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Research Article

Impact of Foreign Direct Investment and Environmental Regulation on Maritime Sector: Evidence from a Growth Seeking Economy

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Abstract

The study investigated the effect of foreign direct investment (FDI), environmental regulation on the maritime sector in a growth seeking economy. Data from 2005 to 2023 were used in the study, which were estimated using the error correction technique. The findings showed that environmental regulations negatively affect maritime gross domestic product (GDP) in both the short and longrun. The overall economic activities support maritime GDP both in the long run and the short run. Foreign Direct Investment has no short-term and long run impact. There is a strong adjustment mechanism ensuring maritime GDP realigns with its long-term equilibrium after a shock in the short-term based on the error correction term. The study recommends, based on the findings, that the execution of environmental regulations by policymakers should be gradual. Secondly, they should enhance the utilization of FDI, especially for the maritime sector of the economy. Thirdly, they should make a long-term plan focusing on sustainable environmental practices, capacity building, and technological advancement is critical for the maritime sector's growth and resilience.

Keywords: FDI, environmental regulation, maritime sector, ECM

Introduction

Globally there have been serious drive for economies to attain environmental quality, weather air or water pollution [1-3]. The effect of maritime activities especially shipping on environmental emissions is particularly important due to its effects of increasing the emission of greenhouse gases [1-5]. Over 940 million tons of carbon dioxide emissions is estimated to be emitted through marine transportation [3]. Ships accounting for approximately 80 percent of world merchandized trade, shipping remains a major source of environmental emission world-wide [3,6]. Empirically understanding the impact of foreign direct investment, environmental regulation and maritime sector in a growth seeking economy is therefore imperative. Although, Ayesu [7] investigated shipping on environmental emissions in Africa, Onwuegbuchunam et al. [8] studied ship-source marine pollution in Nigeria seaports, Olukanni et al. [9] focused on greenhouse gas and vessel operations, and Woria et al. [10] centered on cost effective assessment of marine emissions control, no study have specifically focused on the growth impact on the Nigeria maritime sector and also looked at the mediating role of FDI simultaneously. This research aims to fill the gap in the extant literature.

In recent years, environmental and climate change concerns have increasingly posed challenges for countries striving to attract foreign direct investment (FDI) without causing significant harm to their ecosystems. This has placed developing nations like Nigeria in a difficult position as they aim to boost economic growth by leveraging the maritime sector. Gaining insights into how FDI influences environmental regulations enables policymakers to adjust strategies for attracting investment that supports economic development while mitigating environmental damage [11]. Wang et al. [12], emphasize the need to assess the impact of environmental regulations on FDI amidst growing pressures to reduce carbon emissions and enhance sustainable international trade.

Countries often face a dilemma between promoting economic growth and upholding environmental standards. For instance, studies reveal that economic expansion frequently comes at the expense of

environmental well-being [13-15]. Trade openness and economic diversification, crucial contributors to growth, are shown to exert varying or non-linear effects on environmental degradation [16-17]. Institutions, government bodies, private sectors, and other agencies are intensifying efforts to address air pollution in the maritime sector, which has been linked to severe environmental damage and health issues [18].

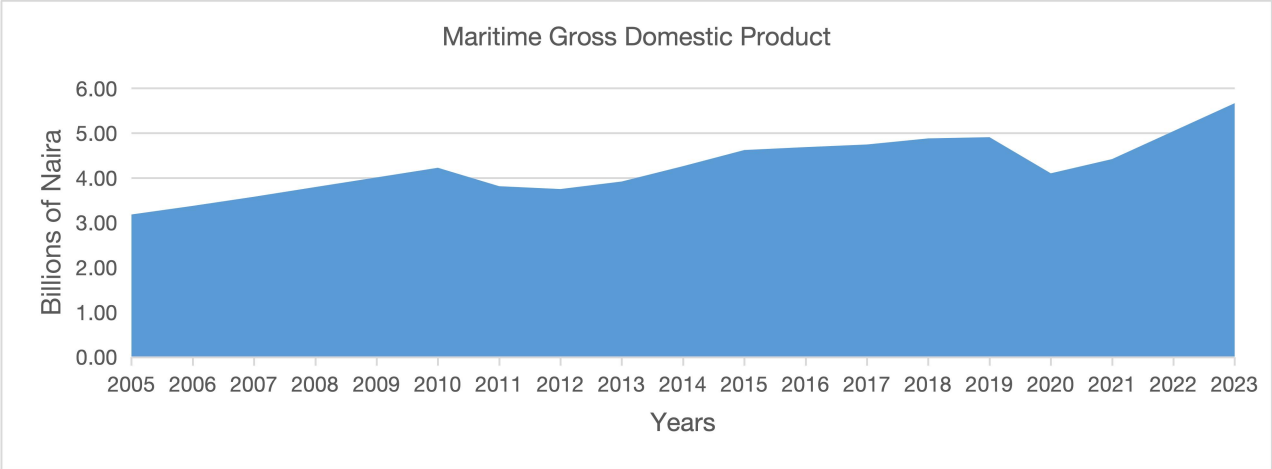

Figure 1. Maritime GDP **Source:** Graphed by Author, underlining data from CBN statistical bulletin

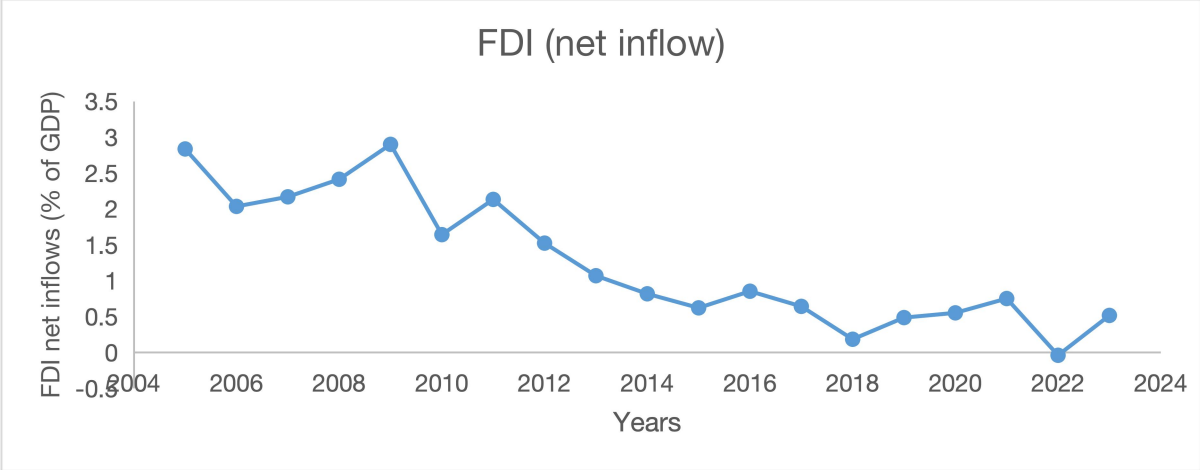

Figure 2. FDI Inflow **Source:** Graphed by Author, underlining data from WDI, World Bank

The Nigerian maritime sector is widely regarded as a critical driver of the country's economic growth due to its untapped potential. By channeling investments into this sector, Nigeria can reduce its dependence on crude oil exports and diversify its economy. Maritime activities contribute significantly, accounting for approximately 30% of the nation's GDP, as they play a key role in the oil and gas industry-whether through support vessels or as a means of exporting oil and gas. Furthermore, the sector is instrumental in other industries such as agriculture, particularly aquaculture and contributes to transportation. It also generates both direct and indirect employment opportunities, thereby alleviating unemployment in the country [19]. The maritime sector thus remains a cornerstone for advancing Nigeria's economic development.

Figure 1 shows the maritime sector gross domestic product which is the contribution of the maritime sector to the economy. We can observe that it has been fluctuating over the study period with its highest value recorded in 2023. Figure 2 shows the net inflow of foreign direct investment in Nigeria, we can observe that there have been a downward trend of FDI into Nigeria, with 2022 recording the lowest during the study period.

The research seeks to investigate the impact of environmental regulation and foreign direct investment on the maritime sector of the Nigerian economy. The remaining part of the research has the literature review in section two, methodology in section three, result in section four and the conclusion and recommendations in section five.

Literature Review

Huang et al. [26], in their findings indicated that FDI contributes to improving GTFP, while environmental regulation indirectly influences GTFP through FDI. They also noted regional disparities in the effects of FDI and environmental regulation on GTFP in their study on the role of environmental regulation in enhancing foreign direct investment (FDI) and green total factor productivity (GTFP). Similarly, [11] explored the interplay between FDI and environmental rules under the host country's political system. Analysed with the two-step system generalised method of moments, data from 21 OECD countries spanning 1990 to 2019 revealed that FDI influences environmental regulations but that political limitations in the host countries moderate this influence.

Yoon and Heshmati [27] looked at how China's green total factor productivity is influenced by outward foreign direct investment (OFDI) and environmental regulation. Their study found that OFDI has a single-threshold impact on GTFP; the bad effect grows as environmental control increases. They decided that changes in green technology inside the home country, not changes in green efficiency, are what mostly drive this effect. Using city-level panel data from 2003 to 2019 and a multi-period difference-in-differences methodology, [24] evaluated how low-carbon city projects affected FDI in China. Their findings indicate that low-carbon policies decreased the efficient use of FDI and caused a drop in foreign-invested companies.

Ayesu [7] focused on the shipping sector's contribution to environmental emissions in Africa. Using data from 31 countries covering 2006 to 2016, analyzed with the system-generalized method of moments, the study concluded that shipping activities increase environmental pollution both the long-run and short-run. Using the non-linear autoregressive distributed lag (NARDL) model, [28] looked at how FDI and environmental pollution affected economic growth in an emerging country from 1986 to 2020. Their results show an uneven link between these factors in both short- and long-term settings, therefore stressing a notable link between environmental pollution and economic growth over the long run.

Wang et al. [16] using panel data from 29 Chinese provinces between 1994 and 2015, investigated how corruption and FDI interacted to influence environmental pollution. Their study found that FDI inflows, enabled by corruption, compromise environmental quality by undermining regulatory standards and lowering the spillover advantages of FDI, therefore supporting the pollution haven hypothesis (PHH).

Huang et al. [29], also confirmed the PHH for China by examining the spatial distribution of FDI in manufacturing sectors from 2003 to 2014. The research discovered that more lax environmental rules drew more FDI into cities.

To et al. [21] examined the connection between FDI and environmental degradation in Asian emerging markets. Employing panel data from 1980 to 2016 and utilizing methods such as panel cointegration, FMOLS, and DOLS, their findings supported the pollution haven hypothesis and the environmental Kuznets curve, demonstrating FDI's considerable environmental impact. Lastly, [30] studied the effects of environmental regulations on Korean outward FDI in the manufacturing sector from 2009 to 2015. They concluded that stricter environmental rules in Asian host countries significantly reduced both the intensity and extent of FDI directed toward those regions.

Theoretical review

Pollution Heaven Hypothesis (PHH)

The anchor theory for the research is the Pollution Heaven Hypothesis (PHH), which says that polluting businesses will be moved to areas with less strict environmental rules [20]. In this instance the Nigerian maritime sector is a budding sector within the Nigeria economy hence, certain regulations concerning the environment that can impede on its growth and that of the entire economy may be relaxed. There are two key points of contention on the advantages FDI offers to the economic growth of host nations [21]. First, technical innovation by FDI reduces environmental deterioration. Secondly, some have claimed that FDIs give the environmental problem greater importance, thereby raising CO_2 emissions because pollution-intensive businesses could be moved from the affluent to the poorer nations because of lax environmental laws and rules in the host countries [21]. The later position is most likely for a growth seeking economy like Nigeria. Nigeria, a developing nation with a rising industrial sector and somewhat weak environmental rules, could be prone to become a pollution paradise. Weak environmental governance, economic priorities and global trade dynamics could produce a regulatory framework which might not be strict enough to discourage polluting industries since the emphasis maybe on economic development and job creation which might lead to the acceptance of polluting industries. Moreover, Nigeria's inclusion into international trade systems could draw foreign direct investment (FDI) from businesses looking for less regulations.

The PHH speculates that businesses with high pollution levels-including those related to maritime activities-may move to nations with less environmental control. A possible contender for this phenomena is Nigeria's maritime industry, which comprises port operations, shipping, offshore oil and gas activities. Environmental rules that are sometimes badly implemented control Nigeria's maritime industry. For instance, major problems include ballast water discharge, oil spills, and ship emissions; nonetheless, regulatory control is still lacking. Using Nigeria's ports as hubs for activities that would be more expensive or more controlled in industrialized nations, international shipping firms may take advantage of loose environmental laws there. Major component of Nigeria's marine industry, offshore oil has been under fire for environmental damage including gas flaring and oil spills. These operations fit the PHH since global companies could benefit from less rules. Most developing countries-including those in Latin America, Asia, and Africa-keep suffering environmental pollution as the output of commodities and services rises [22]. Particularly in developing nations, evidence indicates that carbon related emissions account for over 75% of greenhouse gas emissions overall and almost 80% of them are produced by energy generation and consumption [23].

Environmental Kuznets Curve (EKC)

The Environmental Kuznets Curve (EKC) contends that, up to a certain degree, environmental damage rises with economic development; beyond that, more growth results in environmental benefit. Given Nigeria's present level of economic development, it would fit the EKC model since the country may be in early phases of the EKC, in which case rising pollution accompanies economic development. Consequently, as the Nigerian economy develops and wealth levels improve, there can be a movement towards more environmentally friendly methods and tougher laws. This knowledge about the EKC can guide policy decisions in Nigeria particularly for the marine industry, such the necessity of proactive environmental rules to minimize the harmful effects of early industrialization. Among other things, gas flaring causes air pollution that results from the expansion of its economy largely on energy production and exploration of crude oil with corresponding environmental effects [23]. [23], have proven the detrimental consequences of economic development on the environment. [24], confirmed a mixed effect, though. [25], did not find existence of the EKC hypothesis. In addition, in relation to economic growth and emission, this relationship is complicated and inconsistent [24]. There have however, been mixed findings from previous studies, depicting that FDI can have a positive or negative impact on the environment [24].

Methodology

Model Specification

Multiple linear regression is used to test the hypotheses of the study and in estimating the linear relationship between dependent variable (Maritime GDP) and independent variables environmental regulation (CPIA policy and institutions for environmental sustainability rating; 1=low to 6=high) [31], foreign direct investment and economic growth.

The model formulated for the study adopts that of [7] and [28] with some modifications.

The functional form is given as;

LMGDP = f (ENVR, FDI, LGDP)

This ECM emphasizes both short-term dynamics and long-term adjustments, making it an effective tool for analyzing maritime GDP in the context of environmental regulation and economic factors.

The error correction model is given as mentioned equation 1.

$$\Delta LMGDP = \beta_0 + \beta_1 \Delta ENVR + \beta_2 \Delta FDI + \beta_3 \Delta LGDP + \beta_4 ECM(-1) + \varepsilon_1 \quad \text{Eq-(1)}$$

Where; Maritime sector contribution to the economy is (MGDP) environmental regulation is (ENVR), foreign direct investment is (FDI) and economic growth is (GDP). L is the natural log of the data, β_0 - β_4 are the parameters and Δ is the change operation measuring the changes in the coefficients. The data used in the study are from 2005 to 2023 and were sourced from the Central Bank of Nigeria (CBN) statistical bulletin and the World Bank's World Development Indicators (WDI) [31].

Results and discussion

The descriptive features of the data used in the research is presented in table 1. It can be observed that MGDP have an average of 4.26 which indicated that it contributed an average of 4.3 billion to the country's GDP. ENVR have an average score of 3.3 showing that the level of environmental compliance is quite stable in the study period. FDI accounted for about 1.27 percent to the GDP of Nigeria on average. The economy on average record a 4.4 billion naira within the study period. All the variables are platykurtic as indicated by their kurtosis values. MGDP and FDI are positively skewed showing that most of their observations lies above their mean values, while ENVR and GDP lies below their mean values as indicated by their negative skewness. All the variables are normally distributed based on their Jarque-Bera probability values.

Table 1. Descriptive statistics.

VARIBLES	MGDP	ENVR	FDI	GDP
Mean	4.262583	3.315789	1.268839	436000000000
Median	4.225754	3.500000	0.853396	480000000000
Maximum	5.667240	3.500000	2.900249	552000000000
Minimum	3.182963	3.000000	-0.039522	274000000000
Std. Dev.	0.635137	0.247797	0.908525	877000000000
Skewness	0.295815	-0.545545	0.454346	-0.571353
Kurtosis	2.545323	1.297619	1.908612	1.967491
Jarque-Bera	0.440765	3.236790	1.596673	1.877714
Probability	0.802212	0.198217	0.450077	0.391075
Observations	19	19	19	19

Source: Author's computation with E-views, 2024. Note: MGDP-Maritime Sector Gross Domestic Product, ENVR-Environmental Regulation, FDI-Foreign Direct Investment, GDP- Gross Domestic Product

Table 2. ADF unit root test.

Variables	ADF Statistics (Level)	t-critical values (5%)	P-value	ADF Statistics (Level)	t-critical values (5%)	P-value	Conclusion
MGDP	-1.041743	-3.040391	0.7045	-3.022587	-3.052169	0.0528	I(1)
ENVR	-2.656845	-3.052169	0.1017	-5.083911	-3.065585	0.0011	I(1)
FDI	-0.866810	-3.052169	0.7731	-6.644282	-3.052169	0.0000	I(1)
GDP	-4.126363	-3.040391	0.0058	-	-	-	I(0)

Source: Author's computation with E-views, 2024

The Augmented Dickey-Fuller unit root test result for the variables employed in the study is presented in table 2. Three of the variables are stationary at first difference, while one is stationary at level. We therefore proceed to conduct the longrun model estimate and the error correction model.

Table 3. Long-run estimates.

Dependent Variable: LMGDP				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENVR	-0.322514	0.070965	-4.544685	0.0004
FDI	-0.034368	0.031294	-1.098233	0.2894
LGDP	0.732671	0.136629	5.362483	0.0001
C	-17.06875	3.620839	-4.714031	0.0003
R-squared	0.903735	Mean dependent var		1.439393
Adjusted R-squared	0.884482	S.D. dependent var		0.148873
F-statistic	46.93983	Durbin-Watson stat		1.398213
Prob(F-statistic)	0.000000			

Source: Author's computation with E-views, 2024. Note: ADF- Augmented Dickey-Fuller.

Table 3 showed the longrun model estimates. The coefficient -0.322514 suggests that, assuming other factors constant, a one percent rise in environmental regulation causes a 0.3225 percent drop in maritime GDP. Foreign direct investment has a minor negative effect on marine GDP. Therefore, a 1% rise in FDI would cause a 0.034368% drop in maritime GDP. Maritime GDP is positively and significantly affected by economic growth (GDP); a one percent rise in the general GDP in the economy will result in a 0.7327 percent rise in maritime GDP. A satisfactory fit for the model is indicated by the R-squared of 0.903735, which indicates that the independent variables (ENVR, FDI, and LGDP) explain 90.37 percent of the variation in marine GDP. There joint significance among the variables of the study indicated by F-statistic probability value of 0.000000. The Durbin-Watson statistic 1.398213 falls within the gray area, although, further test found no evidence of autocorrelation in the residuals.

Table 4 showed the estimates of the error correction model. The coefficient of -0.2638 suggests that a one percent rise in environmental regulation causes a 0.2638 percent drop in maritime GDP in the shortrun. Also, in the shortrun, foreign direct investment has a negative and non-significant effect on maritime GDP. This indicates that a 0.020310 percent drop in maritime GDP would result from a one percent rise in FDI. In the shortrun, economic growth (GDP) has a positive and significant effect on maritime GDP; a one percent rise in the total GDP in the economy will result in a 0.804386 percent rise in maritime GDP. Being negative and statistically significant, the error correction term -0.659452 fits econometric theory. This suggests the rate of return to equilibrium. Hence, about 65.95 percent of the disequilibrium in maritime GDP is corrected in the next period. There is a strong adjustment mechanism ensuring maritime GDP returns to its long-term equilibrium after short-term shocks. The R-squared of 0.654662 suggests that 65 percent of the variation in maritime GDP is explained by the independent variables (ENVR, FDI,

LGDP and the ECT) which is indicative of a good fit for the model. The F-statistic probability value shows the model is highly significant. The Durbin-Watson statistic 1.6 showed no evidence of serial-correlation in the residuals.

Table 4. Error correction model.

Dependent Variable: LMGDP				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENVR)	-0.263767	0.071629	-3.682396	0.0028
D(FDI)	-0.020310	0.023961	-0.847645	0.4120
D(LGDP)	0.804386	0.460489	1.746810	0.1042
ECM(-1)	-0.659452	0.276961	-2.381027	0.0332
C	-0.001134	0.021244	-0.053370	0.9582
R-squared	0.654662	Mean dependent var		0.032049
Adjusted R-squared	0.548404	S.D. dependent var		0.074339
F-statistic	6.161068	Durbin-Watson stat		1.605493
Prob(F-statistic)	0.005238			

Source: Author's computation with E-views, 2024. ECM- Error Correction Term

Diagnostic tests

The variance inflation factor is used to test for multicollinearity, the result showed that the model estimated for the study is free from multicollinearity as the centered VIF is less than 10.

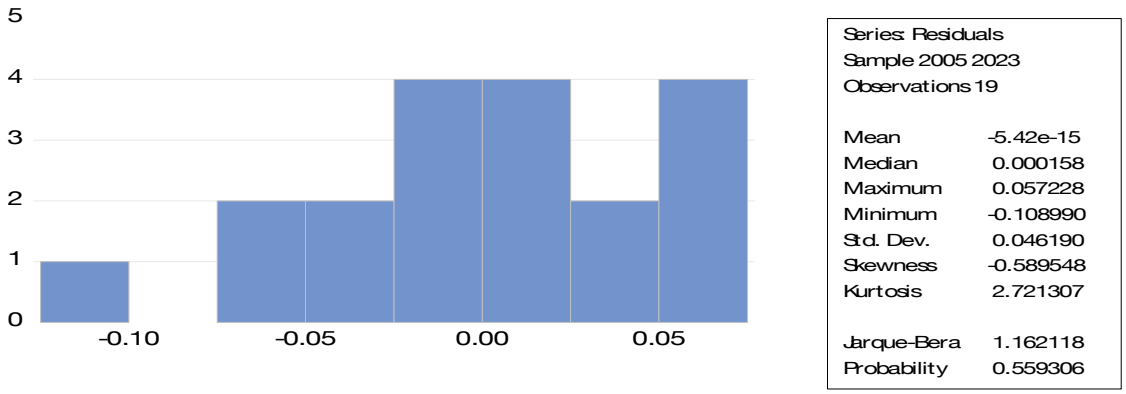

Figure 3: Normality test **Source:** Author's computation with E-views, 2024

Table 5. Variance Inflation Factor (VIF).

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
ENVR	0.005036	413.0737	2.174072
FDI	0.000979	17.38364	5.683095
LGDP	0.018667	99361.12	6.309807
C	13.11047	97295.08	NA

Source: Author's computation with E-views, 2024.

The normality test is conducted with the Jarque-Bera statistic. The result is presented in figure 3. The probability value 0.559306 shows that the residuals of the model are normally distributed.

Table 6. Breusch-Godfrey serial correlation LM test.

Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	1.407819	Prob. F(1,14)	0.2552
Obs*R-squared	1.736038	Prob. Chi-Square(1)	0.1876

Source: Author's computation with E-views, 2024

Table 7. Heteroskedasticity Test: Breusch-Pagan-Godfrey.

Null hypothesis: Homoskedasticity			
F-statistic	1.608549	Prob. F(3,15)	0.2293
Obs*R-squared	4.624681	Prob. Chi-Square(3)	0.2014
Scaled explained SS	2.480764	Prob. Chi-Square(3)	0.4788

Source: Author's computation with E-views, 2024

The estimated model is free from serial correlation and heteroskedasticity based on their test results presented in table 6 and 7 respectively which are greater than 0.05.

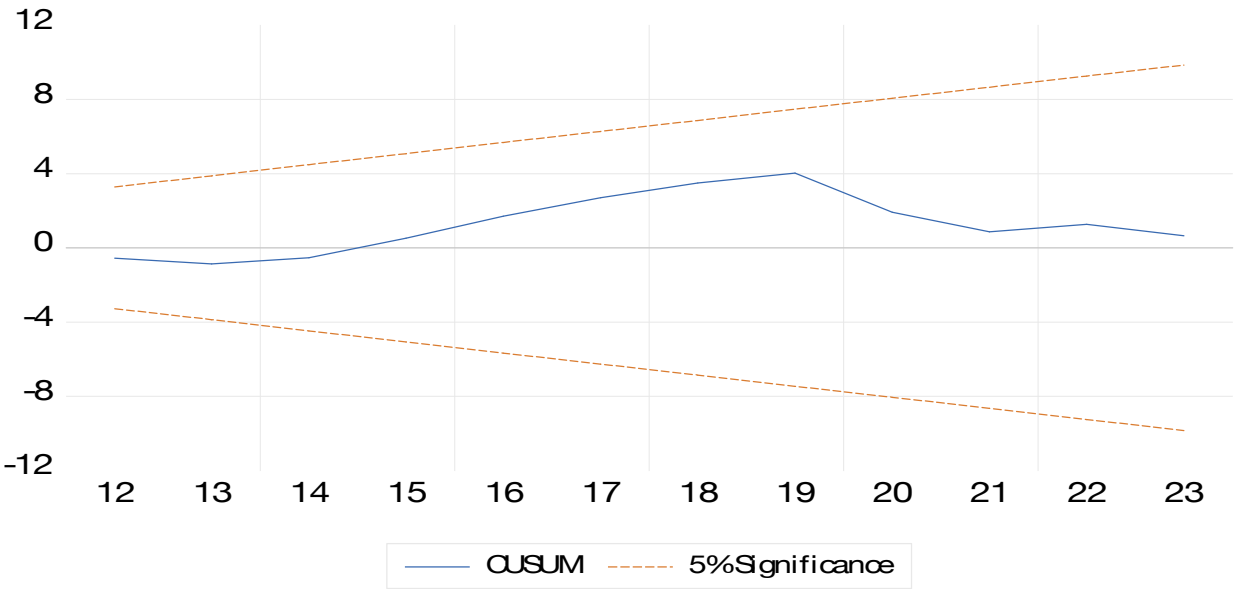

Figure 4. CUSUM. **Source:** Author's computation with E-views, 2024.

The stability tests conducted for the model is presented in figure 4 and 5. Both the CUSUM and the CUSUM of Squares test shows that the model is stable and can be relied on to make economic policies.

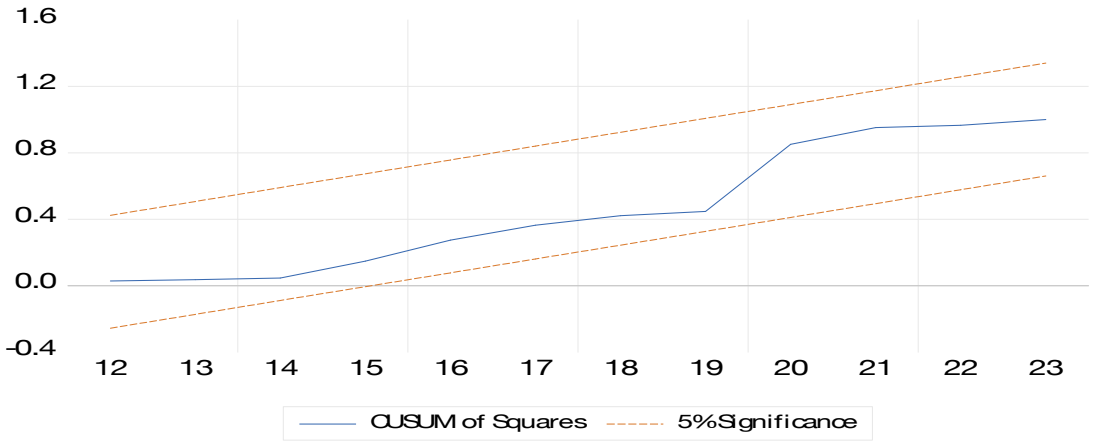

Figure 5. CUSUMQ. **Source:** Author's computation with E-views, 2024

Conclusion and Policy Implications

The study 'Foreign Direct Investment, Environmental Regulation and Maritime Sector in a Growth Seeking Economy' showed the importance of environmental regulations in determining maritime GDP. In the shortrun and longrun the impact are negative. The overall economic activities support maritime GDP both in the longrun and shortrun. However, FDI appears to have no short-term and longrun impact, which may indicate structural or institutional barriers in the maritime sector's ability to leverage foreign investment effectively. The error correction mechanism indicates the resilience of the maritime sector in realigning with its long-term equilibrium. Based on the findings therefore, the study suggests that the implementation of environmental regulations by policymakers should be gradual. They should consider a phased approach to environmental regulations to minimize short-term disruptions in maritime activities while maintaining long-term sustainability. Secondly, they should try to enhance the utilization of FDI especially for the maritime sector of the economy. Policymakers should make effort to remove barriers to the effective use of foreign direct investment in the maritime sector, such as improving infrastructure, reducing bureaucratic hurdles, and providing targeted incentives for foreign investors. Thirdly, they should make a long-term plan focusing on sustainable environmental practices, capacity building, and technological advancement is critical for the maritime sector's growth and resilience. Policies that stimulate trade, port efficiency, and logistics networks can amplify the sector's response to economic growth. This will integrate the maritime sector more deeply into broader economic activities.

Declaration

Ethics approval/declaration: Not applicable.
Consent to participate: Not applicable.
Consent for publication: Not applicable.
Acknowledgment: Not applicable.
Conflict of interest: The authors declare no conflict of interest.
Data availability: Data used in the study will be provided by corresponding author upon request.
Authors contribution: Porwekobowei Aruwei, Catherine Chimma Obasi, Christopher Oghenemaro Etugbo contributed equally to the conceptualization, data collection and analysis of the study. Specifically, Porwekobowei Aruwei provided support in data analysis, interpretation and contributed to the manuscript's critical revision. All authors reviewed and approved the final manuscript.
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The Supplementary Material for this article can be found online at:
https://www.jspae.com/index.php/jeee/article/view/600/286

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