLOS) 1982, states that it consists of any;

1) Illegal act of violence, act of detention, or any act of depredation, committed for private ends by the crew or the passengers of a private ship or a private aircraft and directed:

(i) In International Waters against another ship or aircraft, or a person or property on board such ship or aircraft.

(ii) Against a ship, aircraft, persons or property in a place outside the jurisdiction of any State;

2) Act of voluntary participation in the operation of a ship or an aircraft with knowledge of facts making it a pirate ship or aircraft; and

3) Act of inciting or of intentionally facilitating an act described in subparagraph (a) or (b).

Onuoha et al. (2013), Yorulmaz (2016), and Tokulah-Oshoma (2019) argued that the UNCLOS definition of piracy is deficient, as it is limited by geographical location. The authors observed that the definition failed to capture the inland waterways, the ports, and anchorages, as it concentrated on acts against a ship on the high seas as being piratical. It did not recognize that piratical attacks can be politically motivated.

Furthermore, Yorulmaz (2016) noted that Article 105 of UNCLOS gives authority to every state to seize a pirate ship on the high seas or any place outside the jurisdiction of any state. Also, UNCLOS Article 110 capacitates warships to board any vessel which they see as suspicious, including piracy on the high seas. Neethling (2010) argued that the definition given by the International Maritime Bureau (IMB) is more acceptable, as they defined piracy as "an act of boarding or attempting to board any ship with the intent to commit theft or any other crime and with the attempt to or capability to use force in the furtherance of that act". This definition was adopted for this study, justifying the use of IMB piracy data.

The United Nations Office on Drug and Crime (2021) report opined that piracy in the GoG was initiated by politically motivated early militant groups, such as Movement for the Emancipation of Niger Delta (MEND), who attack oil and gas infrastructure, and recent criminal groups who take seafarers for ransom from international vessels transiting deep off the West African coast.

Maritime security governance entails a country's ability to successfully monitor its territorial waters and EEZ to investigate illegal activities, enforce maritime law, and mitigate security risks (Stable Seas, 2019). Most states in the GoG region lack the capacity to maintain a naval presence and effectively monitor their coasts. In the year 2020, the International Chamber of Commerce (ICC) - International Maritime Bureau (IMB) reported that more than 95 % of all seafarers kidnapped globally were incidents recorded in the GoG region (NATO SOUTHERN HUB, 2021).

A study conducted by Keter (2022) demonstrated that maritime threats remain a security issue in the realization of blue economy benefits. This paper will focus on key maritime security threats particular to the Nigerian maritime space, such as piracy, kidnap for ransom, crude oil theft, and IUU fishing. Relating crude oil theft (COT) to the onshore dimensions of the issue of Niger Delta-based piracy, the drop in piracy in year 2022 in the region can be linked to the increase in oil crime, and does not obliterate the fact that piratical activities might resume anytime soon in the region.

2.3 Establishing the hypotheses of study

To ascertain the relationship between maritime security and blue economy development in the Nigerian context, two theories are espoused, comprising the situational crime prevention theory and the routine activity theory.

The situational crime prevention theory applies to understanding the causes of maritime security threats and formulates the best method to circumventing them. This informs the basis for the formulation of hypothesis (1) of the study, where maritime threats such as piracy, kidnap for ransom, and crude oil theft are conceptualised as a seaward expression of shore social malfeasance. Deploying the situational crime prevention theory to the subject matter of the research leads to an assumption that the success of the blue economy sector in Nigeria and the Gulf of Guinea region depends on the prioritising of maritime risks factors and maritime threats prevalent in the region.

H_{O1}: Maritime security threats do not have a significant cause and effect relationship with blue economy development in Nigeria.

However, Kigerl (2012) noted that the Routine Activity Theory (RAT) is an ecological approach to the causation of crime. The theory explains the convergence of the elements necessary for a crime to occur (Groff, 2008). The triangulation of a motivated offender, a suitable target, and the absence of a guardian in space and time leads to the actualization of crime. However, if crime

requires a motivated offender's convergence in time and space, an appropriate target, and the lack of a competent guardian (the 'crime triangle'), this implies crime can be avoided by keeping motivated offenders away from appropriate objectives at times and in spaces, or by enhancing the existence of capable guardians (Kleemans et al., 2012). This forms the basis for the formulation of hypothesis (2) of the study, stated as follows;

H_{O2}: Maritime security measures do not have a statistically significant relationship with blue economy development in Nigeria.

The study progresses to the next section 3, which highlights the data source, model specification, and method of data analysis.

3. Methodology

3.1 Sources of data

This study employed a structural equation model (SEM) to analyze a 33-year (1990 - 2022) time series data, obtained in the main from the Nigerian Ports Authority (NPA), International Maritime Bureau (IMB) annual report, Nigerian Oil Spill Detection and Response Agency (NOSDRA) portal, Central Bank of Nigeria (CBN) annual Statistical Bulletin, and World Bank Development Database. These data were used to test the specific objectives.

Structural equation modeling (SEM) are complex models permitting the study of real world complexity by considering a whole number of causal relationships among latent concepts (blue economy development, maritime security threats and consequences), each measured by several observed indicators usually defined as manifest variables (Russolillo & Trinchera, 2019; Fan et al., 2016). SEM is a combination of two statistical methods: confirmatory factor analysis and path analysis. Path coefficients and the corresponding significance levels are used to explain each constructs' predictive ability (Gusenther et al., 2023). In SEM, latent or manifest variables can serve both as dependent or independent variables in a chain of causal hypotheses; SEM also includes a measurement model in its analysis, which removes biases due to errors of measurement (Olaoye et al., 2020).

A study by Nze et al. (2016) applied SEM to study cost optimization models of port operations in Nigeria with emphasis on emerging river ports. Another study by Onwuegbuchunam et al. (2021) applied PLS-SEM to assess the impacts of port security regimes on security incidents and performance of Nigerian ports.

3.2 Mathematical equation specification of the measurement model

$$Ln(X_1) = \Lambda_{11} Ln(\xi_1) + \partial_1 \quad \text{(A.1)}$$

$$Ln(X_2) = \Lambda_{21} Ln(\xi_1) + \partial_2 \quad \text{(A.2)}$$

$$Ln(X_3) = \Lambda_{31} Ln(\xi_1) + \partial_3 \quad \text{(A.3)}$$

$$Ln(X_4) = \Lambda_{42} Ln(\xi_2) + \partial_4 \quad \text{(A.4)}$$

$$Ln(X_5) = \Lambda_{52} Ln(\xi_2) + \partial_5 \quad \text{(A.5)}$$

$$Ln(X_6) = \Lambda_{62} Ln(\xi_2) + \partial_6 \quad \text{(A.6)}$$

$$Ln(X_7) = \Lambda_{72} Ln(\xi_2) + \partial_7 \quad \text{(A.7)}$$

$$Ln(X_8) = \Lambda_{82} Ln(\xi_2) + \partial_8 \quad \text{(A.8)}$$

$$Ln(X_9) = \Lambda_{93} Ln(\xi_3) + \partial_9 \quad \text{(A.9)}$$

$$Ln(X_{10}) = \Lambda_{103} Ln(\xi_3) + \partial_{10} \quad \text{(A.10)}$$

$$Ln(X_{11}) = \Lambda_{113} Ln(\xi_3) + \partial_{11} \quad \text{(A.11)}$$

$$X = \Lambda\xi + \partial$$

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \\ X_7 \\ X_8 \\ X_9 \\ X_{10} \\ X_{11} \end{bmatrix} = \begin{bmatrix} \Lambda_{11} & 0 & 0 \\ \Lambda_{21} & 0 & 0 \\ \Lambda_{31} & 0 & 0 \\ 0 & \Lambda_{42} & 0 \\ 0 & \Lambda_{52} & 0 \\ 0 & \Lambda_{62} & 0 \\ 0 & \Lambda_{72} & 0 \\ 0 & \Lambda_{82} & 0 \\ 0 & 0 & \Lambda_{93} \\ 0 & 0 & \Lambda_{103} \\ 0 & 0 & \Lambda_{113} \end{bmatrix} + \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \end{bmatrix} + \begin{bmatrix} \partial_1 \\ \partial_2 \\ \partial_3 \\ \partial_4 \\ \partial_5 \\ \partial_6 \\ \partial_7 \\ \partial_8 \\ \partial_9 \\ \partial_{10} \\ \partial_{11} \end{bmatrix}$$

Where the endogenous latent variables:

ξ_1= Maritime security threats (MST), and ξ_3= maritime security measures (MSM) (exogenous latent variables), ξ_2 = blue economy development (BED),

The endogenous manifest variables include;

X_1 = Piracy ($PirAtk$), X_2 = crews kidnapped for ransom ($NoCKFR$), X_3 = crude oil theft ($COTsabtage$), X_4 = GDP cont. from maritime transport ($GDPMtrp$), X_5 = GDP from fishing sector ($GDPFishn$), X_6 = GDP from offshore oil and gas sector ($GDPOFog$), X_7 = number of ships calling at Nigerian ports ($NSHPCall$), X_8 = number of people employed at Nigerian ports ($NPEmlyport$), X_9 = military expenditure in Nigeria EEZ ($MiLEXP$), X_{10} = marine protected area percentage of Nigerian territorial waters (MPA), X_{11} = marine insurance premiums paid by ships operating in Nigerian waters (MIP).

Other variables in the model:

$\Lambda_{11} - \Lambda_{311}$ = Path Coefficients, ∂ = Error term, ϕ = Covariance, Ln = Logarithm,

3.2.1 Mathematical specification of the structural equations

$$\eta_1 = 0 + r_{11}\xi_1 + r_{12}\xi_2 + \varepsilon \quad \text{(B.1)}$$

$$\eta_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix} + [r_{11}\, r_{12}] + \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + [\varepsilon]$$

Where; $\eta_1 =$ blue economy development (BED) (endogenous latent variable), ξ_1 = maritime security threats (MST) & ξ_2 = maritime security measures (MSM) are the exogenous latent variables, ε = represents the error term in the structural model, capturing the unexplained variance in the common factor (BED)Y_1,

Exogenous manifest variables

X_1 = piracy ($PirAtk$), X_2 = crews kidnapped for ransom ($NoCKFR$), X_3 = crude oil theft ($COTsabtage$), X_4 = military expenditure in Nigeria EEZ ($MiLEXP$), X_5 = marine protected area percentage of Nigerian territorial waters (MPA), X_6= marine insurance premiums paid by ships operating in Nigerian waters (MIP).

Endogenous manifest variables

Y_1 = GDP cont. from maritime transport ($GDPMtrp$), Y_2 = GDP from fishing sector ($GDPFishn$), Y_3 = GDP from offshore oil and gas sector ($GDPOFog$), Y_4 = number of ships calling at Nigerian ports ($NSHPCall$), Y_5 = number of people employed at Nigerian ports ($NPEmlyport$),

where $r_{11} - r_{12}$ = Structural Path Coefficients, are the path coefficients of the observed latent endogenous variables. To estimate the model parameters ($r_{11} - r_{12\,1,}\ \varepsilon$), dedicated econometric software, AMOS (V23), was employed (See **Figure 1**).

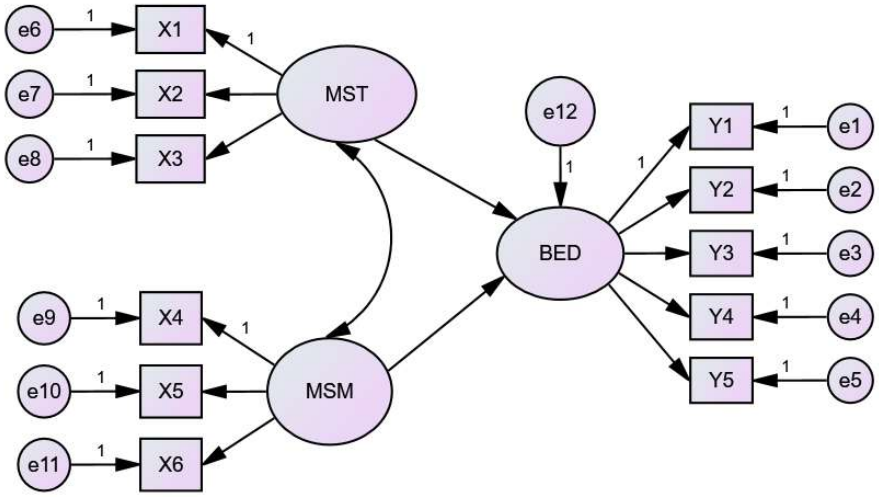

Figure 1 Conceptual structural model for blue economy development and maritime security constructs.
Source: Specified by the Author's in AMOS (V23).

4. Results

This section presents the results and a discussion of the findings of the analyzed data using Analysis of Moment Structure (AMOS V23).

The descriptive statistics, reported in **Table 1**, indicate that GDP contribution from the maritime transport sector has an approximate mean of 0.5431, with a corresponding standard deviation of 0.09482. Also, GDP contribution from the fishing sector has an approximate mean of 2.2734, with a corresponding standard deviation of 0.25002, Number of ships calling at Nigerian ports has an approximate mean of 3.5967, with a corresponding standard deviation of 0.15147 (these mentioned items form the blue economy development construct (BED)). Similarly, military expenditure by the Nigerian government has an approximate mean of 0.5008, with a corresponding standard deviation of 0.14775. Number of crude oil installation sabotage incidents leading to crude oil theft has an approximate mean of 1.5048, with a standard deviation of 1.25683 (these items form the maritime security risk/threat construct (MST)).

Table 1 Descriptive statistics summary.

Items	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
GDPMtrp	33	0.5431	0.09482	0.257	0.409	-1.422	0.798
GDPFishn	33	2.2734	0.25002	-0.260	0.409	-1.265	0.798
SHPcall	33	3.5967	0.15147	-3.545	0.409	15.315	0.798
MilExp	33	0.5008	0.14775	0.051	0.409	0.286	0.798
MPAptrw	33	0.1348	0.06366	-1.253	0.409	0.026	0.798
NoCKFR	33	0.8954	0.62762	-0.280	0.409	-1.258	0.798
PirAtk	33	0.9462	0.56577	-0.692	0.409	-0.962	0.798
COTsabtg	33	1.5048	1.25683	-0.099	0.409	-1.946	0.798

Source: AMOS iterations.

Furthermore, to test for the reliability of the model, a construct reliability test was carried out. Construct reliability is comparable to Cronbach's alpha. Sampling instrument/data with CR > 0.70 is considered reliable (Hair et al., 2010). The construct reliability (CR) and convergent validity (AVE) values for MST (exogenous latent variable) are 0.87 and 0.73, respectively; this construct is thus considered reliable and valid, having met the model fit indices; Chi-square = 0.00, CMIN/df = 0, RMR = 0.000, GFI = 1.00, AGFI = 1.00, NFI = 1.00, RFI = 1.00, IFI = 1.01, TLI = 1.071, CFI = 1.00, RMSEA = 0.00. The construct reliability (CR) and convergent validity (AVE) values for the maritime security measures (MSM) (exogenous latent variable) are 0.745 and 0.66, indicating that the construct is reliable and valid for the model. The fit indices as follows: Chi-square =0.00, CMIN/df = 0, RMR = 0.000, GFI = 1.000, NFI = 1.000, IFI = 1.000, CFI = 1.000, RMSEA = 0.30.

4.2 Results of the measurement model

The second step in SEM is estimating the measurement model. All latent variables in the analysis were placed as one level (regardless of whether they were exogenous or endogenous variables). From the analysis in AMOS (V23) all the factor loadings are greater than (0.50) and the model fit indices are as follows; Chi-square = 27.03, CMIN/Df = 1.802, RMR = 0.009, GFI = 0.819, NFI = 0.899, RFI = 0.812, IFI = 0.952, TLI = 0.906, CFI = 0.950, RMSEA = 0.158. Having satisfied the criteria for acceptability discriminant validity is tested for.

The results of the discriminant validity tests reveal that the √AVE values (0.683, 0.485, 0.573) are higher than the maximum shared squared variance (MSV) values (0.044, 0.044, 0.564), and lower than the CR; thus, the constructs show adequate discriminant validity (see **Table 2**).

Table 2 Result of the discriminant validity tests.

	CR	AVE	MSV	MaxR(H)	BED	MST	MSM
BED	0.853	0.683	0.044	0.971	**0.826**		
MST	0.726	0.485	0.044	0.861	1.022	**0.696**	
MSM	0.745	0.573	0.564	0.769	-0.751	-0.495	**0.757**

Source: Gaskins discriminant validity estimator.

In testing for the normality of the data, the skewness and kurtosis values for the variables provided evidence for univariate normality, as there was no evidence of a departure from univariate normality condition. The skew fell within the range of (-2 & + 2) and the kurtosis between (-7 & +7). Skewness values between -2 and +2 are reasonably consistent with normality (Pituch & Stevens, 2016), whereas values > 3 (in absolute value) indicate more severe non-normality (Kline, 2016).

From the structural equations analyzed, the specified model met the minimum/necessary conditions (Df => 0) for model identification. Degree of freedom = number of distinct sample moments - number of distinct parameters to be estimated. Where, number of distinct sample moments = 36, number of distinct parameters to be estimated = 21. Therefore, Df = 36 -21 = 15. This implies that the minimum condition was achieved, and the parameters were uniquely identified. Since the p-value (0.029 < 0.05), the null hypothesis of an exact fitting model is rejected. The model fit indices from AMOS iterations are as follows; Chi-square = 27.027, CMIN/df = 1.8, RMR = 0.009, GFI = 0.819, NFI = 0.899, RFI = 0.812, IFI = 0.952, TLI = 0.906, CFI = 0.950, RMSEA = 0.158.

From the model fit results, the GFI value (0.819), though less than 0.90, but very close to 0.90, indicates a well-fitting model. A good fitting model is accepted if the CMIN/df is <= 3 0r 5 (Dash & Paul, 2021); the model produced a CMIN/df value of (1.8), which indicates that it has a good fit. The TLI and CFI values (0.906 and 0.950), respectively, are both > 0.90, where both indicate an

acceptable good fitting model. The root mean-square error of approximation (RMSEA) also can be considered an 'absolute fit index', with 0 indicating the 'best fit', and values (> 0) suggest worse fit (Kline, 2016). Values of .05 or below on the RMSEA are generally considered indicative of a close-fitting model. Values between up to (0.08) or (0.10) are considered acceptable. From the model fit summary in **Table 3**, the RMSEA = 0.158, falls between 0.05 (close fit) and 0.10 (poor fit). So, the RMSEA, based on the results suggests the model does not represent a close fit to the data, but nevertheless indicates acceptable fit.

Table 3 Model fit summary.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	21	27.027	15	0.029	1.802
Saturated model	36	0.000	0		
Independence model	8	267.921	28	0.000	9.569

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.009	0.819	0.566	0.341
Saturated model	0.000	1.000		
Independence model	0.115	0.338	0.149	0.263

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.899	0.812	0.952	0.906	0.950
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.158	0.051	0.253	0.049
Independence model	0.517	0.462	0.575	0.000

Source: AMOS iterations.

The reduced mathematical equation of the structural model is stated as follows (see **Table 4** for the standardized regression weights);

Table 4 Standardized regression weights: (Group number 1 - Default model).

Variables			Estimate
BED	←	MST	0.861
BED	←	MSM	0.324
SHPcall	←	BED	0.407
GDPFishn	←	BED	0.964
GDPMTrp	←	BED	0.976
NoCKFR	←	MST	0.560
PirAtk	←	MST	0.548
COTsabtg	←	MST	0.917
MilExp	←	MSM	0.650
MPAptrw	←	MSM	-0.850

Source: AMOS iterations.

Substituting the path coefficients using the standardized regression weights in **Table 4** in the structural and measurement models specified,

The structural model

$$BED = 0.86(MST) + 0.32(MSM) + \varepsilon \quad (B.2)$$

The measurement models

$$PirAtk = 0.55(MST) + \varepsilon \quad (B.3)$$

$$NoCKFR = 0.56(MST) + \varepsilon \quad (B.4)$$

$$COTsabtg = 0.92(MST) + \varepsilon \quad (B.5)$$

$$GDPMtrp = 0.97(BED) + \varepsilon \quad (B.6)$$

$$GDPFishn = 0.96(BED) + \varepsilon \quad (B.7)$$

$$SHPcall = 0.41(BED) + \varepsilon \quad (B.8)$$

$$MilExp = 0.65(MSM) + \varepsilon \quad (B.9)$$

$$MPAptrw = -0.85(MSM) + \varepsilon \quad (B.10)$$

Where; BED = blue economy development, GDPMtrp = GDP contribution from maritime transport, GDPFishn = GDP contribution from fishing, SHPcall = total number of ships calling at

Nigerian ports, MST = maritime security risks, MSM = maritime security measures, NoCKFR = number of crewmen kidnapped for ransom in Nigerian waters, PirAtk = total number of pirate attacks in Nigerian waters, COTsabtg = crude oil theft, MilExp = military expenditure by Nigerian government, MPAptrw = marine protected area, t = period under study.

4.3 Test for research objectives

Objective one

To determine the cause and effect relationship between maritime security threats and blue economy development in Nigeria.

Eq. (B.2) depicts that 86 % of blue economy development in Nigeria is predicted by the rate of maritime security threats in Nigerian waters. Eq. (B.3) revealed that pirate attacks on vessels in Nigerian coast predicts maritime security threats by 55 %. Eq. (B.4) showed that 56 % of maritime security threats in Nigeria waters was predicted by the number of crewmen kidnapped for ransom, and 92 % by crude oil theft in Nigerian waters, as shown in Eq. (B.5).

Eq. (B.6) revealed that blue economy development will improve by 97 % for every one percent increase in GDP contribution from maritime transport; additionally, Eq. (B.7) depicts that BED will increase by 96 % for every one percent increase in GDP contribution from the fishing sector. Eq. (B.8) revealed that 41 % of blue economy development is predicted by the number of ships calling at Nigerian ports. It is pertinent to note that blue economy development has a positive/direct relationship with GDP contribution from maritime transport, GDP contribution from fishing, and the total number of ships calling at Nigerian ports.

Objective two

To determine the cause and effects relationship between maritime security measures and blue economy development in Nigeria.

Eq. (B.2) revealed that 32 % of blue economy development in Nigeria is predicted by maritime security measures on Nigeria's coast. It can be deduced that maritime security measures in Nigerian waters have a direct effect on blue economy development in Nigeria.

Eq. (B.9) revealed maritime security measures in Nigeria has a direct relationship with military expenditure (cost of providing security in Nigerian waters) and predicts MSM by 65 %. Eq. (B.10) revealed that an 85 % decrease in maritime security measures in Nigeria is predicted by marine protected area designation (MPA) and has an inverse relationship with the designation of a marine protected area in Nigerian waters.

4.4 Hypotheses testing

Table 5, showing paths coefficient results, was used for the hypotheses testing interpretation. The study assessed the effects of maritime security risk on blue economy development in Nigeria. Following the assessment of the measurement model, the next step is the evaluation of the path coefficients (relationship among study constructs) and their statistical significance.

Table 5 Paths coefficient results presentation.

Hypotheses	b	β	CR/t-value	p-value	Decision
BED ← MST	0.151	0.861	2.023	0.043	Accepted
BED ← MSM	0.208	0.324	1.936	0.053	Accepted

Source: Extract from the estimate table of AMOS iterations.

Where b = regression weights estimates, β = standardized regression weights, *** = significant (< 0.05).

4.4.1 Test for hypothesis one

H_O1: Maritime security threats do not have a significant cause and effect relationship with blue economy development in Nigeria.

Hypothesis one evaluates the cause and effect of maritime security threats (MST) (piracy, kidnap for ransom, crude oil theft, IUU fishing) on blue economy development in Nigeria. The results (see **Table 5**) revealed that MST has a statistically significant and positive effect on blue economy development in Nigeria (B = 0.861, t = 2.023, P-value = 0.043 < 0.05). Hence, Ho1 (maritime security threats do not have a significant cause and effect relationship with blue economy development in Nigeria) is rejected. Therefore, H1 (maritime security threats have a significant cause and effect relationship with blue economy development in Nigeria) is **accepted**. The beta coefficient value of (0.861) shows that 86.1 % of blue economy development in Nigeria is predicted by maritime security threats in Nigerian waters. The remaining 13.9 % might be accounted for by stochastic factors or variables not included in the model.

4.4.2 Test for hypothesis two

H_O2: Maritime security measures do not have a statistically significant relationship with blue economy development in Nigeria.

Hypothesis two seeks to determine the effects of maritime security measures (MPA designation, military expenditure) on blue economy development in Nigeria. The AMOS results (see **Table 5**) show that MSM has a positive and statistically significant effect on blue economy development in Nigeria (B = 0.324, t = 1.936, P-value = 0.053 =< 0.05), Thus, H_O2 (maritime security measures do not have a statistically significant relationship on blue economy development in Nigeria) is rejected.

Therefore, H2 (maritime security measures have a statistically significant relationship with blue economy development in Nigeria) is **accepted**. The beta coefficient value of (0.324) shows that 32.4 % of blue economy development in Nigeria is predicted by the level of maritime security measures in Nigerian waters. The remaining 67.6 % might be accounted for by stochastic factors or variables not included in the model.

5. Discussion of findings

The discussion of results is based on the findings from the techniques of confirmatory factor analysis and structural equation model (SEM), in order to know whether the stated objectives/hypotheses were achieved.

5.1 The effects of maritime security threats (MST) on blue economy development in Nigeria

To determine the effects of maritime security threats on blue economy development, a 33-year (1990 - 2022) time series data on key maritime security threats such as piracy, kidnap for ransom, and crude oil theft were subjected to confirmatory factor analysis, measurement modelling, and structural equation modelling. The results revealed that 86 % of blue economy development in Nigeria was predicted by maritime security threats in Nigerian waters. This corroborated with the findings of Marc et al. (2015) and Oluniyi (2017), who revealed that attacks by militant groups not only jeopardise Nigeria's economic stability, but also risk aggravating maritime insecurity in the Gulf of Guinea (GoG). The findings also validated the empirical study by Belhabib et al. (2018), who opined that offshore racketeering and kidnapping deters some legitimate fishing vessels from going to sea, therefore negatively affecting blue economy development.

Explicitly, Eq. (B.8) of the structural model revealed that 56 % of maritime security threats in Nigeria waters can be predicted by the number of crewmen kidnapped for ransom, and 55 % by pirates' attacks on vessels transiting Nigerian waters; this validates the empirical study by Okafor-Yarwood (2020), who averred that persistent piracy and armed robbery at sea have led to the laying

off of most fishing and shrimping vessels due to increasing incidences of piracy and sea robbery at sea. Furthermore, 92 % of maritime security threats in Nigeria's EEZ are predicted by crude oil theft, especially in the oil rich Niger Delta region. This finding corroborates with the findings of Kyari (2019), who noted that the threats to the nation's oil assets by oil thieves and pirates are a direct threat to the economic survival of Nigeria. Furthermore, the empirical findings of Transparency International Defence and Security (2019) highlighted that regular oil spills, arguably caused by oil theft and sabotage, have polluted the waterways, contaminated crops and other food sources (marine fisheries), and released toxic chemicals into the atmosphere in the Niger Delta region of Nigeria. The findings of Onuoha et al. (2013) depicted that the stolen oil is somehow introduced to the global supply chain through the black market onshore or offshore.

Similarly, the results revealed that maritime security threats (MST) have a significant and positive effect on blue economy development in Nigeria and the GoG (B = 0.861, t = 2.023, P-value = 0.043). Hence, H1 (maritime security risks have a positive and significant effect on blue economy development in Nigeria) was accepted. This aligns with the study conducted by Pichon and Pietsch (2019), where it was stated that Nigeria loses approximately US$6 billion annually in freight costs because of piracy in her waters.

Additionally, the findings of the empirical study conducted by Ngada and Bowers (2018) revealed that spatial clustering of crude oil theft was statistically significant, indicating manipulation of vulnerable situational contexts (absence of law enforcement agents). Also, no significant correlation was found between crude oil theft and local unemployment or poverty rate.

Eq. (B.5) showed that blue economy development will improve by 98 % for every one percent increase in GDP contribution from maritime transport and increase by 96 % for every one percent increase in GDP contribution from fishing. This is validated by the empirical findings of Sumaila et al. (2020), who noted that the overexploitation of fish resources by both legal fishing and IUU fishing has severe maritime security and socio-economic implications in the Gulf of Guinea region. This corroborates the findings of Lam, et al. (2012), Okafor-Yarwood (2019), Okafor-Yarwood (2020), Okafor-Yarwood and Belhabib (2019), and Gutierrez et al. (2018).

Furthermore, the findings depicted that blue economy development in Nigeria will improve by 41 % for every one percent increase in ships calling at Nigerian ports. It is pertinent to note that blue economy development has a positive/direct relationship with GDP contribution from maritime transport, GDP contribution from fishing, and the total number of ships calling at Nigerian ports.

5.2 The effects of maritime security measures (MSM) on the development of the blue economy in Nigeria

To determine the effects of maritime security measures on the development of blue economy in Nigeria, variables such as costs of providing maritime security proxied as military expenditure and designated marine protected area (percentage of territorial waters) were subjected to structural equation modelling. The findings showed that maritime security measures by the Nigerian government predicted that Nigerian blue economy will develop by 32.4 % for every one percent increase in maritime security measures. It was deduced that maritime security measures in Nigerian waters have a direct relationship with blue economy development in Nigeria. This corroborates the findings of Onwuegbuchunam et al. (2021), who showed that implementation of appropriate security measures can engender significant reductions in port security incidents and improve port performance.

The findings further revealed a direct relationship with military expenditure (cost of providing maritime security in Nigeria) and an inverse relationship with the designation of a marine protected area in Nigerian waters. Explicitly, 65 % of blue economy development in Nigeria was predicted by military expenditure by the Nigerian government. However, blue economy development will decrease by 85 % for every one percent decrease in marine protected area designated in Nigerian waters. This is corroborated by the study conducted by Atakpa (2021), who noted that maritime

wealth blindness is prevalent in most Gulf of Guinea countries such as Nigeria and is largely responsible for the absence of MPAs in the country's maritime space.

The results of the study further show that maritime security measures in Nigerian waters have a positive and statistically significant effect on blue economy development in Nigeria (B = 0.324, t = 1.936, P-value = 0.053). This authenticates the Routine Activity Theory (RAT), which postulated the triangulation of a motivated offender, a suitable target, and the absence of a guardian (provision of maritime security) in space and time for the actualization of crime. Most states in the Gulf of Guinea (GoG) region lack the capacity to maintain a naval presence and effectively monitor their coasts, creating ungoverned spaces which criminals exploit. In the year 2020, the International Chamber of Commerce (ICC) - International Maritime Bureau (IMB) reported that more than 95 % of all seafarers kidnapped globally were incidents recorded in the GoG region (NATO SOUTHERN HUB, 2021).

6. Conclusions

In conclusion, based on the literature reviewed and the findings of this study, the Nigerian blue economy sector comprises a wide range of activities, including shipping, port operations, fishing, offshore oil and gas exploration, tourism, and other numerous maritime activities. This diverse industry contributes significantly to the Gross Domestic Product (GDP) of Nigeria, and serves as a catalyst for job creation, food security, revenue generation, and foreign exchange earnings. This was authenticated by the findings of the study, which revealed that blue economy development has a positive/direct relationship with GDP contribution from maritime transport, GDP contribution from fishing, and the total number of ships calling at Nigerian ports. The study also revealed that maritime security threats have posed significant threats to the development of the Nigerian blue economy sector. Key security threats such as piracy, armed robbery at sea, illegal fishing, kidnapping of crewmen for ransom, crude oil theft, and environmental crimes are among the most pressing challenges faced by the industry. The findings revealed that 56 % of maritime security threats in Nigeria waters can be predicted by the number of crewmen kidnapped for ransom, 55 % by pirates' attacks, and 92 % by crude oil theft in Nigerian waters. These threats not only endanger lives, vessels, and cargoes, but also disrupt trade flows, impede economic growth, and degrade the marine environment.

7. Recommendations

Based on the findings of this study, and the results of the structural equation modelling, the following recommendations are made;

1) The coastal communities' welfare should be incorporated in the Nigerian blue economy development strategy and implementation plan to forestall maritime security threats in Nigerian waters and the Gulf of Guinea at large.

2) Nigeria should enhance maritime wealth awareness through the designation of about 30 % of her territorial waters as marine protected areas (MPAs), as required by IUCN. This will ensure the protection of marine natural capital (fish and other marine biodiversity) and ecosystem services from depletion and preserve the livelihood of locals who depend on the marine environment as a source of work and food.

3) The Nigerian government should prioritize cooperation and collaboration with other regional navies to ensure adequate maritime security interdiction within her exclusive economic zone, as provided by the Yaoundé code of conduct security architecture. This will significantly unlock other clusters of the blue economy, such as maritime transport, seabed mining, and marine tourism, in Nigerian waters.

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