Exchange Rate Volatility, Blue Economy, and Shipping Industry Financial Performance in Nigeria

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BENIN CITY

JANUARY, 2026

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BEING A DISSERTATION WRITTEN IN THE DEPARTMENT OF FINANCE AND SUBMITED TO THE COLLEGE OF POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.) IN FINANCE, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA.

JANUARY, 2026

DECLARATION

I, Mina Enaikpobomene IREJEH**,** a Doctor of Philosophy (Ph.D.) candidate of the Department of Finance, Faculty of Management Sciences, University of Benin, Benin City, Nigeria, do hereby declare that this dissertation is entirely my research work. The work embodied in this dissertation has not been submitted in candidature for any degree and it is not concurrently being submitted for any other degree. All references from other works have been duly acknowledged.

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CERTIFICATION OF DISSERTATION

We certify that this dissertation written by Mina Enaikpobomene IREJEH is adequate in scope and quality in partial fulfilment of the requirements for the award of Doctor of Philosophy (Ph.D.) Finance in the Department of Finance, Faculty of Management Sciences, University of Benin, Benin City, Nigeria.

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ATTESTATION

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DEDICATION

This work is dedicated to the loving memory of my late parents, Chief Irejeh Sakarah Dickson, and Mrs. Irejeh Isene Taraghan, whose sacrifices and guidance laid the foundation for my academic journey; to my wife, Mrs. Irejeh Tina, for her unwavering support and patience; and to my beloved daughter, Miss. Irejeh Ebikonboere Grace, whose love and inspiration made the successful completion of this work possible.

Mina Enaikpobomene IREJEH **……**
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ACKNOWLEDGEMENTS

I am profoundly grateful to God Almighty, whose infinite mercy, grace, and unfailing love sustained me throughout this academic journey. I sincerely appreciate my chief supervisor, Professor S. O. Igbinosa, for his invaluable guidance, patience, and constructive feedback, which shaped the direction and quality of this research. I am equally grateful to my co-supervisor, Professor E. J. Idolor, whose unwavering support, keen attention to detail, and constructive criticism significantly enriched this work and motivated me throughout the research process.

My sincere appreciation goes to Dr. Aigbovo Omoruyi for his encouragement and counsel, and to Dr. Joel Obayagbona for his critical insights and guidance that contributed to the successful completion of this dissertation.

I acknowledge with gratitude all the lecturers who taught me during the course of my study for their dedication and invaluable contributions to my academic development. I also appreciate the former and current Heads of Department for their leadership and encouragement, the non-academic staff for their administrative support, and the Vice-Chancellor for his visionary leadership and commitment to academic excellence and research advancement within the university.

I gratefully acknowledge the financial support of the Tertiary Education Trust Fund (TETFund), provided through the Nigeria Maritime University, Okerenkoko, Delta State.

Finally, I extend my sincere gratitude to my family members, friends, and colleagues for their prayers, encouragement, and support in various forms. May God richly bless you all. Amen.

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ABSTRACT

This study examined the effect of exchange rate volatility, and the blue economy on the financial performance of Nigeria's shipping industry from 1990 to 2024. A longitudinal research design was adopted, allowing for the analysis of cause-and-effect relationships across time. Secondary data were sourced from the World Bank Development Indicators, and the Central Bank of Nigeria Statistical Bulletin, while exchange rate volatility was derived using the GARCH (1,1) model. The study employed an econometric framework grounded in the Traditional Flow Theory and the Balance of Payments (BoP) Theory to investigate how volatility in exchange rates and blue economy activities affect shipping sector financial performance. Financial performance was measured using container throughput revenue, shipping costs, and port revenue, while blue economy proxies include fisheries, aquaculture, and desalination, controlled by macroeconomic variables such as inflation, labour force, and trade freedom. The analysis adopted the autoregressive distributed lags (ARDL) framework to capture both short-run and long-run relationships among the variables. Empirical findings showed that exchange rate volatility reduced container throughput revenue and port revenues while increasing shipping costs. Fisheries had a short-term positive impact, while, aquaculture significantly boosted long-run performance by lowering costs and raising revenues. Desalination has limited influence, showing short-term benefits but long-term drawbacks. The study recommended that the Central Bank of Nigeria (CBN) and other statutory Ministries Departments and Agencies (MDA's) connected with blue economy, and, the shipping and maritime sector of the economy; formulate policies and embark on activities that will help stabilize the naira, promote risk hedging instruments, and encourage investments in fisheries terminals, aquaculture integration, and desalination facilities.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Exchange rate volatility is a central feature of international trade and global financial markets, with far-reaching implications for businesses, particularly those highly dependent on imports and exports that occur in the shipping and maritime sector. In a developing country like Nigeria, the shipping industry plays a pivotal role in enabling international trade and driving economic growth. As a key pillar of the blue economy, Nigeria's maritime sector significantly contributes to gross domestic product (GDP), foreign exchange earnings, employment creation, and regional economic integration, especially given its strategic positioning along the Gulf of Guinea. The Nigerian shipping industry faces considerable operational costs, including vessel chartering, maintenance, insurance, and port handling fees, most of which are denominated in foreign currencies. Meanwhile, earnings are predominantly naira-based. This currency mismatch exposes shipping firms to exchange rate risks, undermining profitability, delaying capital projects, and deterring both local and foreign investments (Ajayi & Olayiwola, 2021).

These risks are further exacerbated by other macroeconomic variables such as inflation, which raises the cost of inputs and erodes purchasing power; labour force dynamics, which determine the availability and cost of skilled maritime manpower; and trade freedom, which influences the ease of engaging in cross-border shipping and port operations. Consequently, the sector's financial performance has become increasingly vulnerable to macroeconomic shocks. With approximately 90% of global trade transported by sea, the shipping industry is indispensable to global commerce. Nigeria's ports, particularly Apapa, Tin Can, Onne, and Port Harcourt, serve as gateways for trade, logistics, and regional supply chains. However, these ports' operational

efficiency and financial viability, measured through port revenue, shipping costs, and ocean throughput, are heavily influenced not only by currency volatility but also by inflationary pressures, restrictive trade policies, and labour market inefficiencies. Exchange rate instability affects freight rates, insurance premiums, cargo handling charges, and trade volumes, thereby impacting both cost structures and revenue generation (Adewuyi & Okodua, 2019). Globally, the maritime industry is expanding, driven by increasing globalization and cross-border trade. According to UNCTAD, (2025), global shipping is projected to grow at an annual average rate of 2.1% through 2024 and 2029, underscoring the sector's long-term importance in sustaining international commerce. Cision PR Newswire (2025), reported that the global shipping container market valued at US$9.5 billion in 2021 is expected to reach US$15.3 billion by 2027, reflecting robust investment trends in maritime logistics. These developments emphasize both the growth potential and strategic importance of the shipping sector. As Njoku et al. (2020) aptly stated, "He who rules the sea, rules the world," reflecting the industry's geopolitical and economic influence.

Nigeria's growing interest in the blue economy, defined as the sustainable use of ocean resources for economic growth, environmental protection, and improved livelihoods, has added another layer of strategic importance to its maritime sector. Key components of this economy include fisheries, aquaculture, maritime transport, offshore oil and gas, desalination, and coastal tourism. With over 850 kilometers of Atlantic coastline, Nigeria is well-positioned to harness these resources. However, macroeconomic instability especially exchange rate volatility, high inflation, and limited trade freedom has significantly undermined these efforts (UNCTAD, 2018a). A stable exchange rate regime, moderate inflation, liberalized trade environment, and efficient utilization of the labour force are essential for ensuring predictability in business operations and for attracting sustained investment. For stakeholders in maritime transport and blue economy

sectors, such stability is critical to planning and financing infrastructural projects, port modernization, aquaculture expansion, and sustainable fisheries development. In the Nigerian context, persistent exchange rate volatility coupled with rising inflation and labour market inefficiencies has delayed investment in critical areas such as port automation, desalination plants, and cold-chain logistics for fish exports (Onuoha, 2021). Although, NIMASA (2022) has prioritized the blue economy as a path to economic diversification, its success depends on stable macroeconomic conditions.

Comparatively, countries like Kenya, Mauritius, and South Africa have made substantial progress in implementing their blue economy frameworks, owing to stable currency environments, strategic investments, skilled labour force utilization, lower inflation rates, and clearer trade policies (Eneh & Eze, 2020). Nigeria, on the other hand, continues to face hurdles including underdeveloped infrastructure, weak policy coordination, high inflation, and exchange rate unpredictability.

Exchange rate volatility defined as the persistent and often unpredictable changes in currency values can alter the competitiveness of exports and imports, increase the cost of maritime operations, and significantly affect profitability. In Nigeria, currency volatility is driven by a combination of external shocks including oil price volatilities, inflationary pressures, capital flight, and dwindling foreign reserves. These factors introduce high levels of uncertainty into port revenue projections, investment planning, and shipping contract negotiations, thereby reducing the global competitiveness of Nigerian ports and maritime services (Okonkwo & Ogbonna, 2020). Moreover, sectors under the blue economy framework, such as aquaculture logistics, fish export pricing, and desalination technology deployment, are increasingly affected

by these macroeconomic uncertainties. This unpredictability compounded by inflation, a large but underutilized labour force, and weak trade freedom indices deters private sector investment, complicates long-term financial planning, and weakens investor confidence, especially in capital-intensive maritime infrastructure projects (Okechukwu, 2021).

Therefore, understanding how exchange rate volatility and blue economy variables affect the financial performance of Nigeria's shipping industry, within the context of a growing blue economy, is critical for policymakers, investors, and maritime stakeholders. While, previous research has explored the broader economic implications of exchange rate volatility in Nigeria, very limited studies have focused specifically on the joint effect of exchange rate volatility and blue economy on the financial performance of the Nigerian shipping industry. It is against the above background that this study is being carried out.

1.2 Statement of the Research Problem

The Nigerian shipping industry, as a key pillar of the blue economy, plays an important role in facilitating trade, generating maritime employment, and contributing to national revenue. However, its performance has been persistently constrained by internal and external shocks, particularly exchange rate volatility. Over the past decade, recurrent depreciation of the naira has increased operational costs and weakened investor confidence in the maritime sector (Adewale & Aluko, 2022). Despite fiscal and monetary stabilization efforts, shipping firms continue to face high import tariffs on marine equipment, limited access to foreign exchange for vessel maintenance, and sustained inflationary pressures (NIMASA, 2022). These challenges have been compounded by recent global trade disruptions, including renewed protectionist policies under Donald Trump's second administration in 2025, which disrupted global supply chains and

heightened macroeconomic uncertainty in developing economies such as Nigeria (Holland & Knight, 2025).

Domestic policy interventions have yielded limited results. Although the Cabotage Vessel Financing Fund (CVFF) was revived in 2023 to support indigenous ship owners, delays in disbursement and transparency concerns have reduced its effectiveness. Similarly, slow reviews of port concession agreements, regulatory bottlenecks, and institutional inefficiencies have undermined efforts to attract private investment and improve sector competitiveness (Eze & Oladipo, 2023).

Nigeria's adoption of a blue economy framework has also been hindered by weak coordination and implementation. The creation of the Ministry of Marine and Blue Economy in 2023 provided institutional focus and prompted selective port infrastructure upgrades in Apapa and Tin Can ports. However, limited support for fisheries and aquaculture, inadequate funding, and fragmented policy execution continue to constrain progress. While initiatives such as the Deep Blue Project have improved maritime security, the national Blue Economy Roadmap remains largely unimplemented, restricting synergies between sustainable maritime development and financial performance (NIMASA, 2023).

Exchange rate volatility remains a central but inadequately addressed challenge. Persistent naira depreciation has raised the cost of importing vessels, spare parts, fuel, and maritime technologies, while foreign-denominated debt has become increasingly burdensome for local shipping firms (Okeke & Ajayi, 2022). Unpredictable exchange rate movements further complicate revenue forecasting, investment decisions, and cost management, especially for firms operating long-term

naira-denominated contracts amid rising foreign currency expenses (Olawale & Nwachukwu, 2023).

Despite the recognized importance of shipping to Nigeria's blue economy, a disconnect persists between policy objectives and financial outcomes. Existing studies largely examine exchange rate volatility or blue economy policies in isolation, with limited empirical attention to their combined effects on shipping firms' financial performance (Adebiyi & Adeyemi, 2022; Ekanem & Okechukwu, 2022). Moreover, much of the global literature focuses on developed economies, overlooking the unique challenges of currency instability and foreign exchange constraints faced by Nigerian shipping companies (UNCTAD, 2021).

This gap in the literature necessitates a comprehensive empirical investigation. Accordingly, this study examines the joint effects of exchange rate volatility and blue economy dynamics on the financial performance of shipping companies in Nigeria, with emphasis on operational costs, profitability, and revenue generation, to inform policies aimed at enhancing the sector's sustainability and competitiveness.

1.3 Research Questions

The following research questions are formulated to help in the achievement of the objectives of this study;

1. How does exchange rate volatility affect shipping industry financial performance in Nigeria?
2. How does fisheries affect shipping industry financial performance in Nigeria?
3. How does aquaculture affect shipping industry financial performance in Nigeria?

4. How does desalination affect shipping industry financial performance in Nigeria?

1.4 Objectives of the Study

The main objective of this study is to investigate the effect of exchange rate volatility and blue economy on financial performance of the shipping industry in Nigeria. Specifically, the study intends to:

(i) ascertain the effect of exchange rate volatility on the financial performance of shipping industry in Nigeria.

(ii) examine the effect of fisheries on the financial performance of shipping industry in Nigeria.

(iii) determine the effect of aquaculture on the financial performance of shipping industry in Nigeria.

(iv) analyze the effect of desalination on the financial performance of shipping industry in Nigeria.

1.5 Hypotheses of the Study

The following null hypotheses were tested:

$H0_1$: Exchange rate volatility has no significant effect on the financial Performance of shipping industry in Nigeria.

$H0_2$: Fisheries has no significant effect on the financial performance of shipping industry in Nigeria.

$H0_3$: Aquaculture has no significant effect on the financial performance of shipping industry in Nigeria.

$H0_4$: Desalination has no significant effect on the financial performance of shipping industry in Nigeria.

1.6 Scope of the Study

The scope of the study covers the following aspects:

Conceptual Scope: The conceptual scope of this study is centered on exchange rate volatilities, blue economy and financial performance of shipping industry in Nigeria. The independent variables are exchange rate volatility and blue economy. Blue economy is measured by some of its components, which are, fisheries, aquaculture and desalination. Meanwhile, financial performance of shipping industry which is the dependent variable of the study; when decomposed, is measured by container throughput revenue, shipping costs, and port revenue. Thereby resulting in three distinct dependent variables for the study.

Geographical Scope: This study focuses on Nigeria's shipping industry, specifically examining the impact of exchange rate volatility and the blue economy on its financial performance. The choice of Nigeria as the domain for this study is based on its prominent position in global trade, especially in maritime activities, and the significant challenges it faces due to exchange rate volatility. As one of Africa's largest economies, Nigeria relies heavily on its shipping sector for both imports and exports. Volatility in exchange rates directly affects the cost structures, competitiveness, and profitability of shipping businesses, making it a critical factor for the industry’s financial performance.

Time Scope: This study covers a 35 years period from 1990 to 2024, selected to capture major shifts in Nigeria's economic landscape and their impact on the shipping industry. The starting year, 1990, reflects the aftermath of the structural adjustment programme (SAP) and the deregulation of Nigeria's foreign exchange market, which triggered chronic naira volatility. Key periods of heightened exchange rate instability include 1991-2001 (political transition), 2008-2009 (global financial crisis), 2014-2016 (oil price crash), and 2020-2023 (Covid-19 pandemic and economic disruption). These events significantly affected port revenue, container through-put, shipping costs, and financial performance in the maritime sector.

The year 2024, is particularly significant as it intensified global focus on the vulnerability of supply chains, heightened exchange rate volatility, and the pressing need for sustainable and adaptive strategies within the shipping sector. It also reflects a period of growing national discourse in Nigeria on blue economy development, highlighted by the establishment of the Ministry of Marine and Blue Economy in 2023.

1.7 Significance of the Study

This study conducts a disaggregated analysis of the impact of exchange rate volatility and the blue economy on the financial performance of Nigeria's shipping industry. In doing so, it addressed the inconsistencies and gaps in the findings of previous research by providing a more nuanced and sector-specific perspective, thereby contributing to a deeper understanding of the complex interactions between macroeconomic factors and maritime financial outcomes. In view of this, this study will be of immense benefits and significance to the following stakeholders in the following manner:

Academia: This study provides both theoretical insights and practical guidance for academics, researchers, and policymakers in Nigeria by addressing key challenges affecting the financial performance of the shipping industry. These challenges include rising operational costs from exchange rate volatilities, reduced profitability due to currency mismatches, inadequate infrastructure limiting competitiveness, inconsistent policies that impede long-term planning, and environmental issues threatening the sustainable use of blue economy resources.

Policy Makers in Statutory Government Regulatory Institutions: The research provides evidence-based insights to guide shipping policies in Nigeria, helping policymakers and agencies like the Nigeria Maritime Administration and Safety Agency (NIMASA), Nigeria Port Authority (NPA), and the Federal Ministry of Marine and Blue Economy manage exchange rate volatilities, enhance financial resilience, and leverage blue economy sectors such as fisheries, aquaculture, maritime tourism, and offshore resources to boost trade, sustainability, and the shipping industry's contribution to gross domestic product (GDP).

Shipping Industry: By examining the relationship between exchange rate volatilities, blue economy development, and the financial performance of the shipping industry, this study provides critical insights that can help the industry better understand and respond to macroeconomic pressures. The findings will support strategic planning, risk management, and investment decisions, ultimately contributing to improved operational resilience, profitability, and long-term sustainability of Nigeria's shipping sector.

1.8 Limitations of the Study

The first limitation of this study relates to the reliability and consistency of data. The study relies predominantly on secondary time-series data, which may be subject to measurement errors, revisions, definitional inconsistencies, and reporting lags arising from the original data-

generating institutions. Such shortcomings in the values of the variables could potentially affect the accuracy and stability of the estimated parameters and, by extension, the validity of the study's conclusions. To mitigate this limitation, the study relies exclusively on data sourced from the World Bank databases and the Central Bank of Nigeria (CBN) Statistical Bulletin, which are widely recognized for their methodological rigor, standardized data compilation procedures, and international credibility. The use of these authoritative sources minimizes data inconsistencies and enhances the overall reliability and comparability of the dataset.

While, time-series econometric analysis offers valuable insights into both short-run and long-run dynamics, it also presents inherent methodological challenges, particularly in the context of developing economies characterized by macroeconomic volatility, policy regime shifts, and structural changes. To address these challenges, this study adopts the Autoregressive Distributed Lag (ARDL) modeling framework as the primary analytical tool. The ARDL approach is particularly advantageous because of its flexibility in accommodating regressors integrated of different orders specifically I(0) and I(1) and its ability to estimate short-run and long-run relationships within a single-equation framework. Moreover, the ARDL bounds testing procedure is well suited for small sample sizes, a common limitation in macroeconomic studies involving developing countries such as Nigeria.

Despite these strengths, the ARDL model is not without methodological weaknesses. One key limitation is its sensitivity to lag length selection, as inappropriate lag choices may lead to over-parameterization, loss of degrees of freedom, or biased coefficient estimates. In addition, the ARDL framework cannot accommodate variables integrated of order two, I(2), and its estimates may be unstable in the presence of structural breaks arising from major policy reforms, economic crises, or external shocks. Furthermore, because ARDL is a single-equation model, it may not

fully capture potential endogeneity and feedback effects among variables, particularly in complex macroeconomic systems.

To minimize these limitations and ensure appropriate model specification, the study incorporates a comprehensive set of preliminary and post-estimation diagnostic procedures. First, unit root testing is conducted as a critical pre-estimation step using the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The combined use of these tests each with different underlying assumptions regarding serial correlation and stationarity enhances the robustness of the stationarity assessment and ensures that none of the variables are integrated of order two or higher, a necessary condition for the valid application of the ARDL model. This approach significantly reduces the risk of spurious regression and strengthens the credibility of the estimated long-run relationships. Additionally, optimal lag lengths are selected using established information criteria such as the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC), thereby reducing the risk of model misspecification associated with arbitrary lag selection. Where possible, structural stability is further examined using post-estimation stability tests such as the CUSUM and CUSUM of Squares tests, which help detect parameter instability over time and mitigate the potential impact of structural breaks on the estimated results.

Furthermore, the regression models are subjected to a series of diagnostic tests to ensure overall model adequacy and robustness. These include heteroskedasticity tests to examine the constancy of the error variance, Variance Inflation Factor (VIF) tests to detect multicollinearity among explanatory variables, and the Ramsey RESET test to identify functional form misspecification or omitted variable bias. Where violations are detected, appropriate corrective measures such as

the use of robust standard errors or model respecification are applied to improve the reliability of the estimates.

Taken together, these methodological safeguards significantly reduce the inherent weaknesses associated with time-series modeling and the ARDL framework. By combining rigorous data selection, comprehensive pre-estimation diagnostics, careful model specification, and extensive post-estimation testing, the study ensures that its empirical findings are methodologically sound, internally consistent, and suitable for informing policy-relevant conclusions within the Nigerian macroeconomic context.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter focuses on various concepts relevant to the study, previous work in the subject area, indicators, findings and techniques utilized in previous studies. Attempts are also made to consider the theoretical foundation of the study. Area covered include exchange rate volatility, components of blue economy as well as the various aspects and metrics for shipping industry financial performance within and outside Nigeria. The review is done in the order conceptual, theoretical, empirical literature; including the gaps in the extant literature.

2.1 Conceptual Review

2.1.1 Financial Performance of Shipping Industry

Financial performance of the shipping industry refers to the ability of maritime firms to generate sufficient revenue, control operational costs, and maintain profitability over a sustained period. In the context of Nigeria, financial performance in the shipping sector is particularly critical due to the industry's structural dependence on imported inputs and services, most of which are priced in foreign currencies. Nigerian shipping firms incur significant foreign-denominated expenses in areas such as vessel acquisition, maintenance, bunker fuel procurement, marine insurance, and port handling charges. As a result, the volatility of the naira against major currencies especially the U.S. dollar has direct implications for cost structures and profitability (Olaniyi, 2021). For

instance, a depreciation of the naira increases the local currency cost of foreign obligations, putting pressure on cash flow and limiting the capacity for reinvestment.

The financial performance of the shipping industry is the ability of firms operating within the maritime sector to generate income, manage expenses, fulfill debt obligations, invest sustainably, and provide returns to stakeholders. It reflects the industry's health, viability, and responsiveness to macroeconomic variables, such as exchange rates, inflation, and international trade flows (Stopford, 2009). In developing economies such as Nigeria, shipping industry performance is especially critical given the country's reliance on seaborne trade, which accounts for over 90% of its import and export volume, (UNCTAD, 2023).

The financial performance of the shipping industry is a critical metric that reflects how well maritime transport firms manage their resources to achieve profitability, growth, and sustainability. In the context of a developing economy like Nigeria, this performance is influenced by multiple macroeconomic and sector-specific factors such as exchange rate volatility, port infrastructure, global freight trends, and regulatory frameworks (Stopford, 2009; Ezeaku et al., 2020).

However, the financial performance of Nigerian shipping companies is heavily influenced by exchange rate volatility. Naira depreciation increases the cost of foreign-denominated transactions, raises customs duties, and fuels inflation, thereby escalating operational expenses. These factors reduce profit margins, limit financial flexibility, and hinder long-term investment in maritime assets and infrastructure (Okonkwo & Ifediora, 2020). Conversely, favorable currency conditions may reduce costs but might also dampen export competitiveness. These dynamics directly affect revenue generation, operational efficiency, and overall financial sustainability.

The financial performance of Nigeria's shipping industry encompasses not only profitability but also its resilience to external shocks, particularly foreign exchange volatility. Volatility in the naira increase the cost of importing ships and maritime equipment, undermining the sector's stability and growth potential (Eze & Uchenna, 2021). Aligning with the blue economy framework, which promotes sustainable use of ocean resources for long-term prosperity, the industry must adopt sustainable practices, invest in local shipbuilding, and implement policies to mitigate forex risks (Ayeni, 2023). Key strategies to enhance performance include infrastructure upgrades, revenue diversification, and capacity building, all essential for sustainable maritime development in Nigeria (Central Bank of Nigeria, 2023).

Therefore, the concept of financial performance in Nigeria's shipping industry encompasses not only profitability but also the sector's ability to withstand external economic shocks, especially those arising from foreign exchange market volatility. This perspective is essential in aligning maritime operations with the goals of the blue economy, which aims to ensure that ocean-based industries contribute to long-term economic prosperity without compromising sustainability.

2.1.2 Indicators of Financial Performance of Shipping Industry

To assess this financial performance, analysts rely on key financial performance indicators (KPIs) that reflect the industry's health, competitiveness, and capacity for growth. These include container throughput Revenue, shipping costs, and Port Revenue (Babubudjnauth, 2020; UNCTAD, 2021). These indicators not only measure physical operations but also serve as proxies for financial efficiency. For instance, rising shipping costs could indicate financial strain.

2.1.2.1 Container Throughput Revenue

Container throughput revenue refers to the income generated from handling containerized cargo in ports, typically measured in Twenty-foot Equivalent Units (TEUs). This metric serves as a critical indicator of port performance, international trade volume, and the financial viability of shipping and logistics operations (Notteboom & Rodrigue, 2005). As container shipping dominates global trade due to its cost-efficiency and cargo security, throughput revenue becomes a major source of income for port authorities, terminal operators, and maritime service providers. In the Nigerian context, container throughput is central to the financial performance of the shipping industry, as the country's economy relies heavily on seaborne trade. Key ports such as Apapa, Tin Can Island, and Onne handle a significant portion of Nigeria's imports and exports, making container traffic a barometer of national economic activity. According to the Nigerian Ports Authority (NPA), container traffic in Nigerian ports stood at approximately 1.8 million TEUs in 2021, with Apapa Port accounting for the majority of this throughput (NPA, 2021).

Exchange rate volatility poses a significant challenge to container throughput revenue. Volatilities in the naira-dollar exchange rate directly affect the volume of imported and exported goods, which in turn impacts container handling volumes. A depreciating naira increases the cost of imports, discouraging import activities and thus reducing the number of inbound containers (Olayiwola & Oloko, 2020). Simultaneously, unstable exchange rates affect the pricing and competitiveness of Nigerian exports, which may reduce outbound container volumes and lower overall port revenue. Moreover, port-related charges, maintenance costs, and capital expenditures often denominated in foreign currency may escalate in periods of exchange rate depreciation. This can reduce profit margins for port operators and shipping firms unless matched by corresponding increases in container handling charges, which might further discourage trade (Obadan, 2006). Container throughput revenue, when managed efficiently and sustainably, can

be an enabler of shipping industry development. Investments in port modernization, automation, and environmentally friendly logistics can improve container handling efficiency while, minimizing carbon footprints (OECD, 2016). Higher container throughput, driven by diversified and sustainable trade, can contribute significantly to port revenue while, aligning with ecological and economic sustainability goals (UNCTAD, 2020).

Container throughput revenue is a direct determinant of the financial health of the shipping industry. A steady flow of containers enhances revenue streams from terminal handling, customs clearance, storage fees, and inland transportation services. Higher throughput contributes to economies of scale, improved asset utilization, and more consistent cash flows for maritime businesses (Talley, 2009). Conversely, low throughput due to economic disruptions or infrastructure bottlenecks can result in revenue shortfalls, underutilization of assets, and increased operational costs. Volatilities in cargo volumes impacted terminal operators' income, observing that ports experienced revenue volatility in periods of macroeconomic instability and declining container throughput (Adewole & Osagie 2020). In Nigeria, recurring issues such as port congestion, dilapidated infrastructure, bureaucratic bottlenecks, and inadequate rail connectivity have constrained the full realization of container throughput revenue potential (Akinyemi, 2016). Addressing these challenges through strategic investments and reforms is essential for improving port performance and strengthening the financial resilience of the shipping sector.

2.1.2.2 Port Revenue

Port revenue is a critical component of the maritime economy and serves as a direct measure of the financial viability and operational efficiency of port authorities. It includes income generated from port dues, cargo handling charges, berthage, storage fees, ship pilotage, and lease of port

infrastructure (World Bank, 2013). In Nigeria, major ports such as Lagos (Apapa & Tin Can), Port Harcourt, and Calabar serve as key nodes in the logistics chain, with port revenue forming a vital link between shipping operations and national economic performance.

According to (Igbokwe & Okorie, 2017), volatility in exchange rates have a significant impact on port revenue. When the naira depreciates against foreign currencies, the cost of import duties and port charges (often denominated in USD) increases, affecting trade volumes. This dynamic can lead to a reduction in port throughput and, by extension, a decline in revenue for port authorities and terminal operators. Similarly, Okeudo & Eze (2012) note that volatility in currency exchange rates undermines the predictability of port service charges, making it difficult for stakeholders to plan and budget effectively.

Port revenue also plays an instrumental role in financing maritime infrastructure and supporting blue economy initiatives. For example, Adepoju & Olowu (2020) argue that sustainable port revenue generation enables investments in eco-friendly port operations, digitalization, and safety compliance all of which are pillars of the blue economy. However, these potentials are often hindered by inefficiencies, such as cargo congestion, long dwell times, corruption, and underutilization of port assets (Olukoju, 2020). In addition to being a key revenue stream for port authorities and concessionaires, port revenue directly influences national economic performance and maritime sector financing. In Nigeria, the Nigerian Ports Authority (NPA) collects port revenues through multiple channels, including terminal leases, cargo handling tariffs, and marine services. These revenues are essential for reinvesting in port infrastructure, digital technology, and environmental sustainability, which are integral to unlocking the full potential of the blue economy (NPA, 2022).

However, Nigeria's port revenue generation faces challenges from both internal inefficiencies and external economic volatility. Exchange rate volatilities, for instance, affect the cost of importing port equipment and maintaining maritime infrastructure (Obadan & Omoruyi, 2021). According to Emefiele & Okonjo (2019), the devaluation of the naira has led to higher operational costs for port authorities, as many spare parts and technical services are imported and paid for in foreign currency. Consequently, to preserve revenue margins, Nigerian ports often adjust tariffs, which can discourage port users and reduce throughput.

Additionally, port revenue is heavily influenced by trade volume, which itself is sensitive to exchange rate dynamics. A study by Osobase & Nwankwo (2018) found a significant positive relationship between exchange rate stability and port cargo throughput in Nigeria. The study suggested that predictable and stable currency exchange conditions encourage higher trade volumes and attract more shipping traffic, thereby boosting port revenue. On the other hand, weak enforcement of port regulations, bureaucratic delays, and infrastructural limitations such as poor road access to ports undermine port efficiency and erode potential revenue. These inefficiencies not only reduce the competitiveness of Nigerian ports compared to neighboring ports (e.g., Cotonou, Lomé) but also impair the financial performance of shipping companies operating in the country, as they face increased turnaround time and logistics costs (Olayemi & Fashola, 2021). Furthermore, in the context of the blue economy, sustained port revenue is essential for funding eco-conscious initiatives such as green port operations, waste management systems, and coastal protection. As noted by UNCTAD, (2020), a sustainable blue economy requires ports to transition into smart, green logistics hubs. This transition depends heavily on consistent and reliable port income.

In conclusion, port revenue serves as a linchpin between the financial performance of the shipping industry and broader macroeconomic conditions, particularly exchange rate volatility. Its management and optimization are crucial for Nigeria to harness the full benefits of its maritime domain within the blue economy framework. Improving port governance, modernizing infrastructure, and stabilizing foreign exchange conditions can significantly enhance revenue performance and, by extension, the entire shipping and maritime logistics sector (UNCTAD, 2020).

2.1.2.3 Shipping Costs

Shipping cost refers to the total expenditure incurred in the movement of goods from one geographical location to another via maritime transport. It encompasses various cost components such as freight rates, port handling charges, insurance, bunker (fuel) costs, crew salaries, maintenance, canal dues, and demurrage charges. These costs are critical determinants of international trade competitiveness and directly influence the financial performance of shipping companies (Stopford, 2009).

Shipping cost is the total expenses associated with the transportation of goods by sea from the point of origin to the destination. It encompasses various direct and indirect cost elements including freight charges, fuel costs, port dues, handling fees, customs levies, insurance premiums, and administrative expenses. In the global economy, shipping cost is a crucial determinant of trade competitiveness, logistics efficiency, and the financial viability of maritime operations (Stopford, 2009; Talley, 2009).

Shipping costs are directly linked to the financial performance of shipping firms. High operational costs can erode profit margins, reduce competitiveness, and affect the ability of firms to reinvest in capital assets or maintain service quality. On the other hand, cost-effective shipping

operations can improve earnings before interest and tax (EBIT), return on investment (ROI), and overall financial sustainability (Talley, 2009). Shipping cost inefficiencies have broader implications for national trade performance. High transport costs reduce the price competitiveness of Nigerian exports, particularly in bulk commodities such as cocoa, rubber, and cashew, which are sensitive to logistics overheads. According to UNCTAD, (2018), developing countries like Nigeria spend up to 15% more on shipping than developed economies, largely due to higher logistics inefficiencies and poor port infrastructure.

Hoffmann & Kumar **(**2010) show that companies with tighter cost controls and efficient vessel deployment strategies tend to outperform competitors in volatile economic environments. Similarly, in the Nigerian maritime sector, Akinyemi (2016) observed that firms operating through more efficient routes and port facilities incurred lower shipping costs, which significantly improved their bottom line. Moreover, shipping costs also affect the competitiveness of Nigerian exports. High freight rates reduce the price attractiveness of locally manufactured or processed goods in global markets, thereby limiting the capacity of the shipping sector to contribute meaningfully to national economic growth (Adewuyi & Saibu, 2017). In the context of Nigeria's maritime economy, shipping costs play a fundamental role in shaping the cost structure of imports and exports, influencing consumer prices, and determining the profitability of shipping lines and port authorities, exchange rate volatility plays a central role. As an import-dependent economy with growing export aspirations, Nigeria's exposure to external price shocks and currency volatility significantly affects the cost of shipping and port operations (Adewuyi & Ogege, 2019).

Exchange rate volatility significantly affects the cost of shipping, especially in economies like Nigeria where most maritime transactions are denominated in foreign currencies such as the US

dollar. A depreciating local currency raises the cost of foreign-denominated inputs such as bunker fuel, ship maintenance, and spare parts. This, in turn, increases the operational expenses of shipping companies and inflates freight rates for shippers and importers (Obadan, 2006; Olayiwola & Oloko, 2020). According to Clark, et al. (2004), exchange rate volatility contributes to uncertainty in shipping markets, often leading to price distortions in trade logistics. For Nigerian shipping operators, currency depreciation increases their cost base and reduces profitability, especially when earnings are in local currency but expenses are dollar-denominated. This creates a mismatch in financial planning and may discourage long-term investment in fleet expansion or port services.

2.1.3 Exchange Rate Volatility and Shipping Industry Financial Performance

A currency's "exchange rate" is the rate at which it can be purchased with another currency (foreign currency). When discussing the value of one country's currency in terms of another, we talk about the foreign exchange rate. Due to disparities in factor endowment, (Osiegbu & Onuorah 2012) argue that no country can remain economically independent, making the exchange rate a vital part of international economic interactions. Exchange rate volatility is the volatilities in the value of a country's currency relative to others, often driven by market forces, macroeconomic indicators, and policy decisions. Nigeria operates under a managed floating exchange rate regime, which exposes it to frequent and unpredictable currency swings, particularly due to its dependence on oil exports and vulnerability to external shocks (Ilechukwu, et al., 2020). This volatility affects the cost structure and profitability of shipping companies, which often deal in foreign currencies for ship acquisition, spare parts, and port services, while, earning revenue largely in the local currency, the naira.

In an effort to address persistent exchange rate volatility, the Central Bank of Nigeria (CBN) implemented unified exchange rate policy after 2023, aimed at minimizing arbitrage opportunities and improving market transparency (Adegboye & Olawale 2024). While, this policy is critical for fostering long-term currency stability, it has simultaneously increased the naira's exposure to external shocks, notably the repercussions of ongoing U.S. China trade tensions (Bown, 2020). On the maritime front, the establishment of the Ministry of Marine and Blue Economy in 2023, signaled a renewed governmental commitment to leveraging Nigeria's extensive ocean and coastal resources (Eneh & Eze, 2020). The ministry's initiatives, though strategically aligned, have been impeded by funding shortages and sluggish policy rollout, resulting in a pronounced divergence between intended targets and real-world results. Nigeria's Blue Economy Roadmap which prioritizes port reforms, fisheries development, and coastal tourism remains a work in progress (UNCTAD, 2022). However, the sector's growth prospects are heavily influenced by global trade fluctuations, rendering it susceptible to external economic shocks.

The exchange rate plays a pivotal role in economic development by influencing inflation, trade volumes, output, and overall macroeconomic stability. It acts as a bridge aligning domestic prices with international market trends, thereby affecting the balance of payments and competitiveness in foreign trade. Since Nigeria's adoption of the Structural Adjustment Programme (SAP) in 1986, the naira has experienced persistent depreciation, which, compounded by volatile oil prices, has posed significant challenges to the country's economic growth and stability (Adeniran & Akinwale, 2021; Obaseki, 2018).

Usman (2009), suggests that budget deficits correlate with falling oil revenues in Nigeria, whereas rising oil revenues are more typically linked to rising Government spending. Nigeria

does import a lot of refined petroleum and other industrial commodities, but it does derive a significant amount of its revenue from oil sales. Generally speaking, an exchange rate is the price of one currency in terms of another (Mordi, 2006). The exchange rate describes how much one country's currency is worth in terms of that of other nations. The degree to which domestic industries can compete with those in foreign nations may be gauged by watching the real exchange rate as it rises or falls (Razazadehkarsalari et al., 2011). When the value of an exchange rate considerably deviates from its equilibrium level, it is said to be volatile (Azeez et al., 2012). Unsynchronized currency rates are indicative of a situation where parallel marketplaces to the official market are flourishing.

2.1.4 Concept of Blue Economy

The concept of the blue economy has gained global prominence as an inclusive framework for harnessing the economic potential of oceans, seas, and inland waterways in a sustainable manner. The blue economy, as defined by the (World Bank, 2017), encompasses economic activities that rely on marine ecosystems, including fisheries, maritime transport, tourism, offshore energy, and seabed mining. It emphasizes sustainable development, environmental conservation, and social equity in the use of aquatic resources.

The Blue economy, often interchangeably referred to as the ocean or maritime economy, signifies the responsible and sustainable utilization of oceanic and coastal resources to foster economic advancement, improve livelihoods, and preserve marine eco-systems. Encompassing a broad spectrum of sectors, fisheries, aquaculture, shipping, marine tourism, offshore energy, and marine biotechnology, this economic paradigm has gained prominence as a tool for achieving inclusive growth, environmental sustainability, and poverty alleviation (Yousef, 2023; Smith-Godfrey, 2016).

The blue economy reflects a marine-based economic development model that integrates conservation and sustainable use of biodiversity with equitable sharing of marine resources' benefits Voyer, et al. (2018). Over recent years, the global community has increasingly recognized the vast potential of oceans, seas, and coastal regions as engines of prosperity and sustainability, culminating in the integration of the blue economy concept into policy agendas and development strategies worldwide (UNEP, 2012). Central to the blue economy concept lies the acknowledgment of the interconnectedness between economic prosperity, social well-being, and environmental sustainability. Through the embrace of principles such as ecosystem-based management, integrated coastal zone management, and sustainable resource utilization, the blue economy charts a course towards achieving the triple bottom line of economic, social, and environmental benefits (OECD, 2016).

The blue economy is the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems (World Bank, 2017). Sectors pivotal in job creation, such as tourism, and essential for food production, such as fisheries, rely on pristine coastal environments. Future prospects in sustainable blue energy and ocean mining are pivotal for enhancing countries' competitiveness. Moreover, ecosystem services provided by mangroves and coastal habitats, upon which coastal populations rely, can be bolstered through innovative revenue-generating mechanisms such as blue carbon. However, the productivity of coastal marine ecosystems on the African continent faces' threats from unsustainable infrastructure development, pollution, and inadequate natural habitat and resource management. Climate change-related events, including sea level rise and coastal flooding, exacerbate the region's vulnerability. The pressing challenge today revolves around how coastal

countries can effectively manage their coastal landscapes to stimulate economic growth, reduce poverty, and adapt to the effects of climate change (World Bank, 2022).

Scholars such as (Akinyemi, 2022) argue that the blue economy has the potential to transform Nigeria's economic structure by unlocking new sources of revenue, creating employment, and improving regional trade. However, this potential remains underexploited due to regulatory inefficiencies, inadequate infrastructure, and environmental degradation. The relevance of the blue economy to the financial performance of the shipping industry lies in its capacity to provide a stable, resource-rich, and innovation-driven ecosystem that supports maritime trade and logistics. Investments in blue economy sectors such as port infrastructure, marine ICT, and coastal security directly affect shipping costs, turnaround times, and risk profiles. A well-structured blue economy can serve as a stabilizing factor in mitigating the negative effects of exchange rate volatility on the shipping industry by creating a more efficient and self-reliant maritime economy.

The global rise of the blue economy as a transformative framework in sustainable development discourse has prompted the inclusion of ocean-based growth strategies in national and regional policy agendas (UNEP, 2012). Central to this framework is the recognition of the interconnectedness between economic prosperity, environmental sustainability, and social equity (OECD, 2016). Yet, these objectives can be severely hampered when nations face chronic currency instability.

2.1.5 Measure/Components of Blue Economy

2.1.5.1 Fisheries

Fisheries refer to the organized harvesting, processing, and marketing of fish and other aquatic organisms from marine, coastal, and inland water bodies for human consumption, commercial purposes, and ecological balance. The sector includes two broad categories: capture fisheries, which involve the extraction of fish from natural water bodies such as oceans, rivers, and lakes; and aquaculture, which is the controlled cultivation of fish and seafood in artificial or semi-natural environments (FAO, 2020). Fisheries, a foundational element of Nigeria's maritime economy, significantly influence the financial performance of the shipping industry. As a major source of both domestic consumption and export revenue, the fisheries sector contributes substantial cargo volumes that drive demand for maritime transport, port services, and logistics infrastructure (Olubusoye, 2015). The movement of fresh, frozen, and processed fish products along with fishing gear, ice, and other supplies creates continuous business for local and regional shipping operators.

The shipping industry benefits from both the inbound transportation of inputs required for fishing operations and the outbound shipment of fish products to markets across Nigeria and internationally. This dynamic supports regular cargo flow, increases container utilization, and boosts port revenues. In particular, the export of fish products strengthens revenue streams for shipping firms engaged in international freight, while the distribution of fish within the domestic market fuels activity in coastal and inland shipping routes (Nwaogwugwu, 2018).

However, the financial returns of shipping companies tied to fisheries are influenced by the sector's operational challenges. Rising fuel and transportation costs, along with infrastructure gaps in ports, cold storage, and handling facilities, lead to inefficiencies in the logistics chain (Olawale & Olatunji, 2020). These inefficiencies not only reduce the shelf life and market value

of fish products but also increase the cost of maritime operations, cutting into shipping firms' profit margins.

Small-scale fishers, who account for a significant share of the sector, often operate in areas with limited access to efficient transport and storage. This leads to post-harvest losses and reduced shipping volumes, directly impacting the financial performance of logistics operators and marine transport companies that rely on consistent freight flows (Okafor & Inegbedion, 2020). Inconsistent supply and low economies of scale also deter larger shipping operators from fully investing in fish-related logistics services. Furthermore, the lack of adequate investment in fishing infrastructure such as landing sites, storage facilities, and refrigerated transport limits the sector's ability to scale and, in turn, constrains the growth potential of maritime logistics services connected to fisheries (Omoniyi, 2017). When fisheries underperform, the shipping industry also loses out on potential revenue from expanded cargo and port throughput.

Conversely, targeted investment and policy support for fisheries can drive growth across the shipping value chain. Strengthening fisheries through improved infrastructure, enhanced cold chain logistics, and better access to markets will not only reduce post-harvest losses but also increase shipping volumes and financial returns for maritime operators (Adegboyega & Kuku, 2019). The integration of modern logistics solutions and digital tracking systems for fish shipments can further enhance supply chain efficiency, reduce waste, and improve reliability for shippers and exporters alike. Nigeria's fisheries sector plays a vital role in shaping the financial performance of the shipping industry. By ensuring a steady flow of cargo, creating demand for specialized logistics, and stimulating activity at ports, fisheries offer strong growth potential for maritime transport services. Realizing this potential, however, will require coordinated investments in infrastructure, logistics innovation, and fisheries development across the value

chain (Fasanya & Olayemi, 2016; Ita & Alhaji, 2021; Ogundele, 2020; Oluwatobi & Olawale, 2021).

2.1.5.2 Aquaculture

Aquaculture, is the farming of fish, crustaceans, mollusks, and other aquatic organisms, is increasingly influencing the financial performance of Nigeria's shipping industry. As aquaculture expands rapidly to meet rising demand for fish and seafood, it generates significant cargo volumes that contribute directly to port activity and maritime logistics (Fasanya & Olayemi, 2016). The transportation of fish feed, live aquatic stock, frozen seafood products, and aquaculture-related equipment enhances the flow of goods through ports, boosting revenue for shipping and logistics companies.

The growth of aquaculture increases demand for specialized shipping services, particularly those involving cold chain logistics, live fish transport, and time-sensitive deliveries. This creates new market opportunities for shipping companies to diversify their service offerings and invest in refrigerated containers, handling infrastructure, and route optimization to accommodate perishable goods (Adegboyega & Kuku, 2019). These activities not only improve port utilization rates but also increase shipping volumes and revenues.

However, the shipping industry's ability to capitalize on aquaculture's growth depends on overcoming infrastructure and operational bottlenecks. Inadequate cold storage facilities, poor road-to-port connectivity, and inefficient logistics systems contribute to high post-harvest losses, especially for perishable aquaculture products, (Nwaogwugwu, 2018). These inefficiencies can result in financial losses for both aquaculture producers and transporters, reducing the profitability of shipments and undermining investor confidence in expanding transport capacity. Rising costs of fuel and transportation, often driven by inflation and limited logistics

infrastructure, further erode margins for shipping companies moving aquaculture products (Olawale & Olatunji, 2020). These cost pressures may discourage investment in specialized shipping services for the aquaculture sector unless mitigated through targeted policy and infrastructure upgrades.

Investment in aquaculture infrastructure also influences shipping demand. When fish farmers gain better access to credit, modern production systems, and technical training, their output increases, which translates into higher demand for transportation and export logistics (Ogundele, 2020; Oluwatobi & Olawale, 2021). Thus, investment in upstream aquaculture activities indirectly strengthens the financial performance of maritime logistics and shipping companies by stabilizing cargo flows and expanding the sector's footprint in domestic and international trade.

To maximize the positive impact of aquaculture on shipping, Nigeria should prioritize policies that improve market linkages, expand port and cold chain infrastructure, and support integrated logistics networks. Strengthening these connections would enhance shipping industry performance by reducing delays, increasing cargo turnover, and encouraging investment in value-added maritime services (Fasanya & Olayemi, 2016; Adegboyega & Kuku, 2019).

In conclusion, aquaculture is emerging as a strategic driver of growth in Nigeria's shipping industry. By generating steady cargo volumes, stimulating demand for specialized logistics services, and creating economic activity around coastal ports, the sector offers a valuable opportunity to improve the financial performance and competitiveness of maritime transport networks.

2.1.5.3 Desalination

Desalination is the process of removing salt and other impurities from saline water typically seawater or brackish water to produce freshwater suitable for human consumption, industrial use, and agricultural purposes. It is a key technological solution for addressing water scarcity, particularly in coastal and regions where freshwater resources are limited or under increasing stress due to population growth, climate change, and pollution (Lattemann & Höpner, 2008).

Desalination plays an increasingly important role in supporting the operational efficiency and financial performance of the shipping industry, particularly in coastal and maritime economies like Nigeria. As a technology designed to convert seawater into potable water, desalination provides a reliable source of freshwater that is essential for various maritime operations, including crew consumption, vessel sanitation, ballast systems, and equipment maintenance (Ade & Olowu, 2020).

Shipping companies operating in regions with limited access to clean freshwater supplies often face logistical and financial challenges in securing water for onboard use. Traditional methods involve refueling with freshwater at ports, which can be expensive and time-consuming, especially in areas where freshwater is scarce or supply is inconsistent. By integrating onboard desalination systems or utilizing desalination infrastructure at ports, shipping companies can significantly reduce the costs associated with freshwater procurement, thereby improving overall operational efficiency and financial performance (Uche & Okonkwo, 2021).

Moreover, the availability of desalinated water at key maritime hubs enhances port service quality and reliability. Ports equipped with desalination infrastructure can offer value-added services to shipping companies, reducing turnaround times and minimizing disruptions caused by freshwater shortages. This added efficiency not only benefits individual shipping firms but also enhances the competitiveness of port facilities, which in turn supports greater trade volumes and

improved revenue streams for port authorities and logistics firms (Ibrahim & Nwachukwu, 2019). Nigeria's coastal regions especially cities such as Lagos, Port Harcourt, and Calabar face growing freshwater demand due to population growth, industrial expansion, and port-related activities. Unfortunately, these regions often suffer from inadequate freshwater supply and over-reliance on contaminated surface or underground water sources. The integration of desalination technology could alleviate water stress in these areas, providing reliable water sources for port operations, fisheries, and shipping industries, which are all critical components of the blue economy (Olaniyan & Olutayo, 2019).

Desalination contributes to the financial performance of the shipping industry by improving operational efficiency at ports and supporting critical ancillary services like ship cleaning, cargo handling, and fish processing, all of which rely on reliable access to clean water. Furthermore, industries situated in free trade zones or coastal economic clusters benefit from enhanced water security, which boosts productivity and competitiveness (UNCTAD, 2019; Smith & Rahman, 2020).

However, the adoption of desalination in Nigeria is still in its infancy due to several constraints, including high capital costs, energy intensity, environmental concerns related to brine discharge, and lack of technical expertise. As noted by UNCTAD, (2020), the environmental sustainability of desalination efforts depends heavily on the use of renewable energy sources such as solar or wind power to minimize carbon footprints and reduce dependence on fossil fuels. In addition, exchange rate volatility poses a significant barrier to desalination infrastructure development in Nigeria. Desalination plants often rely on imported technology and components priced in foreign currency. Fluctuating exchange rates increase procurement and maintenance costs, making it more difficult for public and private stakeholders to invest in such projects (Okonkwo & Eze,

2018). Stable exchange rate policies and access to foreign investment could therefore be critical in scaling up desalination efforts in support of Nigeria's maritime and blue economy goals. These costs can be a barrier for smaller shipping firms or ports with limited financial capacity. Nevertheless, when viewed through the lens of lifecycle cost savings and operational independence, desalination often presents a favorable return on investment, especially in regions where traditional freshwater supply chains are unreliable or overly expensive (Ade & Olowu, 2020).

In conclusion, desalination is a strategic enabler of financial and operational efficiency in the shipping industry. By reducing dependence on external freshwater sources and improving the reliability of port services, desalination supports cost savings, environmental compliance, and sustainable growth across maritime logistics networks. For countries like Nigeria with growing shipping activity and water-stressed coastal zones, investing in desalination can yield significant benefits for the financial performance and resilience of the maritime sector (Uche & Okonkwo, 2021; Ibrahim & Nwachukwu, 2019).

2.1.6 Exchange Rate Volatility, Blue Economy, and Shipping Industry Financial Performance

2.1.6.1 Exchange Rate Volatility and Container Throughput

Exchange rate volatility adversely affects container throughput in Nigeria by increasing the cost of imports and disrupting international trade. Studies by (Adewuyi & Adefolami 2021); (Obadan & Omoruyi 2021) reveal that currency instability reduces Twenty-Foot Equivalent Unit (TEU) volumes, delays infrastructure investment, and undermines port efficiency. Furthermore, higher costs of imported logistics inputs (e.g., fuel and machinery) due to naira depreciation limit

container-handling capacity (Chukwu & Ibrahim, 2019). To improve throughput and port performance, exchange rate stabilization and better access to foreign exchange are essential.

2.1.6.2 Exchange Rate Volatility and Port Revenue

Exchange rate volatility significantly impacts port revenue in Nigeria by increasing the costs of imported equipment, spare parts, and fuel needed for port operations, which can reduce efficiency and cargo throughput (Chukwu & Ibrahim, 2019). Volatility in the exchange rate also discourage importers and exporters due to higher transaction costs and uncertainty, leading to decreased cargo volumes and lower income from port charges and customs duties (Adewuyi & Adefolami, 2021). Furthermore, unstable exchange rates disrupt consistent funding for port infrastructure projects, limiting modernization efforts and the ability to handle larger cargo volumes (Obadan & Omoruyi, 2021). While, a depreciated naira may enhance export competitiveness and increase port activity, excessive exchange rate instability raises operational risks and costs, deterring sustained port revenue growth (Chukwu & Ibrahim, 2019). Therefore, stabilizing exchange rates and improving foreign exchange policies are essential for protecting and boosting Nigeria's port revenue (Chukwu & Ibrahim, 2019; Adewuyi & Adefolami, 2021; Obadan & Omoruyi, 2021).

2.1.6.3 Exchange Rate Volatility and Shipping Cost

Exchange rate volatility significantly impacts shipping costs in Nigeria by increasing the prices of essential imported inputs such as fuel, spare parts, and maintenance equipment. This rise in operational expenses often leads shipping firms to pass on higher freight charges to customers. Studies, including those by (Chukwu & Ibrahim, 2019; Adewuyi & Adefolami, 2021), confirm that both short-term shocks and long-term currency depreciation contribute to surging shipping

expenses. Similarly, companies adopt costly risk mitigation strategies like currency hedging, which further elevate costs and reduce investment incentives in shipping infrastructure. Overall, stabilizing exchange rates and improving hedging options are crucial to controlling shipping costs and supporting the sector's growth in Nigeria.

2.1.6.4 Fisheries and Container Throughput

The fisheries sector plays a vital role in driving container throughput revenue by increasing demand for specialized refrigerated containers and time-sensitive logistics, especially in coastal economies like Nigeria. Rising fish production and aquaculture exports have led to higher cargo volumes at Nigerian ports, positively impacting container throughput and associated port revenues from handling charges and tariffs (Eze & Ugochukwu, 2021; Obioma & Bassey, 2020). However, inadequate port infrastructure such as limited cold storage and slow customs processing restricts the sector’s full revenue potential (Adewumi et al., 2023). Investments in fisheries infrastructure, including cold chain facilities and processing hubs, significantly boost container throughput by strengthening the linkages between fisheries production and maritime logistics (Ibe & Nwaogu, 2023). To fully harness fisheries-related container revenue, improvements in port modernization, export facilitation, and exchange rate stability are essential.

2.1.6.5 Fisheries and Port Revenue

The fisheries sector significantly drives port revenue in Nigeria by increasing cargo volumes through fish product imports and exports, which generate income from port charges, customs duties, and logistics services. Studies such as, (Obioma & Bassey, 2020) found that a 1% rise in marine fish output led to a 0.4% increase in seafood container shipments, boosting port throughput and revenue. (Ekanem & Bako, 2021) also highlighted fisheries’ substantial

economic contribution, including employment and over ₦25 billion annually in customs and port fees. However, inadequate port infrastructure, inefficient customs processes, and limited cold storage hinder growth. Exchange rate volatility further raises operational costs and input prices, constraining fisheries trade and port activity (Chukwu & Ibrahim, 2019). To fully realize fisheries' revenue potential, improvements in port facilities, customs efficiency, and macroeconomic stability are essential.

2.1.6.6 Fisheries and Shipping Cost

The fisheries sector significantly influences shipping cost revenue through its demand for maritime logistics, especially for transporting perishable fish products that require specialized cold-chain services. In Nigeria, growth in both marine capture and aquaculture production has driven higher volumes of refrigerated cargo, leading to increased freight charges and shipping company revenues (Eze & Ugochukwu, 2021; Onuoha & Okonkwo, 2018). However, inadequate fisheries infrastructure, fragmented cold-chain logistics, and energy constraints limit the full potential of revenue generation from fisheries-related shipping activities (Adewuyi et al., 2022). Also, exchange rate volatility raises production and shipping costs, which impacts freight rates and the competitiveness of Nigerian shipping firms in global markets (Chukwu & Ibrahim, 2019). Overall, while, fisheries growth can boost shipping revenues, systemic inefficiencies and macroeconomic instability pose significant challenges.

2.1.6.7 Aquaculture and Container Throughput

Aquaculture is a key driver of container throughput revenue at Nigerian ports, due to increased demand for refrigerated containers used to transport perishable fish products. Studies by (Onuoha & Okonkwo 2018; Ibe & Nwaogu 2023) confirm a positive correlation between

aquaculture growth and container volumes, particularly where cold storage and processing infrastructure are present. However, port congestion, limited cold chain capacity, and exchange rate volatility hinder the full realization of revenue potential. Addressing these infrastructural and macroeconomic challenges is crucial to maximizing aquaculture's contribution to port throughput and associated revenues (FAO, 2022).

2.1.6.8 Aquaculture and Port Revenue

Aquaculture significantly boosts port revenue in Nigeria by increasing demand for containerized transport, especially refrigerated containers, and generating income from handling charges, customs duties, and storage fees. Studies by (Eze & Uchenna 2021; Chukwu & Adebayo 2021) demonstrate a strong positive link between aquaculture exports and port throughput, with ports equipped with cold storage and efficient customs processing seeing higher revenue. (Ekanem & Bako 2021) quantified this impact, showing substantial customs and service charge revenues from aquaculture cargo. However, infrastructural deficits like inadequate cold chain facilities and slow inspection processes, highlighted by Adewumi et al. (2023), hinder the sector's full revenue potential. To maximize port income from aquaculture, investments in cold logistics, automation, and digital customs, alongside coordinated policies among key agencies, are essential.

2.1.6.9 Aquaculture and Shipping Cost

Aquaculture expansion in Nigeria drives demand for specialized shipping services, particularly refrigerated containers and cold chain logistics, boosting shipping companies' revenues. Onuoha & Okonkwo (2018) found a strong positive link between aquaculture output and shipping earnings, emphasizing the importance of cold chain services for product quality and higher freight charges. Abila, et al. (2021) confirmed increased demand for specialized vessels in West

Africa but noted that exchange rate volatility raises input costs such as fuel and maintenance. Chukwu & Ibrahim (2019) highlighted how currency volatility and port congestion increase operational expenses, pushing shipping firms to raise charges, which can hurt competitiveness. Adekunle & Eyo (2022) also found that fuel price shocks and port inefficiencies inflate costs, though long-term aquaculture growth benefits shipping profitability. Generally, while aquaculture growth boosts shipping revenues, managing exchange rate risks, infrastructure, and logistics efficiency is essential to control shipping costs and sustain profitability.

2.1.7 Desalination and Container Throughput

Desalination is an emerging blue economy subsector that positively contributes to container throughput revenue in Nigeria by increasing demand for the importation of specialized equipment via containerized shipping. Okoro et al. (2022); Eze & Onyekachi (2023) highlight that over 85% of desalination imports use sea freight, with a strong correlation between desalination activity and container traffic at key ports. However, infrastructural bottlenecks, energy costs, and exchange rate volatility pose constraints. Enhancing port infrastructure and ensuring macroeconomic stability are key to unlocking the full revenue potential of desalination-related shipping.

2.1.7.1 Desalination and Port Revenue

Desalination contributes to port revenue in Nigeria through increased imports of specialized equipment and materials that drive container handling, storage, and customs processing. Studies by Okoro et al. (2022); Eze & Onyekachi (2023) show a positive correlation between desalination imports and port revenue, with a 1% increase in imports linked to a 0.5% rise in

revenue. However, infrastructural constraints, exchange rate volatility, and high energy costs limit the sector's full potential. Improving port facilities and ensuring macroeconomic stability are necessary to maximize desalination’s contribution to port income (Lattemann & Höpner, 2008).

2.1.7.2 Desalination and Shipping Cost

Desalination within the blue economy drives demand for specialized maritime logistics, such as temperature-controlled containers and timely deliveries, which command higher shipping costs and revenue. Eze & Onyekachi (2023) found that rising desalination imports increase container throughput and premium shipping charges. Okoro et al. (2022) emphasized that about 85% of desalination equipment is imported via sea freight, underscoring the sector’s reliance on maritime transport with higher operational costs but also higher freight rates. However, Adekoya & Olubunmi (2022) noted that energy shortages and exchange rate volatility raise operational expenses, pushing freight charges up and affecting affordability. Adewuyi & Otubu (2021) showed that desalination investments create significant shipping contracts but stressed that exchange rate stability is vital to controlling shipping costs. Essentially, desalination boosts shipping cost revenue through specialized service demand, but energy and currency volatility moderate these gains.

2.1.8 The Nigeria Blue Economy Initiative

The blue economy concept has gained global recognition as a sustainable development framework that harnesses oceanic and marine resources to promote economic growth, environmental health, and social equity. For Nigeria, the blue economy presents a strategic avenue to diversify its economy, create employment, and enhance maritime sector performance, especially as the country seeks to reduce its dependence on oil revenues (Gambo & Shehu, 2021). Nigeria's geographic advantage, with approximately 853 kilometers of coastline along the Gulf of Guinea and extensive inland waterways, positions it uniquely to capitalize on marine resources spanning fisheries, shipping, aquaculture, marine tourism, offshore energy, and port services. Recognizing this potential, the Nigerian government has prioritized the blue economy in its national development agenda, aligning policy initiatives to foster sustainable maritime growth (NIMASA, 2023). A significant milestone in Nigeria's blue economy evolution is the establishment of the Ministry of Marine and Blue Economy. This ministry provides dedicated governance and coordination across various marine sectors, reflecting the government's commitment to developing a cohesive and sustainable blue economy strategy (Federal Ministry of Marine and Blue Economy, 2024).

Similarly, the Nigerian Maritime Administration and Safety Agency (NIMASA) has formulated a comprehensive Blue Economy Policy and Strategy. This policy articulates priorities such as sustainable shipping practices, maritime security, environmental protection, and capacity building in line with international frameworks like the African Union's Blue Economy Strategy (2020) and global maritime conventions (NIMASA, 2023; African Union Commission, 2020). The integration of the blue economy into Nigeria's National Development Plan (2021–2025) further underscores the government's commitment to leveraging marine sectors for economic

diversification and inclusive growth (Federal Government of Nigeria, 2021). The Nigeria Blue Economy Initiative is centered on several key objectives. First, it aims to drive economic diversification by reducing reliance on oil and expanding maritime sectors such as fisheries, aquaculture, shipping, and marine tourism, thereby making a significant contribution to GDP growth (Olajide & Oladipo, 2021). Secondly, the initiative emphasizes environmental sustainability through the implementation of conservation strategies to protect marine biodiversity and reduce pollution, in accordance with international agreements like UNCLOS and MARPOL (Adebayo et al., 2022). Third, it promotes social inclusion and community development by empowering coastal communities through skills training, equitable resource management, and job creation in maritime industries (Ibe, 2023). Besides, the initiative focuses on enhancing maritime security and governance by strengthening regulatory frameworks and enforcement to combat piracy, illegal fishing, and other maritime crimes, ensuring safe and secure operations (Obi & Olayinka, 2020). Lastly, it seeks to foster regional and international collaboration by deepening cooperation with Gulf of Guinea nations and engaging global partners to improve maritime governance and sustainable resource management (African Union Commission, 2020).

Shipping and Port Services play a vital role as Nigeria's ports serve as major gateways for international trade. Ongoing modernization efforts aim to boost efficiency, alleviate congestion, and attract foreign investments (World Bank, 2019). Given that over 90% of global trade is conducted via sea, shipping remains a cornerstone of the blue economy with immense economic significance (IMO, 2020). Fisheries and Aquaculture are critical for providing employment and ensuring food security. The initiative prioritizes sustainable fisheries management and the development of aquaculture to address overfishing and promote resource renewal (FAO, 2022).

Offshore Energy represents an emerging opportunity beyond traditional oil, as Nigeria explores renewable sources such as offshore wind and tidal power, aligning with the global shift toward clean energy (Olajide & Oladipo, 2021). Marine Tourism and Recreation offer promising avenues for economic diversification, provided that development is environmentally sustainable and incorporates community engagement (Gambo & Shehu, 2021). Desalination and Water Security are essential for addressing freshwater shortages in coastal areas. Implementing desalination technologies supports both industrial operations and community needs, thereby enhancing resilience and sustainability (FAO, 2022).

Despite these promising opportunities, several challenges hinder the full realization of Nigeria's blue economy potential. Infrastructure deficits, including aging port facilities, insufficient cold storage for fisheries, and limited research infrastructure, constrain sectoral growth (Akanbi & Adetunji, 2021). Regulatory overlaps and limited institutional capacity, caused by multiple agencies with intersecting mandates, impede effective governance and enforcement, Eze, et al. (2022). Furthermore, environmental degradation manifested through pollution, oil spills, and coastal erosion poses significant threats to marine ecosystems vital for sustainable economic activities (Adebayo et al., 2022). Finally, macroeconomic risks such as exchange rate volatility and inflation elevate operational costs for shipping and marine businesses, thereby diminishing investment appeal (Adeniran & Akinwale, 2021).

2.1.8.1 Harnessing Opportunities in the Blue Economy

The blue economy represents a transformative framework for leveraging marine and aquatic resources to drive sustainable economic growth, social development, and environmental stewardship. Globally, the blue economy has emerged as a vital engine for innovation and investment, with countries recognizing the vast potential embedded in oceans, seas, and inland

waters (World Bank, 2017). For Nigeria, a country endowed with rich coastal and marine ecosystems, the blue economy offers unparalleled opportunities to diversify the economy, create jobs, and improve livelihoods especially in the face of fluctuating oil revenues and exchange rate volatility. One of the primary opportunities presented by the blue economy is its capacity to diversify Nigeria's economy beyond oil dependence. The maritime sectors including shipping, fisheries, aquaculture, maritime transport, offshore energy, and coastal tourism offer vast untapped potential for GDP growth, (Olajide & Oladipo, 2021). According to the Nigerian Maritime Administration and Safety Agency (NIMASA, 2023), sustainable exploitation of these sectors can contribute significantly to national income, foreign exchange earnings, and industrial development. Shipping, in particular, plays a critical role in Nigeria's international trade, given that over 90% of global trade is conducted via maritime routes (International Maritime Organization [IMO], 2020). Enhancing shipping capacity and port infrastructure can thus improve trade efficiency, reduce logistics costs, and stimulate export competitiveness. Furthermore, expanding aquaculture and fisheries presents food security benefits while generating employment for coastal communities (FAO, 2022).

The blue economy also offers significant potential for employment generation and social empowerment. Fisheries and aquaculture are labor-intensive sectors that support millions of livelihoods worldwide. In Nigeria, coastal populations, including vulnerable groups such as women and youth, can benefit from skill development, entrepreneurship, and access to blue economy value chains (Ibe, 2023). Initiatives aimed at building capacity in sustainable fishing practices, marine technology, and eco-tourism can drive inclusive growth and reduce poverty in coastal regions (Akanbi & Adetunji, 2021). Moreover, the blue economy promotes equitable resource governance, ensuring that local communities have a say in managing marine resources

and benefit fairly from economic activities. This social dimension is essential for mitigating conflicts, preserving traditional livelihoods, and fostering community resilience (Gambo & Shehu, 2021).

Sustainable management of marine ecosystems is a cornerstone of the blue economy. Nigeria's initiative seeks to align economic development with conservation efforts by adhering to international environmental protocols such as the United Nations Convention on the Law of the Sea (UNCLOS) and the International Convention for the Prevention of Pollution from Ships (MARPOL) (Adebayo et al., 2022). Protecting biodiversity, combating marine pollution, and promoting sustainable fishing practices help maintain ecosystem services vital for fisheries productivity and climate regulation. Climate change poses a significant threat to Nigeria's coastal zones through sea-level rise, coastal erosion, and extreme weather events. The blue economy framework incorporates adaptive strategies, such as investment in resilient infrastructure, coastal habitat restoration, and disaster risk reduction, to safeguard marine and coastal assets, (United Nations Development Programme, UNDP, 2021).

Harnessing blue economy opportunities also involves leveraging technology and infrastructure development. Modernizing ports with digital systems, implementing automated cargo handling, and adopting green shipping technologies enhance operational efficiency and reduce environmental footprints (World Bank, 2019). Investment in renewable offshore energy such as wind, wave, and tidal power presents new avenues for clean energy generation while supporting national energy transition goals (Olajide & Oladipo, 2021). Desalination technologies, for example, can address freshwater scarcity challenges in coastal cities and support industrial activities reliant on water security (FAO, 2022). Furthermore, integrated maritime spatial planning and data sharing promote effective governance and optimize resource allocation across

competing uses (Gambo & Shehu, 2021). For Nigeria to fully harness these opportunities, robust policy frameworks and institutional capacities are essential. Coordinated governance mechanisms involving federal, state, and local agencies ensure effective regulation, investment coordination, and stakeholder engagement (NIMASA, 2023). Public-private partnerships can mobilize finance and expertise for large-scale infrastructure and innovation projects. Regional cooperation within the Gulf of Guinea and adherence to frameworks such as the Yaoundé Code of Conduct enhance maritime security and resource management, further unlocking blue economy potential (African Union Commission, 2020).

While, opportunities abound, Nigeria's blue economy is constrained by several challenges, including inadequate infrastructure, regulatory fragmentation, environmental degradation, and macroeconomic risks such as exchange rate volatility. The latter affects the cost of importing vessels, equipment, and fuel, impacting shipping firms' profitability and investment capacity (Adeniran & Akinwale, 2021). Addressing these constraints through targeted reforms, capacity building, and financial stability measures is crucial.

2.1.8.2 The Blue Economy and Maritime Development

In the context of developing countries like Nigeria, the blue economy is seen as a transformative pathway to diversify the economy, reduce dependency on oil, and stimulate growth in underutilized sectors such as shipping, aquaculture, and marine biotechnology (NIMASA, 2022). Nigeria, with its extensive coastline, inland waterways, and access to the Atlantic Ocean, is strategically positioned to benefit immensely from blue economy initiatives. However, actual development in this domain remains limited, with numerous structural, financial, and policy barriers hindering progress (Nwokedi, 2020). Maritime transport is a cornerstone of the blue economy, and its development has profound implications for national trade competitiveness and

regional integration. Investments in seaports, inland waterway networks, green port infrastructure, and maritime security are crucial for unlocking the sector's potential. According to Onuoha & Ugwoke (2021), port modernization and the adoption of digital logistics systems can reduce turnaround times, lower operating costs, and enhance the financial performance of shipping companies.

Nigeria's engagement with the blue economy is guided by initiatives such as the Deep Blue Project, which aims to combat piracy and enhance maritime domain awareness. This project, managed by the Nigerian Maritime Administration and Safety Agency (NIMASA), seeks to improve the security environment for maritime operations, thus attracting investment and facilitating safer shipping corridors (NIMASA, 2022). Security improvements directly influence shipping firms' operating costs, as reduced piracy risks lower insurance premiums and enable more efficient route planning.

However, despite these policy strides, the implementation of blue economy strategies remains fragmented. A major challenge is the lack of coordination among regulatory agencies, such as NIMASA, Nigerian Ports Authority (NPA), and Nigerian Inland Waterways Authority (NIWA), leading to policy overlaps and inefficiencies (Okafor & Nnaji, 2023). Furthermore, inadequate investment in maritime infrastructure such as dredging, port automation, and intermodal connections continues to impede the effectiveness of blue economy programs.

From a sustainability standpoint, the blue economy encourages the transition to low-carbon shipping practices. According to Virdin et al. (2021), decarbonation strategies in maritime transport not only contribute to environmental protection but also offer long-term cost advantage. (NIMASA, 2021; Okafor & Dike, 2022) emphasized that Nigeria's marine resources can significantly contribute to GDP if sustainably harnessed. However, most empirical work notes

that institutional inefficiency, weak regulatory enforcement, and poor inter-agency coordination hinder blue economy growth (Aniebonam & Ekpo, 2021). Moreover, Ibe & Nwokocha (2020) found that blue economy initiatives such as port modernization, marine security (e.g., Deep Blue Project), and aquaculture development have begun to impact the financial viability of shipping-related enterprises in Lagos and Rivers States.

Importantly, the literature identifies a growing consensus that sustainable blue economy initiatives can provide competitive advantages to shipping firms. By embracing environmental, social, and governance (ESG) principles, these firms can attract green financing, improve customer loyalty, and align with international trade partners that prioritize sustainable logistics (UNCTAD, 2021). However, empirical data specifically linking these sustainability efforts to firm-level financial outcomes in Nigeria remains limited.

Additionally, a weak legal and institutional framework hinders Nigeria's ability to scale up its blue economy. Regulatory uncertainty, corruption, and the slow pace of reforms have discouraged private sector participation and limited foreign direct investment (FDI) in the maritime sector (Ibrahim & Olaniyi, 2019). Strengthening the blue economy requires not only infrastructure but also institutional integrity, financial innovation, and stakeholder collaboration. To overcome these barriers, policy makers have emphasized the need for a comprehensive national blue economy policy that aligns economic development with marine ecosystem conservation. This includes adopting environmentally friendly port operations, promoting green shipping technologies, and fostering partnerships with private investors and regional bodies such as the African Union and ECOWAS (African Union, 2020).

Integrating the blue economy into Nigeria’s broader development framework not only enhances the financial performance of maritime industries but also supports long-term ecological

sustainability. For the shipping industry, this means more efficient port operations, access to new markets, and improved resilience against external shocks such as exchange rate volatility and global trade disruptions (Ayeni, 2023).

2.1.9 An Overview of the Nigerian Shipping Industry

Maritime transport, driven by shipping activities, is the cornerstone of global trade and the economy (United Nations, 2016). Maritime transport supports international trade with its capacity to facilitate the exchange of vast volumes of goods across various countries of the world. The International Chambers of Shipping (2020) affirmed that the shipping trade lies at the heart of the world economy, with a total value of $14 trillion in 2019. The ocean functions as a critical international trade route, with approximately 90% of global trade dependent on maritime transportation. As a vital sub-sector of the transport industry, the maritime sector offers cost-effective and large-scale transport services that underpin international trade (UNCTAD, 2020). The Nigerian shipping industry is a critical component of the country's economy, given Nigeria's strategic location along the Gulf of Guinea and its dependence on maritime trade for both domestic and international commerce. This industry plays a vital role in facilitating the movement of goods, oil, and other resources to and from Nigeria. The Nigeria’s Maritime sector is a neglected goldmine that possesses the potentials and could serve as a significant driver of economic growth and long-term development if proactive measures are taken to improve its efficiency (Ikenna & Paul, 2021). Nigeria has several major ports which are operated by both government-owned and private companies, with Lagos being the most significant as it is home to the Apapa and Tin Can Island Ports, which handle a substantial portion of the country's cargo, other notable ports include Port Harcourt, Onne, Calabar, and Warri (Nwanosike, 2014).

The Nigerian government has shown increased commitment to leveraging maritime assets to diversify the economy beyond oil. Agencies like the Nigerian Maritime Administration and Safety Agency (NIMASA) and the Nigerian Ports Authority (NPA) have been at the forefront of promoting marine-related development, capacity building, and the enforcement of safety regulations to enhance sector performance (NIMASA, 2021). The Nigerian shipping industry faces several challenges, including insufficient infrastructure, security issues, and corruption. Recognizing these obstacles, Nigeria has started aligning with regional and international frameworks aimed at promoting blue economy growth. The African Union's Blue Economy Strategy (2020) urges member states to develop national policies that integrate environmental sustainability with economic development. Nigeria's ongoing initiatives include the proposed Blue Economy Policy and Strategy by the Nigerian Maritime Administration and Safety Agency (NIMASA), which seeks to coordinate investments across key maritime sectors. Additionally, regional cooperation with other Gulf of Guinea countries on maritime security, data sharing, and ocean governance is vital for building a resilient blue economy. Institutions such as the Interregional Coordination Centre (ICC) and the Yaoundé Code of Conduct framework play important roles in enhancing regional maritime collaboration (African Union Commission, 2020; NIMASA, 2023; ICC, 2022).

However, the Nigerian government has recognized the need for reforms in the shipping industry. Hence, various initiatives such as port concessions, enhancement of security in the Gulf of Guinea, the enactment of the Nigerian Maritime Administration and Safety Agency Act (NIMASA Act, 2007) to provide a legal framework for the regulation of the maritime industry, and the establishment of the Maritime Academy of Nigeria (MAN) at Oron as well as the

Nigerian Maritime University at Okerenkoko for adequate training and re-training of personnel in the maritime industry, were launched to address the challenges (Kpechukwu et al., 2020).

In contemporary time, the number of shipping companies operating in Nigeria's maritime sector are presented in the Table 2.1.

Table 2.1: Shipping Companies, Agents, and Addresses

S/N	Company Name	Agent Name	Address
1	3MO Shipping & Trading Company Limited	3MO Shipping & Trading Company Limited	Aquarius Block, 1st Floor, 1 Commercial Road, Eleganza Plaza, Apapa Lagos
2	Advanced International Merchants Limited	Advanced International Merchants Limited	22, Oduyemi Street, Anifowoshe, Ikeja
3	African European Lines (Nig.) Limited	African European Lines (Nig.) Limited	9, Creek Road, Apapa
4	African European Lines Nigeria Limited	African European Lines Nigeria Limited	9, Creek Road, Apapa
5	Air Sea Freighter Limited	Air Sea Freighter Limited	213 Aba Road, Opp. Shell RA, Trans Amadi, Port Harcourt
6	Alan Caray Technical Ltd.	Alan Caray Technical Limited	11, Wharf Road, Apapa Lagos
7	Antonio Assaf & Sons (Nig.) Limited	Antonio Assaf & Sons (Nig.) Limited	41/43 Bombay Crescent, Apapa Lagos
8	Antwerp Shipping	Antwerp Shipping	1, Commercial Road, 1st Floor Leo

	Nigeria Limited	Nigeria Limited	Block, Eleganza Plaza, Apapa
9	Ayolas Cargo & General Services Limited	Ayolas Cargo & General Services Limited	129, Agege Motor Road, Alakija, Idi-Oro, Lagos
10	Balaquer Limited	Balaquer Limited	Aquarius Block, 2nd Floor, Eleganza Plaza, 1, Commercial Rd., Apapa
11	Batun Investment Nig. Ltd.	Batun Investment Nig. Ltd.	1, Aerodrome Road, Eleganza Plaza, Apapa
12	BHN Transport & Logistics Limited	BHN Transport & Logistics Limited	Plot 018 Trans Amadi Ind. Layout, Port Harcourt
13	Blue Star Shipping Line Limited	Blue Star Shipping Line Limited	24, Creek Road, Apapa, Lagos
14	Captino Global Shipping Company Limited	Captino Global Shipping Company Limited	AO 41/42 Enugu Plaza, Trade Fair Complex, Badagry Expressway, Lagos
15	Casablanca Shipping Agency	Casablanca Shipping Agency	8, Olofin Street, Apapa
16	China Shipping	Cross Marine Services	28, Burma Road, Apapa
17	China Shipping & Container Line (CSC)	Cross Marine Services Limited	28, Burma Road, Apapa
18	Contraco (Nig.) Limited	Contraco (Nig.) Limited	Suite 8D, Princes Court, Ahmed Onibudo Street, Victoria Island, Lagos

19	COSCO	SDV	26, Creek Road, Apapa
20	Cross Traders	Cross Marine Services	28, Burma Road, Apapa
21	Deino Maritime Services	Deino Maritime Services	Eleganza Plaza, Aquarius Block, Ground Floor, 1, Commercial Road, Apapa Lagos
22	Delmas (Nig.) Limited	Wasa Delmas	26, Creek Road, Apapa
23	Denca Services Limited	Denca Services Limited	37, Alhaji Yusuf Adebayo Street, Olodi Apapa
24	DLB Concerns Limited	DLB Concerns Limited	9A Adeola Odeku, Victoria Island
25	DSR Senator Lines	Alraine Shipping Agency	4B Balogun Omidiora Road (Former Hinderer Street), Apapa, Lagos
26	Dully Shipping & Trading Limited	Dully Shipping & Trading Limited	28, Palace Road, Olodi Apapa, Lagos
27	East Atlantic Cargo & Marine Services Limited	East Atlantic Cargo & Marine Services Limited	1, Station Road, Town, Port Harcourt
28	Equitrail Marine Oil & Gas Co. Ltd.	Equitrail Marine Oil & Gas Co. Ltd.	30/32 Creek Road, End Floor, Apapa Lagos
29	Fedrick Marine Services Limited	Fedrick Marine Services Limited	48/50 Rumuolumini Road, Off Wempey Junction, Rumueprikom, Port-Harcourt
30	Fesco Marine Services Ltd.	Fesco Marine Services Limited	16, Warehouse Road, Apapa

31	Fidepat International Co. Limited	Fidepat International Co. Limited	Okoi Arikpo House, 5, Idowu Taylor Street, V/Island, Lagos
32	Fleming International Agencies Limited	Fleming International Agencies Limited	56/58 Opebi Road, Ikeja
33	Frang International Ltd.	Frang International Ltd.	33, Creek Road, Apapa
34	Franig International Limited	Franig International Limited	33, Creek Road, Apapa, Lagos
35	Frikden Shipping Investment Limited	Frikden Shipping Investment Limited	12, Ashabi Shoniyi Street, Ijeshatedo, S/Lere
36	Gasop Nig. Limited	Gasop Nig. Limited	19B Birabi Old GRA Phase 1, Port Harcourt
37	Gold Star Lines	Lagos & Niger Shipping Agency	4, Creek Road, Apapa
38	Green West Africa Nig. Limited	Green West Africa Nig. Limited	68B Perekule Road, GRA II, Port Harcourt
39	Grimaldi Roro Oceanic		17, Burma Road, Apapa
40	Gulf Agency & Shipping (Nig.) Limited	Gulf Agency & Shipping (Nig.) Limited	14, Creek Road, Apapa
41	Gus Mek Bay (GMB) Nigeria Limited	Gus Mek Bay (GMB) Nigeria Limited	33, Creek Road, Ibru Building, Apapa, Lagos

42	Hamada Shipping Limited	Hamada Shipping Ltd.	1, Commercial Road, Eleganza Building, Apapa
43	Investment Keepers Services Limited	Investment Keepers Services Limited	1/3 Creek Road, Apapa
44	Ivory Marine & Oilfield Services Limited	Ivory Marine & Oilfield Services Limited	149/153, Broad Street, Lagos
45	Jafana Ventures Nigeria Limited	Jafana Ventures Nigeria Limited	40, Calcuta Crescent, Apapa, Lagos
46	Jaros Shipping Company Limited	Jaros Shipping Company Limited	2B Burma Road, Apapa, Lagos
47	Jetro Shipping Limited	Jetro Shipping Limited	21, Warehouse Road, Apapa
48	JNAX Panalpina Nig. Limited		4, Creek Road, Apapa
49	Jotransitos Nigeria Limited	Jotransitos Nigeria Limited	8/10, Broad Street, Lagos
50	Kanapex Nigeria Limited	Kanapex Nigeria Limited	175, NAHCO Office Complex, Ikeja, Lagos
51	Kein Hung	Elder Dempster Agency	34 Wharf Road, Apapa
52	Kerildbert Holdings Limited	Kerildbert Holdings Limited	L/C Prince Court, 37, Ahmed Onibudo Street, V/Island, Lagos
53	Lat Best Venture Limited	Lat Best Venture Limited	1, Commercial Road, Aquarius Block, Eleganza, Apapa

54	Mabail Nigeria Limited	Mabail Nigeria Limited	46, Burma Road, Apapa
55	Maersk Line	Maersk Nigeria Limited	121 Louis Solomon Close, V/Island, Lagos
56	Majose (Nig.) Enterprises Limited	Majose (Nig.) Enterprises Limited	75, Olorunshogo Street, Mushin, Lagos
57	Mannan Nig. Limited	Mannan Nig. Limited	46, Burma Road, Ground Floor, Apapa, Lagos
58	Marine & Oil International Limited	Marine & Oil International Limited	26, Norman Williams Street, S/W Ikoyi, Lagos
59	Maskime Maritime Services Limited	Maskime Maritime Services Limited	50, Napex Suite, Off American Embassy, Eleke Crescent, V/Island
60	Messina	Comet Shipping Agency	4B Balogun Omidiora Road (Former Hinderer Street), Apapa, Lagos
61	Michelle Nigeria Limited	Michelle Nigeria Limited	8, Akanbi Onitiri Crescent, Off Eric Moore Road, Iganmu
62	Mitsuio S. K.	Alraine Shipping Services/Transcap	28, Burma Road, Apapa
63	MSC Line	Comet Shipping Agency	4B Balogun Omidiora Road (Former Hinderer Street), Apapa, Lagos
64	NAL/Comet Shipping	NAL/Comet Shipping Line	4B Balogun Omidiora Road

	Line		(Former Hinderer Street), Apapa
65	N-Fizah Investment Limited	N-Fizah Investment Limited	1A Lander Close, Off Liverpool Road, Apapa
66	O.T. Africa	Cross Marine Services	28, Burma Road, Apapa
67	Ocean Blocks Limited	Ocean Blocks Limited	33, Creek Road, Ibru Boulevard, Ibru Office Yard, Apapa
68	Ocean Handlers International Limited	Ocean Handlers International Limited	188, Awolowo Road, S.W. Ikoyi, Lagos
69	Oladayo International Agencies Limited	Oladayo International Agencies Limited	56, Kofo Abayomi Avenue, Apapa, Lagos
70	P & O Nedlloyd	Nedlloyd Nig. Limited	5, Creek Road, Apapa
71	Peewee Marine Limited	Peewee Marine Limited	9, Oyekan Road, Apapa
72	Petrodel Resources Maritime Limited	Petrodel Resources Maritime Limited	2B Reeve Road, Ikoyi, Lagos
73	Petroleum Projects Intermodal (PPI) Limited	Petroleum Projects Intermodal (PPI) Ltd	22B Temple Road, Ikoyi, Lagos
74	PIL	Blue Funnel Nig. Ltd.	34, Creek Road, Apapa
75	Polmaz Limited	Polmaz Limited	14, Old Aba Road, Rumukurushi, Port Harcourt
76	Prize International Limited	Prize International Limited	20, Oyekan Road, Apapa

77	Progress Marine Limited	Progress Marine Limited	20 Thopson Avenue Road, Ikoyi, Lagos
78	Quality Freight Agency Limited	Quality Freight Agency Limited	7B Ezira Close, Kirikiri Town, Apapa, Lagos
79	Sahara Sea Support Services Limited	Sahara Sea Support Services Limited	234B Adeola Odeku Street, V/Island, Lagos
80	SDV Wasa-Delmas Nigeria Limited		26, Creek Road, Apapa, Lagos
81	Silver Ocean Shipping Company Limited	Silver Ocean Shipping Company Limited	4, Saka Tinubu Street, Victoria Island, Lagos
82	Skanga Oil Limited	Skanga Oil Limited	292, Ajose Adeogun Street, V/Island, Lagos
83	Stars Investment Co. Ltd.	Stars Investment Co. Limited	Reclamation Road, Near PH Boat Club, Port Harcourt
84	Sundersons Limited	Sundersons Limited	33, Creek Road, Apapa
85	Temtum Global Services Limited	Temtum Global Services Limited	1, Aerodrome Road, Eleganza Plaza, Apapa
86	Tha Shipping & Marine Service Limited	Tha Shipping & Marine Service Limited	3, Pelewura Way, Apapa
87	Tokke Maritime Services Limited	Tokke Maritime Services Limited	NNPLC Comm. Building, Tin Can Island, Apapa, Lagos
88	Torm Lines	Alraine Shipping Agency	4B Balogun Omidiora Road

			(Former Hinderer Street), Apapa, Lagos
89	Trans-Oceanic Shipping Ltd	Trans-Oceanic Shipping Limited	Jaros House, 90, Iwofe College of Education Road, Rumuepirikan, PH
90	Transmarine Shipping Services Nig. Limited	Transmarine Shipping Services Nig. Ltd	1 Commercial Road, Eleganza Plaza, Apapa
91	Tru-Sell Ventures Limited	Tru-Sell Ventures Limited	1/3 Creek Road, Apapa, Lagos
92	United Africa Lines (NAL)	United Africa Lines (NAL)	2, Oroabaw Street, Amadi Flat, Port Harcourt
93	VTN Dredging Limited	VTN Dredging Limited	1, Arine Base Estate Road, Port Harcourt
94	WAL	Elder Dempster Agency	34 Wharf Road, Apapa
95	Wolid International Services Limited	Wolid International Services Limited	
96	World Link Travel Agencies	World Link Travel Agencies	7, Ogba Road, Sango, Agege, Lagos
97	Socar Talamiz Limited	Socar Talamiz Limited	Shop 80, Tafawa Balewa Square, Lagos
98	Michelle Nig. Limited	Michelle Nig. Limited	29, Burma Road, Apapa; 8, Akanbi Onitiri Crescent, Off Eric Moore

99	BHN Transport & Logistics Limited	BHN Transport & Logistics agency.	
100	Carldon International Agencies	Carldon International agency	Plot 018, Trans Amadi Industrial Layout, Port Harcourt
101	Trans-Atlantic Shipping & Transport Agencies	Trans-Atlantic Shipping & Transport Agencies Limited	89/91, Kofo Abayomi Avenue, Apapa, Lagos

Source: Nigerian Ports Authority, (2024).

2.2 Measure of Exchange Rate Volatility

To measure exchange rate volatility in this study, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is employed. Introduced by Bollerslev (1986) as an extension of the ARCH model developed by Engle (1982), the GARCH framework is widely recognized for its effectiveness in modeling and forecasting financial time series with time-varying volatility. Unlike traditional models that assume constant variance, the GARCH model accounts for volatility clustering a common characteristic of exchange rate movements by allowing the conditional variance to depend on past shocks and previous periods' volatility. According to Nelson (1991), GARCH-type models are particularly useful in capturing the persistence of volatility in financial markets, making them ideal for analyzing currency fluctuations in economies prone to macroeconomic instability.

In the context of exchange rate analysis, several studies have demonstrated the applicability of the GARCH model. For example, Choudhry (2005) applied GARCH techniques to estimate exchange rate risk in emerging markets, while, Ajao & Igbekoyi (2013) used a GARCH

framework to model naira volatility and its implications for foreign trade. Similarly, Okonkwo et al. (2020) showed that GARCH models provide more accurate insights into Nigeria's exchange rate behavior than static models.

In this study, the GARCH (1,1) specification is used to generate a time-varying measure of exchange rate volatility, which is then incorporated into the main model to evaluate its impact on the financial performance of Nigeria's shipping industry. This approach ensures that the influence of exchange rate uncertainty is appropriately captured and analyzed in relation to the sector's operational stability and investment outcomes.

2.2.1 The Interplay Between Exchange Rate Volatility, Blue Economy, and the Shipping Industry Financial Performance

The interrelationship between exchange rate volatility, the blue economy, and the financial performance of the shipping industry is complex and multifaceted, especially in an emerging economy like Nigeria. These three variables interact dynamically, with each element influencing and being influenced by the others through various economic channels, market mechanisms, and policy environments (Adeniran & Akinwale, 2021; UNCTAD, 2020). Exchange rate volatility represents a macroeconomic shock mechanism that directly affects both the operational costs and financial viability of the shipping industry. A depreciating naira increases the cost of importing vessels, spare parts, port equipment, and other maritime infrastructure since these are often denominated in foreign currencies, particularly the U.S. dollar (Adewuyi & Olayiwola, 2021). Shipping firms operating in Nigeria must often settle international freight charges, insurance premiums, and regulatory fees in foreign currencies, thus making them highly vulnerable to adverse currency movements. This, in turn, compresses profit margins, disrupts capital investment plans, and raises the cost of financing.

On the other hand, the blue economy comprising sectors like fisheries, aquaculture, coastal tourism, marine biotechnology, desalination, and offshore energy offers a pathway for economic diversification and resilience. Blue economy sectors generate cargo, support maritime employment, and create demand for port and shipping services (Onyeukwu, 2020). Environmental protection and the adoption of green port practices can lead to operational efficiencies and attract climate-related funding and subsidies (African Union, 2020). While, the blue economy sectors are also affected by exchange rate volatilities particularly through input costs and export competitiveness, they can act as stabilizers. For instance, the depreciation of the naira increases the cost of importing spare parts, fuel, and ship maintenance services, which are typically denominated in foreign currencies. This erodes profit margins (Olusola & Ajayi, 2021). Many shipping companies finance vessels or port equipment through foreign-denominated loans. Currency devaluation increases the local currency cost of debt servicing, weakening balance sheets. Unpredictable exchange rates increase investment risk, discouraging foreign direct investment (FDI) in maritime infrastructure (Akinbobola & Saibu, 2018). A weaker naira makes imports more expensive and reduces trade volumes, affecting port revenue and shipping company income. Thus, exchange rate volatility often results in reduced financial performance for the shipping industry through increased costs, reduced margins, and higher financial uncertainty.

The financial performance of the shipping industry measured by ocean throughput, shipping costs, and port revenue is ultimately shaped by the interplay of these forces. Exchange rate volatility introduces risk and uncertainty, while the blue economy presents new opportunities for trade, cargo movement, and service diversification. Where the two forces align positively, for example, when export oriented blue economy sectors thrive amid favorable exchange rates the

shipping industry may experience financial gains. Conversely, if currency volatility leads to inflation, reduced import volumes, and higher maritime operating costs without a compensating boost from the blue economy, the shipping sector's performance is likely to decline (Nwankwo, 2021). Thus, the ability of the shipping industry to perform financially is contingent not only on external macroeconomic conditions but also on the internal development and integration of blue economy activities.

Exchange rate volatility increases uncertainty and risk, which affects firm-level investment decisions (Markowitz, 1952). The balance of payments theory suggests that persistent currency depreciation reflects trade imbalances, which in Nigeria's case are often driven by an overdependence on imports and underutilized export sectors such as fisheries and aquaculture, (Oyejide & Ogun, 2020).

The synthesis of these factors suggests a need for integrated policy responses that stabilize currency markets while promoting blue economy sectors. This could include establishing foreign exchange windows for maritime operations, investing in export-capable blue economy sectors, and modernizing port infrastructure to enhance competitiveness. Investment in local shipbuilding, renewable marine energy, and digitalized logistics can reduce reliance on imported goods and foreign exchange exposure (UNECA, 2016).

2.2.2 Concept of Exchange Rate

Exchange rate volatility refers to unpredictable fluctuations in the value of one currency relative to others over time. For open economies such as Nigeria, where businesses including shipping firms rely heavily on foreign trade, exchange rate instability can significantly distort financial performance. The shipping industry is particularly susceptible due to its dependence on

international transactions, imported inputs, and foreign-denominated debt (Eze & Uchenna, 2021; Okonkwo & Ifediora, 2020).

Numerous empirical studies highlight the complex relationship between exchange rate volatility and firm-level performance. Ezeaku et al. (2018) observe that, exchange rate volatilities in Nigeria lead to increased transaction costs, reduced pricing predictability, and greater risk exposure for firms involved in cross-border operations. These uncertainties compel firms to divert resources toward currency risk management, hedging instruments, and inventory holding, ultimately affecting their operational efficiency and profitability.

In the context of the shipping industry, exchange rate volatility directly influences key cost components such as the purchase of spare parts, fuel, ship maintenance, insurance premiums, and port charges all of which are often denominated in foreign currencies. A depreciation in the naira, for instance, raises the cost of these inputs, reducing the profitability of shipping firms. According to (Adegbite & Azeez, 2022), Nigerian maritime firms have experienced reduced returns on assets during periods of intense exchange rate volatility, underscoring the financial fragility induced by macroeconomic instability.

Moreover, the unpredictability of exchange rates can deter foreign and local investment in the shipping industry. Investors and operators often delay capital expenditure decisions due to fears of currency mismatch and valuation risks. (Ajao & Igbekoyi, 2013), contend that prolonged exchange rate instability in Nigeria has contributed to underinvestment in maritime infrastructure and fleet modernization. At the macroeconomic level, volatile exchange rates can also distort revenue projections and budget planning, especially in sectors with long operational cycles such as shipping. Olayiwola et al. (2021) noted that shipping companies operating in volatile currency environments face challenges in maintaining cash flow stability and servicing foreign-

denominated debt. This further exacerbates their exposure to financial distress and bankruptcy risk.

From a global perspective, Ghosh et al. (2012) noted that developing countries often suffer greater economic costs from exchange rate volatility due to weak institutional structures and the absence of robust hedging mechanisms. This finding is particularly relevant for Nigeria, where forward contracts and futures markets for hedging currency risk are underdeveloped. As such, shipping firms must rely on internal financial strategies, such as increased reserves or local sourcing often at the expense of profitability.

2.2.3 Exchange Rate Volatility

Currency exchange prices on the foreign exchange market go up and down in response to supply and demand volatilities. When demand exceeds supply, the exchange rate of a currency increases in value. When goods and services are in surplus, however, the value of a currency falls. The long-term demand and supply of any currency is very sensitive to changes in the value of imports and exports and long-term capital movements like foreign direct investment (FDI). Capital flight and declining foreign direct investment (FDI), driven by global economic instability, have further undermined Nigeria's economic resilience (World Bank, 2023). The appreciation of the U.S. dollar amidst these uncertainties has placed considerable pressure on the naira, resulting in increased import costs, heightened inflationary pressures, and exacerbation of Nigeria's foreign exchange challenges, International Monetary Fund (IMF, 2023). The blue economy dependent on maritime and coastal resources has been particularly affected by these developments. Slowed global trade has diminished shipping activity at key Nigerian ports such as Lagos and Onne, while investor uncertainty has hindered funding for marine-related infrastructure and

development projects (UNCTAD, 2022). Consequently, the sector remains underdeveloped and highly susceptible to external economic shocks.

Factors that have contributed to this change throughout time include inflation, exchange rates, Ani et al., (2013). It's possible that the inherent volatility of a freely floating exchange rate system may become too great under certain conditions. This phenomenon arises due to the fact that international capital markets 'overshoot' in response to shocks, creating volatilities in exchange rates, whereas goods and services markets react more slowly (Dornbush, 1976). According to (Sonik, 2000), this is the pattern that emerges throughout most monetary crises. To start, the gap between the country's imports and exports is increasing. Therefore, when compared to other currencies using purchasing power parity (PPP), this one is seen as overpriced. If foreign investors are pouring money into a country's booming economy and providing cheap financing to local businesses, the country may seem to have a current account deficit even while it really has a capital account surplus. However, this kind of investment begins to dry up as the outlook for economic growth becomes less clear and volatility rises. As investors leave and the current account deficit becomes more visible, governments are raising exchange rates in an effort to encourage investment. High exchange rates have a detrimental impact on the economy, increasing the need of capital restriction policies

2.3 Maritime Trade and Exchange Rate Volatility

Maritime trade refers to the exchange of goods, commodities, or services via sea routes or waterways. It encompasses all economic activities related to the movement of goods by sea. The exchange rate volatility is the risk of exchange rates and it has some implications for external trade. Exchange rate volatility have significantly affected shipping trade directly through the economic instability and uncertainty, and indirectly through the production system, investment

and national policy (Nyunt, 2019). The fluctuation of exchange rate can cause currency appreciation or depreciation and this fluctuation makes it difficult for countries to trade. Between 1986 and 2022 there has been serious fluctuation of the exchange rate in Nigeria, this exchange rate volatility was due to the implementation of the Structural Adjustment Program (SAP) that mandated deregulation of foreign exchange market and this deregulation resulted in the devaluation of the Nigerian naira. The primary aim of SAP was to diversify the production base of the economy with a significant positive bias for the production of agricultural exports and encourage exports, Danladi, et al. (2015).

Exchange rate volatility in Nigeria have created uncertainty that negatively affects trade, increases the cost of imports, and leads to macroeconomic imbalances such as persistent balance of payments deficits. Despite various government policies, including the Structural Adjustment Program (SAP) introduced in 1986 to diversify the economy and promote exports through naira devaluation, these goals have not been fully achieved. The SAP resulted in higher import costs and limited export growth due to structural challenges. Consequently, exchange rate instability continues to undermine investor confidence and complicate economic policymaking (Nwachukwu & Odii, 2023; Adeyemi, 2024; World Bank, 1994; IMF, 1991; CBN, 1992).

2.3.1 Literature Review on Control Variables

2.3.1.1 Inflation Rate

Inflation rate, commonly measured by the Consumer Price Index (CPI), captures changes in the general price level of goods and services over time. In Nigeria, persistent inflationary pressures have been driven by factors such as exchange rate depreciation, structural supply rigidities, and fiscal imbalances (Central Bank of Nigeria [CBN], 2024). The interaction between inflation and exchange rate volatility is particularly significant, as currency depreciation directly fuels import

driven inflation by increasing the cost of imported inputs such as vessels, spare parts, and bunker fuel (Ojo & Olajide, 2019). This linkage creates a dual burden for shipping firms whose operational expenses are largely denominated in foreign currencies but whose revenues are mostly in naira. From the perspective of the blue economy, inflation undermines the sustainability of maritime activities by raising shipping costs, discouraging investment in port infrastructure, and eroding the real value of revenues generated from ocean throughput and maritime trade (World Bank, 2022). Inflation induced increases in shipping costs also reduce Nigeria's competitiveness as a regional maritime hub, diverting cargo traffic to alternative ports in West Africa (Osho & Fagbamila, 2022). These effects weaken the contribution of the maritime sector to the broader blue economy, which depends on efficient, cost-effective shipping services for sustainable growth.

For the shipping industry's financial performance, inflation exerts both direct and indirect effects. Directly, it increases operating costs and compresses profit margins when firms cannot fully transfer costs to shippers through higher freight rates. Indirectly, it reduces import demand by lowering consumer purchasing power, which in turn diminishes cargo throughput and port revenues (Ajayi & Olayiwola, 2021). Moreover, the combined effect of exchange rate volatility and inflation creates uncertainty that complicates financial planning and investment decisions. Okene et al. (2021) argue that shipping companies often adopt defensive strategies such as reducing fleet expansion, delaying capital projects, or relying on short-term financing when faced with macroeconomic instability. This not only weakens financial sustainability but also undermines the sector's ability to drive the blue economy agenda.

2.3.1.2 Labour Force

The labour force is a fundamental driver of productivity, efficiency, and financial sustainability in the shipping industry. A well-trained and motivated workforce enhances vessel turnaround times, reduces shipping costs, and ensures effective cargo handling, all of which improve the profitability of shipping firms and port authorities (Stopford, 2009). However, the capacity of the labour force to sustain these outcomes is often undermined by macroeconomic instability, particularly exchange rate volatility and inflation. Exchange rate volatility has a dual effect on the shipping labour market. On one hand, currency depreciation raises the cost of training, certification, and capacity-building programs for seafarers and port operators, most of which require foreign inputs or overseas courses (Olayiwola & Ajayi, 2021). On the other hand, volatility increases wage pressures as workers demand higher pay to offset inflationary effects, raising personnel costs for shipping companies. In extreme cases, economic instability can trigger brain drain, with experienced Nigerian seafarers and maritime professionals seeking employment in foreign markets where wages are more stable and competitive (Akinola & Adewumi, 2021).

Within the blue economy framework, human capital is recognized as a cornerstone for sustainable maritime development. A skilled labour force enhances the competitiveness of ports, supports efficient logistics chains, and contributes to the diversification of economic activities such as ship repair, fisheries, coastal tourism, and offshore oil and gas services (World Bank, 2022). However, when labour capacity is weakened by inadequate training, industrial disputes, or high turnover, the maritime sector struggles to contribute effectively to the blue economy agenda (Wu & Yip, 2021).

For the financial performance of the shipping industry, labour force dynamics manifest in both direct and indirect ways. Directly, skilled labour reduces operating costs by improving productivity and minimizing port delays, thereby boosting revenue and profitability. Indirectly, a competitive maritime workforce attracts foreign direct investment, increases cargo throughput, and strengthens port revenues (Nwokolo & Ekong, 2020). When labour productivity is weak or industrial conflicts are frequent, shipping companies face increased demurrage costs and operational inefficiencies, ultimately lowering port revenue and reducing net profit margins (Okeke & Onyema, 2022).

2.3.1.3 Trade Freedom

Trade freedom, a component of economic freedom, refers to the absence of tariff and non-tariff barriers that hinder the free flow of goods and services across borders. It is typically measured by indices such as the Heritage Foundation's Trade Freedom Index, which captures tariff rates, customs efficiency, and trade restrictions. In an open economy, higher trade freedom stimulates international trade, fosters competitiveness, and enhances the contribution of maritime activities to national economic growth (Heritage Foundation, 2023). From a theoretical perspective, trade freedom influences shipping industry performance through trade volumes, cargo throughput, and port revenues**.** Liberal trade policies expand market access and increase shipping demand, which directly improves the financial performance of maritime firms. However, restrictive trade measures or weak trade freedom undermine shipping by constraining volumes, raising transaction costs, and discouraging foreign direct investment (Rodrigue & Notteboom, 2020).

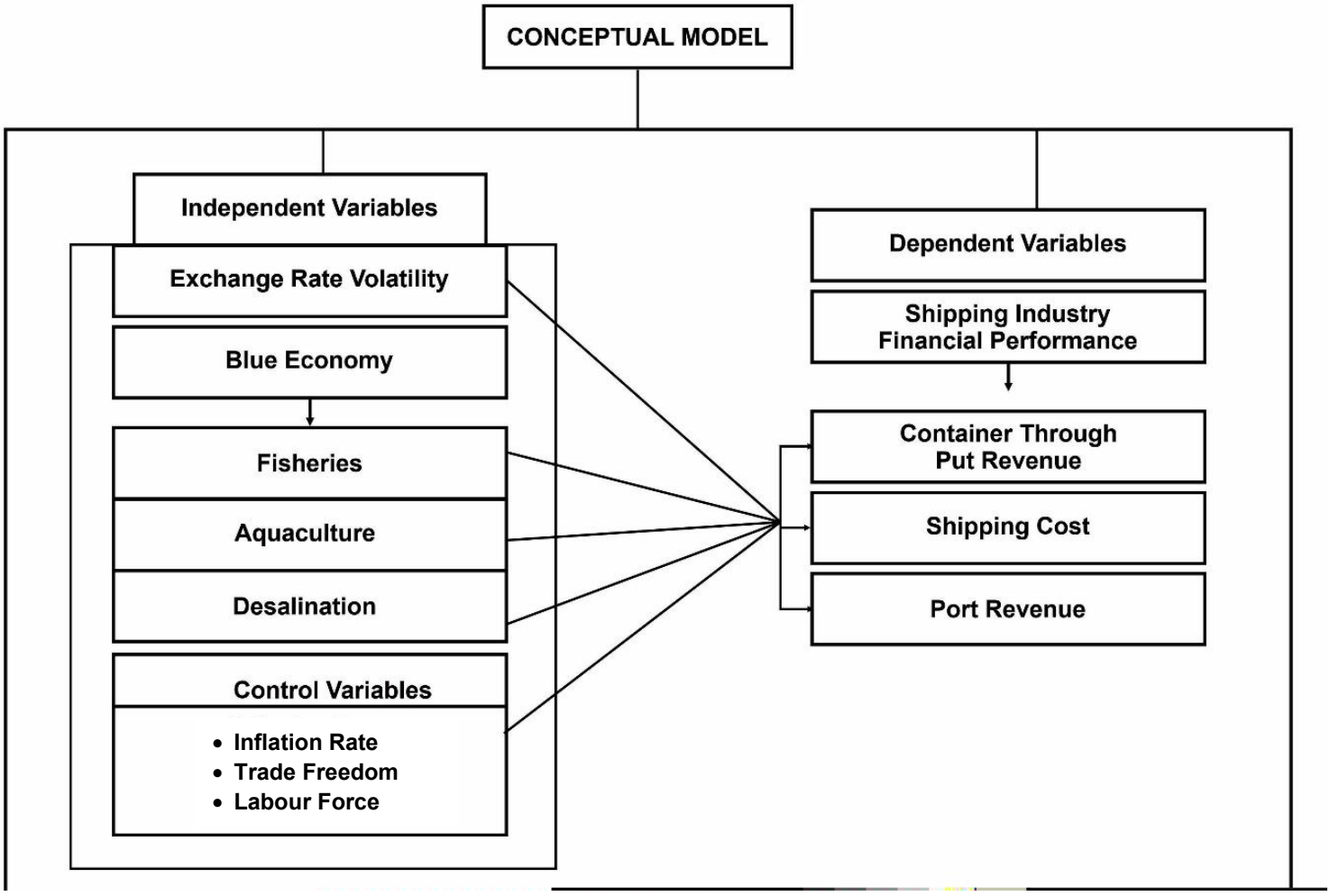
In Nigeria, the benefits of trade freedom are often eroded by macroeconomic instability, particularly exchange rate volatility. A depreciating and unstable naira discourages importers and

exporters by raising transaction risks and inflating costs of cross-border trade, thereby limiting the positive impact of liberal trade policies (Osho & Fagbamila, 2022). High trade costs linked to exchange rate volatility reduce cargo traffic at Nigerian ports and weaken the financial performance of shipping companies. Although, trade freedom has the potential to boost shipping revenues, its practical impact is often undermined by exchange rate instability and persistent inflationary pressures.

Within the blue economy framework, trade freedom is essential for integrating maritime transport with fisheries, offshore energy, marine tourism, and coastal industries. Liberalized trade regimes attract investment in maritime infrastructure and stimulate demand for shipping services, enabling ports to serve as regional trade hubs (World Bank, 2022). However, in Nigeria, excessive reliance on import tariffs, customs bottlenecks, and restrictive trade practices have limited the potential of the blue economy to generate sustainable growth (Okene et al., 2021).

2.3.2 Conceptual Model

The term conceptual model is the hypothesized model under study that shows the relationship between the dependent and independent variables. In view of this, the conceptual models which was used for this study are stated below:



Source: Researcher's Construction, (2025)

Fig. 2.1. Relationship Between Exchange Rate Volatilities, Blue Economy, and Financial Performance of Shipping Industry in Nigeria.

Figure 2.1 illustrates the probable interconnected relationship among exchange rate volatility, components of the blue economy, and the financial performance of the shipping industry. This conceptual framework is designed to capture how both macroeconomic volatility and sector-specific activities may influence key financial outcomes within the maritime transport sector.

Exchange rate volatility, play a significant role in shaping the cost structure and revenue potential of the shipping industry. Specifically, volatility in exchange rates introduces

uncertainties in international trade, which often lead to increased shipping costs due to the need for currency hedging, price adjustments, and insurance. Unfavorable exchange rates also reduce export competitiveness, directly affecting container throughput revenue and port revenue. Similarly, high inflation rates increase operational and maintenance costs for shipping companies and port authorities, thereby reducing profit margins and weakening overall industry performance. Inflation also diminishes consumer purchasing power and raises the cost of imported spare parts, fuel, and shipping equipment, further eroding the sector's profitability.

In parallel, the blue economy represented in this study by fisheries, aquaculture, and desalination exerts a strong influence on the shipping industry's financial indicators. Fisheries and aquaculture activities generate cargo transported via shipping lines, thereby increasing container throughput and enhancing port revenue. Desalination, as a component of sustainable maritime activities, supports port and shipping operations by ensuring a reliable supply of freshwater, which can help reduce long-term operational costs and improve efficiency in shipping logistics.

Beyond these sectoral drivers, institutional and structural factors such as trade freedom and the labour force also shape financial outcomes in the maritime sector. Higher trade freedom facilitates smoother cross-border transactions, lowers trade barriers, and boosts cargo volumes, which in turn improve shipping revenues and port efficiency. However, the benefits of trade liberalization are often constrained in Nigeria by exchange rate misalignments and inflationary pressures that reduce the competitiveness of exports. Likewise, the size and productivity of the labour force influence the industry's cost efficiency and capacity to absorb trade expansion. A skilled and abundant workforce lowers operational bottlenecks, enhances port logistics, and contributes to long-term financial stability in the shipping industry.

Furthermore, the financial performance of the shipping industry is captured through three primary indicators: container throughput revenue, shipping costs, and port revenue. These variables serve as the dependent outcomes within the model and are influenced not only by external macroeconomic variables (such as exchange rate volatility, nominal exchange rate, inflation rate, and trade freedom) but also by the internal growth of blue economy sectors (such as fisheries, aquaculture, and desalination) and structural factors like the labour force. The framework incorporates a dynamic econometric perspective by accounting for the lagged effects of these explanatory variables. This means that past values of exchange rate volatility, inflation rate, labour productivity, and blue economy activities continue to influence current performance indicators, reflecting the delayed nature of economic adjustments within the shipping industry.

In conclusion, the framework adopted for this study tries to demonstrates that the financial performance of the shipping industry is shaped by a combination of macroeconomic instability, institutional trade conditions, labour force dynamics, and sectoral economic development. Effective management of exchange rate and inflation risks, promotion of trade freedom, optimization of labour force capacity, and strategic development of blue economy sectors are thus assumed in the study to be essential for enhancing maritime financial performance and long-term sustainability.

2.4 Theoretical Review

2.4.1 Performance Theory

Performance Theory, originally developed by Richard Schechner in 1988, provides a compelling framework for understanding how symbolic, structural, and behavioral elements influence economic outcomes. When applied to Nigeria's shipping industry within the context of blue

economy development, it reveals how exchange rate volatility and institutional dynamics affect the sector's financial performance (Schechner, 1988; Schechner, 2023). According to the theory, economic actions such as trade flows, shipping logistics, and policy execution can be interpreted as performances enacted by institutions on defined "stages" like ports, trade corridors, and maritime infrastructure. These performances are governed by existing "scripts" policy decisions, operational norms, and historical practices and are continuously shaped by audience responses, including investors, regulators, and international stakeholders, Fligstein, (2001).

In this context, exchange rate volatility becomes more than a macroeconomic variable it becomes a disruptive force on the maritime stage. A depreciation of the naira inflates the cost of essential shipping inputs such as imported marine equipment, foreign-denominated freight charges, and port handling services. These increased operational costs undermine the shipping industry's "performance," diminishing its ability to attract trade flows and foreign investment. In performance terms, the shipping sector appears under-resourced and uncoordinated its "costumes and props" ill-fitted for a global audience (Schechner, 2023; Arowolo et al., 2022). Conversely, a brief appreciation of the naira may reduce import costs and temporarily improve shipping margins, but without sustained exchange rate stability, these financial gains are unreliable and do not foster long-term investor confidence.

A mathematical model of Performance Theory helps quantify how internal capabilities, strategic actions, and external conditions affect the performance of a firm or industry. This model is particularly useful in assessing financial performance in sectors like shipping, where multiple variables interact dynamically. FP = f (C, S, E), where: FP = Financial Performance, C = Internal Capabilities (e.g., capital structure, human resources, technology adoption), S = Strategic

Actions (e.g., investment, innovation, diversification, cost control), E = External Environment (e.g., exchange rate volatility, policy stability, inflation, infrastructure).

Performance Theory also illuminates how the blue economy comprising sectors such as fisheries, marine tourism, aquaculture, and coastal transport interacts with the shipping industry to co-create Nigeria's economic image on the global stage. When exchange rate instability leads to increased maritime logistics costs, blue economy exports become less competitive. For instance, the rising cost of shipping aquaculture products may deter international buyers, weakening Nigeria's overall trade performance. In symbolic terms, the country fails to "deliver its lines" in a globally competitive script, diminishing its relevance in international trade and maritime partnerships (Okafor & Ezenwa, 2023).

Further, the performance lens highlights regional competition as a dynamic theatre of rival actors. Countries like Ghana, with more stable currencies and consistent maritime policies, deliver smoother and more coherent performances, drawing trade, investment, and credibility away from Nigeria. The resulting shift in stakeholder attention can severely limit Nigeria's shipping market share and threaten the financial resilience of its maritime institutions (Bello & Gbadamosi, 2023).

At the core of Performance Theory is the idea that social and institutional actions follow a structured format involving key elements: the script (policy frameworks), performers (government and private actors), audience (stakeholders and global markets), stage (ports and maritime infrastructure), and timeline (economic cycles and policy windows). When these components are out of sync such as unclear policy directives, weak institutional capacity, or mismatched stakeholder expectations the national performance falters. A poorly managed currency devaluation or inconsistent trade policy is not merely a technical failure but a symbolic

breakdown, signaling unreliability and undermining Nigeria's financial and economic positioning (Schechner, 2018; Ojo & Akinyemi, 2024).

Moreover, institutional habits and bureaucratic inertia what Schechner terms "restored behavior" often dictate how Nigerian maritime bodies respond to crises. These ritualized responses may no longer suit the fluid demands of a globally integrated blue economy. To shift the narrative, Nigerian maritime institutions must adopt proactive strategies, modernize operations, and revise outdated "scripts" to improve their performances in front of both domestic and international audiences, Okene et al. (2023).

In conclusion, Performance Theory offers a rich interpretive framework for analyzing how exchange rate volatility and blue economy dynamics affect the financial performance of Nigeria's shipping industry. It shows that economic behavior is not merely technical but performative shaped by perception, alignment, and credibility. For Nigeria to secure a sustained and competitive presence in the global maritime economy, it must focus on rehearsing a more coordinated and transparent performance**.** This includes aligning policy frameworks with institutional behavior, ensuring stable macroeconomic conditions, and fostering investor trust through predictable and effective governance. Only then can Nigeria's shipping sector deliver a performance that commands attention and generates enduring financial success (Fligstein, 20021: UNCTED, 2021: World Bank, 2020).

2.4.2 The Sustainable Ocean Governance Theory

The Sustainable Ocean Governance Theory provides important insights into how governance structures, policies, and stakeholder coordination affect the financial performance of Nigeria's shipping industry, especially as the country advances its blue economy. Sustainable Ocean

Governance Theory has evolved over time through interdisciplinary contributions from fields like marine policy, environmental science, and international law. Key contributions came from Svein et.al. 2009, emphasizing interactive governance that is inclusive, adaptive, and multi-level for sustainable marine and coastal resource management. This theory, grounded in principles such as those from the Lisbon Principles, advocates for integrated, equitable, and ecosystem-based management of ocean resources (Okene et.al. 2023). It stresses the need for clear policies, inclusive governance frameworks, and effective stakeholder engagement to ensure sustainable use of marine assets (National Hydrographic Agency, 2024).

In the Nigerian context, exchange rate volatility significantly influences the costs faced by the shipping industry. When the naira depreciates, the cost of importing essential goods such as marine equipment, fuel, and logistics services rises, increasing operational expenses (Okene et al., 2023). These increased costs challenge the governance institutions responsible for maintaining efficient maritime operations and undermine the financial performance and international credibility of Nigeria's shipping sector (Olisa Agbakoba Legal, 2024). Conversely, a stable or appreciating naira can reduce import costs and improve profit margins for shipping companies. However, without strong governance reforms such as the implementation of coherent marine spatial planning and regulatory oversight these economic gains tend to be short-lived (Nigerian Maritime Administration and Safety Agency, 2024).

The blue economy itself, encompassing fisheries, aquaculture, marine tourism, and offshore energy sectors, depends heavily on effective ocean governance. Weak regulations and fragmented policies fail to support sustainable development and can hinder the shipping industry's competitiveness (UNCTAD, 2021). For instance, rising shipping costs driven by poor governance and currency fluctuations may render Nigerian fish and aquaculture exports

uncompetitive, discouraging international buyers and weakening Nigeria's position in the global blue economy (Olisa Agbakoba Legal, 2024).

Sustainable Ocean Governance Theory also sheds light on regional competition. Neighboring countries like Ghana, with more stable currencies and coherent maritime policies, often provide a more reliable environment for shipping and trade. This can attract shipping demand and investment away from Nigeria, further eroding its market share and threatening the financial health of its maritime sector (Okene et al., 2023). A mathematical model of Sustainable Ocean Governance (SOG) helps quantify how various interacting components (ecological, institutional, social, and economic) can be balanced for long-term ocean health and human benefit. Below is a conceptual mathematical model that synthesizes these interactions:

$$SOG = f(E, I, S, Ec, R)$$

Where: SOG: Level of Sustainable Ocean Governance, E: Environmental sustainability indicators (e.g., biodiversity, pollution control), I: Institutional strength (e.g., legal frameworks, enforcement capacity), S: Stakeholder participation (e.g., coastal communities, NGOs, private sector), Economic sustainability (e.g., blue economy growth, fair resource allocation), and, R: Resilience and adaptability (e.g., climate response, ecosystem-based management). In the context of Nigeria, sustainable ocean governance can provide a mechanism for integrating the interests of port authorities, shipping companies, fishing communities, and offshore oil operators under a unified framework that prioritizes sustainability and equity (African Union, 2020).

While, Sustainable Ocean Governance Theory is largely qualitative, it can be connected to economic modeling through bioeconomic frameworks such as the Gordon-Schaefer model. In this context, the profit of shipping and fisheries operations depends on revenue from exports and

costs influenced by both exchange rate volatility and governance effectiveness (World Bank, 2021). Governance factors such as regulatory clarity, enforcement efficiency, and marine spatial planning directly affect operational costs and revenue stability. Strong governance can reduce costs and stabilize revenues, leading to improved financial performance (National Hydrographic Agency, 2024).

Nigeria has been making efforts to improve ocean governance by establishing institutions like a National Coast Guard, adopting marine policies, and enhancing enforcement mechanisms. These initiatives aim to mitigate the financial risks posed by exchange rate volatility by improving port efficiency and institutional responsiveness. Moreover, they seek to build stakeholder confidence and attract sustainable financing options, such as blue bonds, to fund maritime infrastructure and conservation efforts (Nigerian Maritime Administration and Safety Agency, 2024; Olisa Agbakoba Legal, 2024).

In conclusion, Sustainable Ocean Governance Theory highlights those stable economic conditions alone are not enough to ensure a thriving shipping industry integrated within a sustainable blue economy. Robust governance frameworks and policy coherence are essential. Exchange rate volatility and blue economy development impact the shipping industry's financial performance, but their effects are mediated by the quality of governance. To build a financially resilient and competitive maritime sector, Nigeria must strengthen its governance institutions, ensure policy transparency, and foster coordinated implementation across blue economy sectors. Only by doing so can the country secure a sustainable and prosperous role in the global maritime arena (UNCTAD, 2021; World Bank, 2020; Okene et al., 2023).

2.4.3 Purchasing Power Parity (PPP) Theory

The Purchasing Power Parity (PPP) theory, originally proposed by Gunter Cassel in 1981, offers valuable insights into how exchange rate volatility impacts the financial performance of Nigeria's shipping industry, particularly as the country develops its blue economy (Cassel, 1981; Alagidede & Ibrahim, 2017). According to PPP, exchange rates should adjust in response to differences in the price levels of goods and services between countries, maintaining parity in purchasing power. In practice, when inflation rates or relative prices shift, currency values change, which in turn affects trade flows and, consequently, the performance of shipping and maritime logistics, Bahmani et.al. (2009).

In Nigeria, the PPP framework is useful for understanding how shifts in the value of the naira especially against major trade currencies like the U.S. dollar or the euro affect the cost structure of the shipping industry (Akinbobola, 2012). A depreciation of the naira increases the cost of importing foreign goods and services, including freight rates, marine equipment, and port logistics, most of which are priced in foreign currencies. This rise in costs may discourage imports, reduce shipping volumes, and ultimately lower revenue for shipping companies and port authorities (Ogunleye, 2010).

On the flip side, when the naira appreciates, the cost of imports may decrease, potentially encouraging greater trade activity. Increased import volumes translate to higher shipping demand and improved financial performance for maritime logistics providers. However, such gains are often unstable in the face of persistent currency volatility and inflationary pressures, which distort pricing, erode competitiveness, and introduce uncertainty into shipping operations and long-term investment planning (Oladipo, 2007).

The PPP theory also highlights the interconnectedness of consumer demand, pricing, and international trade flows, all of which are central to the blue economy's performance. Nigeria's blue economy sectors such as fisheries, aquaculture, desalination, and marine tourism are increasingly tied to global markets. As exchange rate induced price shifts affect the affordability and competitiveness of Nigeria's blue economy exports, the downstream effects ripple into the shipping industry. For instance, if fish or aquaculture products become too expensive due to costlier shipping or input inflation, foreign demand may fall, reducing export volumes and limiting growth in shipping revenue (Adegbite & Masha, 2021).

Furthermore, regional competitors may gain an edge if their currencies remain more stable. Neighboring countries like Ghana could experience increased demand for their exports and shipping services, drawing trade away from Nigeria. This would lead to a loss of shipping market share for Nigerian ports and logistics operators, further straining the financial health of the domestic maritime sector (Kutu & Ngalawa, 2016).

The central postulation of the PPP theory is that, in the absence of transportation costs and trade barriers, the same basket of goods should have the same price across countries when expressed in a common currency. This forms the basis of the Law of One Price, Krugman, et.al, (2018). There are two main forms of PPP: Absolute PPP and Relative PPP. Absolute PPP suggests that the nominal exchange rate between two countries should equal the ratio of their overall price levels. For example, if a standardized basket of goods costs ₦100 in Nigeria and $1 in the United States, the PPP exchange rate should be ₦100 per $1. This relationship is expressed mathematically as:

$$E=\frac{Pd}{Pf}$$

Where E is the exchange rate (domestic currency per unit of foreign currency), Pd is the domestic price level, and Pf is the foreign price level.

Relative PPP, by contrast, focuses on the rate of change in prices over time and its impact on exchange rate movements. It posits that the rate of depreciation or appreciation of a currency is determined by the difference in inflation rates between two countries (Froot & Rogoff, 1995). Mathematically, it can be expressed as:

$$\frac{Et}{Eo} = \frac{(1+\pi d)}{(1+\pi f)} \text{ or approximately } \Delta E \approx \pi d - \pi f$$

Where Et and Eo are the exchange rates at time t and time 0 respectively, and πd and πf are the inflation rates in the domestic and foreign economies.

The PPP theory relies on several simplifying assumptions: the absence of transportation and transaction costs, the non-existence of trade barriers such as tariffs or quotas, the presence of homogeneous and perfectly substitutable goods, and the existence of competitive and efficient markets where prices adjust rapidly (Rogoff, 1996). Furthermore, it assumes stable economic conditions and similar consumer preferences across countries.

While, these assumptions often do not hold particularly in developing countries like Nigeria, where inflation, currency controls, and trade distortions are common PPP remains a useful theoretical benchmark for evaluating long-term exchange rate behavior.

In the Nigerian context, PPP provides insights into how fluctuations in the exchange rate, especially between the naira and major currencies such as the U.S. dollar or the euro, affect the financial performance of the shipping industry and broader blue economy. A depreciation of the naira, often driven by domestic inflation, increases the cost of imported maritime goods and

services, such as freight charges, ship maintenance equipment, and port logistics (Akinlo & Apanisile, 2015). This escalation in operational costs can reduce trade volumes and shrink the revenue base of shipping companies and port authorities.

On the other hand, appreciation of the naira may reduce the cost of imports, potentially encouraging trade and increasing shipping volumes. However, the instability of Nigeria's currency, combined with inflationary pressures, often distorts prices and hampers competitiveness, leading to uncertainty in investment planning and maritime operations (Enebeli & Uzor, 2020).

Moreover, the PPP framework emphasizes the interconnectedness between price levels, consumer demand, and international trade flows all of which are integral to the blue economy. As Nigeria's maritime industries including aquaculture, fisheries, marine tourism, and offshore resource management become increasingly integrated with global markets, exchange rate-induced price volatility can affect their global competitiveness. Higher input costs may lead to reduced export volumes, affecting shipping demand and undermining growth (UNCTAD, 2020). Furthermore, regional competitors with more stable currencies, such as Ghana, may attract increased shipping demand and trade flows, eroding Nigeria's market share in the West African maritime corridor.

In conclusion, the purchasing power parity (PPP) theory provides a useful framework for analyzing how exchange rate volatility and price-level changes impact the shipping industry's financial performance in Nigeria, particularly within the broader blue economy context. To stabilize trade flows and sustain maritime sector profitability, policies aimed at controlling inflation, reducing currency fluctuations, and strengthening local blue economy industries are

essential. Such measures will help Nigeria's shipping sector remain competitive and financially resilient in an increasingly globalized trade environment. (Akinlo & Apanisile, 2015).

2.4.4 Traditional Flow Theory

The Traditional Flow Theory emerged from classical trade theory and was shaped by economists such as Robert Mundell and Marcus Fleming**,** and later elaborated upon by scholars like Paul Krugman and Maurice Obstfeld in the context of open economy macroeconomic models. The Traditional Flow Theory provides a foundational framework for understanding how exchange rate volatility and trade dynamics influence the financial performance of the shipping industry in Nigeria, especially within the context of the growing blue economy (Mundell, 1963; Dornbusch, 1976; Krugman et.al. 2018). This theory posits that a country's exchange rate is closely linked to its trade balance: trade surpluses tend to appreciate a nation's currency, while trade deficits typically lead to depreciation (Krugman et al., 2018).

For Nigeria, where the economy heavily depends on the export of oil, agricultural commodities, and increasingly, marine-based products from the blue economy (such as fish and seafood), fluctuations in the trade balance directly impact the naira's exchange rate (Okonkwo & Ukeje, 2015). When the value of exports declines whether due to falling global demand, commodity price shocks, or operational bottlenecks Nigeria's trade deficit may widen. This puts downward pressure on the currency, making shipping services more expensive, particularly those priced in foreign currencies. As foreign shipping companies adjust their rates to cover exchange rate losses, Nigerian shippers and importers face increased costs, reducing the profitability of maritime trade Adegbite, et.al. (2021).

The shipping industry, which serves as a logistical backbone for international trade, is highly sensitive to these changes. As shipping services become more expensive due to currency depreciation, import volumes may decline, which in turn affects shipping company revenues and port activity. These fluctuations in trade flows driven by exchange rate instability make it harder for shipping firms to plan investments or maintain steady income, increasing the sector's financial risk (Onyemaechi, 2020).

This theory is rooted in classical demand and supply dynamics in the foreign exchange market, where trade flows directly impact the availability of foreign currency. Exports generate a supply of foreign exchange, while imports create a demand for foreign currency. Thus, the trade balance plays a central role in determining the direction of exchange rate changes.

Mathematically, the theory can be expressed through a basic equilibrium condition in the foreign exchange market. The demand for foreign exchange (which arises from imports) is denoted as: $D_{FX,}$ and the supply of foreign exchange (arising from exports) is denoted as S_{FX}. At equilibrium, the following condition holds:

$$D_{FX} = S_{FX}.$$

This implies that the value of imports (M) must equal the value of exports (X) for the exchange rate to remain stable. When imports exceed exports (i.e., when M>X), the resulting trade deficit creates excess demand for foreign currency, leading to a depreciation of the domestic currency. Conversely, when exports exceed imports (i.e., X > M), the resulting surplus leads to excess supply of foreign currency and appreciation of the domestic currency.

This relationship can also be written as:

$$\frac{dE}{dt} = f(X-M)$$

Where $\frac{dE}{dt}$ represents the rate of change in the exchange rate over time, and X− M is the trade balance. A negative trade balance (X< M) implies that $\frac{dE}{dt} > 0$ meaning the domestic currency is depreciating. A positive balance (X>M) indicates $\frac{dE}{dt}$ <0, signaling currency appreciation, Krugman et.al. (2018).

Furthermore, the Marshall–Lerner condition refines this theory by stating that a depreciation of the currency will only improve the trade balance if the sum of the price elasticities of exports and imports is greater than one. This condition highlights the importance of how responsive trade flows are to changes in exchange rates.

Furthermore, the Traditional Flow Theory emphasizes the role of domestic income levels in determining exchange rate movements and trade activity (Dornbusch, 1976; Krugman et. al., 2018). In Nigeria, low or unstable domestic income can suppress demand for foreign goods, leading to a decrease in import volumes. This decline reduces cargo throughput and negatively impacts shipping volumes, particularly for companies involved in containerized or bulk import logistics. Similarly, if relative prices of Nigerian goods rise on global markets due to inflation or currency misalignment, export competitiveness can decline further impacting outbound shipping volumes and weakening the financial performance of both private shipping firms and public port authorities (Onyemaechi, 2020; Adegbite et. al., 2021).

The emergence of the blue economy which includes sectors such as aquaculture, offshore energy, fisheries, desalination, and maritime tourism offers potential to diversify Nigeria's export base and enhance trade performance. However, these sectors also rely on stable exchange rates to

attract investment, import critical equipment, and participate in global supply chains. When exchange rate volatility disrupts their operations, the downstream effects are felt across the shipping industry in the form of reduced cargo volumes, delayed infrastructure development, and uncertain revenue streams (UNCTAD, 2020).

In conclusion, the Traditional Flow Theory effectively explains how exchange rate volatility, shaped by trade balances and income dynamics, directly influences the financial stability and operational performance of the Nigerian shipping industry. In the context of an expanding blue economy, mitigating currency volatility and fostering stable trade conditions are essential for enabling sustainable growth in shipping and maritime logistics (Krugman et al., 2018; UNCTAD, 2020)

2.4.5 Balance of Payments (BoP) Theory

The Balance of Payments (BoP) Theory of exchange rate determination was primarily propounded by James E. Meade in the mid-20th century. The theory posits that a country's exchange rate is fundamentally determined by the balance of its international transactions specifically, the relationship between the supply of and demand for foreign exchange arising from exports, imports, capital flows, and other external financial operations (Meade, 1951).

According to this theory, if a country experiences a BoP surplus that is, when the value of its exports exceeds its imports or when it attracts more foreign capital than it sends abroad there is increased demand for the domestic currency. This results in an appreciation of the currency. On the other hand, a BoP deficit where imports exceed exports or capital outflows surpass inflows causes a depreciation of the domestic currency due to excess demand for foreign exchange (Salvatore, 2016).

Mathematically, the exchange rate EXR (defined as the domestic currency per unit of foreign currency) can be expressed as a function of the balance of payments:

$$E=f(X-M)$$

Where:

X represents exports (inflow of foreign currency),

M represents imports (outflow of foreign currency).

If $X>M$ the BoP is in surplus, increasing the supply of foreign currency and causing the exchange rate to appreciate. If $X<M$, the BoP is in deficit, increasing demand for foreign currency and causing the exchange rate to depreciate (Krugman & Obstfeld, 2018).

In the context of Nigeria, the BoP theory offers a robust framework for understanding the persistent exchange rate volatility and its impact on key sectors, particularly the blue economy and shipping industry. Nigeria's economy is heavily reliant on oil exports and simultaneously burdened with high levels of imports, especially for industrial, maritime, and consumer goods. This structural trade imbalance often results in BoP deficits, which apply constant downward pressure on the naira, leading to repeated cycles of depreciation.

Within the blue economy, sectors such as fisheries and aquaculture are significantly affected by this currency volatility. For example, the cost of imported fish feed, hatchery equipment, and cold storage infrastructure rises sharply during periods of naira depreciation, thus eroding profit margins and making local production less competitive. While, a weaker naira could theoretically make Nigerian fish exports more attractive internationally, the sector's limited scalability and

compliance challenges with international standards reduce its ability to capitalize on such opportunities (Olaniyi et al., 2020).

Similarly, desalination projects, which are capital-intensive and depend heavily on foreign technology and finance, become more costly when the naira depreciates. The increase in the local currency value of foreign-denominated debts and operational costs inhibits project implementation and scalability. For the shipping industry, the implications are even more direct and severe. Nigerian shipping firms often lease vessels and obtain marine insurance in foreign currencies. A weaker naira raises the cost of debt servicing, vessel maintenance, and international port handling fees significantly affecting operational efficiency and financial performance. Additionally, exchange rate volatility introduces financial uncertainty, making it difficult for companies to plan investments, price services accurately, or attract foreign investors to maritime infrastructure (Okonjo-Iweala, 2021).

In conclusion, the BoP Theory, as formulated by James Meade, provides a comprehensive explanation for exchange rate movements by linking them to external trade and capital flows. Its application to Nigeria demonstrates how macroeconomic imbalances translate into currency volatility, which in turn affects the blue economy and shipping sector through increased costs, reduced investment, and financial instability. Addressing these challenges requires structural reforms that promote export diversification, reduce import dependency, and stabilize the external sector.

2.4.6 The Transaction Exposure Theory

The Transaction Exposure Theory is a fundamental concept in international finance that explains the risk firms face due to exchange rate volatility between the initiation and settlement of cross-

border transactions. This theory was notably developed and expanded by Howard E. Thompson and Michael G. Gannon in the 1970s as part of their work on managing foreign exchange risk in international business operations (Thompson & Gannon, 1977). Transaction exposure arises when a firm enters into a contractual agreement involving future cash flows either receivables or payables that are denominated in a foreign currency. If the exchange rate changes unfavorably between the contract date and the settlement date, the firm may incur financial losses, even if the underlying transaction itself remains economically sound.

This type of exposure is particularly relevant in economies like Nigeria, where currency volatility is a frequent occurrence due to macroeconomic instability, oil price shocks, and external trade imbalances. The mathematical representation of transaction exposure involves measuring the gain or loss resulting from changes in exchange rates. Let A_t represent the amount payable or receivable in foreign currency at time *t, Et* the exchange rate at the time the contract is initiated, and E_{t+1} the rate at settlement. The transaction's value in local currency at settlement is $V_{t+1}=A_t \times E_{t+1}$ and the gain or loss due to currency movement is given by $\Delta V=A_t \times (E_{t+1}-E_t)$. This formula shows that a depreciation of the domestic currency (naira) increases the cost of foreign currency payables, resulting in losses, while the reverse applies to receivables.

In the Nigerian blue economy, which includes sectors like fisheries, aquaculture, and desalination, transaction exposure has significant implications. Many inputs essential to fish farming and aquaculture, such as hatchery equipment, fish feed, and packaging materials, are imported and priced in foreign currencies. When the naira depreciates between the time of ordering and payment, these inputs become more expensive, straining operational budgets and profit margins, Olaniyi et. al., (2020). Similarly, companies involved in exporting fish or other

marine products may face unfavorable exchange rate movements that reduce the local value of export revenues if the naira appreciates after a contract has been signed.

In desalination projects, transaction exposure also arises through foreign-denominated loans or grants. If the naira weakens after the agreement but before repayment, the real cost of servicing that debt increases, potentially leading to financial stress or project delays.

The shipping industry in Nigeria is particularly vulnerable to transaction exposure due to its heavy reliance on foreign services and capital. Many shipping companies lease vessels, procure spare parts, and purchase marine insurance in U.S. dollars or euros. Naira depreciation between agreement and payment periods leads to unplanned cost increases. Additionally, while many of these firms generate revenue in local currency, their liabilities remain in foreign currency, resulting in a currency mismatch that exacerbates financial instability (Salvatore, 2016).

Another critical challenge is the limited availability of hedging instruments in Nigeria. Unlike more developed markets, most Nigerian maritime and aquaculture businesses do not have access to forward contracts, currency swaps, or options to mitigate transaction exposure. This lack of financial risk management tools amplifies their vulnerability to exchange rate shocks (Krugman & Obstfeld, 2018).

In conclusion, the Transaction Exposure Theory, as articulated by Thompson and Gannon, provides a valuable framework for understanding how short- and medium-term exchange rate volatility can directly impact the financial health of firms operating in Nigeria's blue economy and shipping sector. The theory highlights the importance of exchange rate management, access to hedging tools, and sound financial planning to protect firms from currency-related losses. Addressing transaction exposure is essential for promoting investment, reducing cost

unpredictability, and ensuring the long-term sustainability of Nigeria's maritime and aquatic industries.

2.4.7 Theoretical Framework

The Traditional Flow Theory offers a valuable lens for understanding how exchange rate volatility and blue economy activities influence the financial performance of Nigeria's shipping industry. This theory posits a direct relationship between exchange rate movements, trade balances, and the demand for foreign currency key drivers of trade volumes and shipping transport services (Acha & Acha, 2014). Given that the shipping industry is intrinsically tied to trade flows, any fluctuation in exchange rates can significantly affect its operational costs, cargo volumes, and profitability.

In Nigeria, the economy is heavily dependent on the export of crude oil, agricultural products, and increasingly, marine resources tied to the blue economy, such as fisheries and aquaculture. When the naira depreciates due to trade deficits or macroeconomic instability, the cost of importing goods along with shipping services often priced in foreign currencies rises. This drives up operational costs for shipping companies, reduces import volumes, and negatively affects profitability (Ayodele, 2004). Conversely, favorable exchange rates can enhance affordability of imports, potentially increasing trade volumes and stimulating demand for shipping and port services.

The shipping industry also plays a critical role in supporting and benefiting from Nigeria's expanding blue economy sectors. As activities like fisheries, aquaculture, offshore energy, and coastal tourism grow, they generate increased demand for specialized maritime logistics, cold chain services, and intermodal transportation. However, this growth potential is undermined

when exchange rate volatility creates uncertainty in project financing, inflates costs of imported maritime equipment, or discourages foreign investment in port and shipping infrastructure.

The Traditional Flow Theory also highlights how broader macroeconomic variables such as domestic income levels and relative price changes interact with exchange rate movements to influence trade flows and shipping activity. For instance, a rise in Nigeria's domestic income may boost demand for imported consumer goods, increasing shipping volumes. Similarly, volatility in global demand for Nigeria's oil and marine exports directly affect outbound cargo levels, shaping the operational and financial dynamics of shipping companies (Davis et al., 2015). The shipping industry, acting as the logistical backbone of international trade, is acutely sensitive to currency instability. When exchange rates fluctuate sharply, shipping firms face unpredictable operational costs, making it difficult to plan budgets, service foreign-denominated loans, or hedge financial risks. For instance, fuel costs, insurance premiums, and port fees many of which are settled in US dollars can rise steeply with a depreciating naira, thereby undermining the industry's financial sustainability (CBN, 2022).

The theory posits that a nation's exchange rate responds directly to the net flow of goods and services across its borders. Specifically, when a country experiences a trade surplus meaning it exports more than it imports the value of its currency tends to appreciate. Conversely, when it faces a trade deficit, the demand for foreign currency exceeds its supply, causing the domestic currency to depreciate (Mundell, 1963; Dornbusch, 1976).

In the context of Nigeria, the Traditional Flow Theory offers important insights into how exchange rate volatility impacts the shipping industry and the broader blue economy. Nigeria's economy is heavily reliant on the export of crude oil, agricultural commodities, and increasingly,

marine-based products such as seafood and aquaculture goods. Any decline in export earnings whether due to falling global demand, lower commodity prices, or domestic supply constraints tends to widen the trade deficit. This leads to increased demand for foreign currency and a depreciation of the naira, Nigeria's currency (Okonkwo & Ukeje, 2015).

As the naira depreciates, the cost of imported goods and services rises. This is particularly significant for the shipping industry, which depends on foreign-denominated payments for vessels, port logistics, freight rates, and marine equipment. Increased operational costs are passed on to importers and shippers, leading to reduced profitability and lower shipping volumes, Adegbite et.al. (2021). This also affects port revenues and investment planning, as firms find it more difficult to forecast income in an unstable currency environment.

The Traditional Flow Theory also emphasizes the influence of domestic income levels on trade activity and exchange rate behavior. In Nigeria, unstable or declining incomes reduce consumer demand for imported goods, which in turn decreases import volumes. This has a negative impact on cargo throughput and revenue for shipping companies, especially those engaged in containerized and bulk imports. Similarly, when inflation or currency misalignments make Nigerian exports more expensive on global markets, export competitiveness declines, leading to reduced outbound shipments and financial strain on maritime logistics providers (Onyemaechi, 2020).

By analyzing trade and currency flows through the lens of the Traditional Flow Theory, stakeholders can better understand how exchange rate volatility and blue economy dynamics collectively impact shipping performance. Empirical evidence supports the view that volatility in exchange rates directly influence trade volumes and shipping demand (Das & Das, 2012). This

makes the theory particularly relevant for Nigeria, where the integration of blue economy strategies with a volatile macroeconomic environment requires coordinated policy efforts to stabilize currency, support infrastructure development, and enhance sectoral resilience.

The Traditional Flow Theory provides a robust framework for analyzing how exchange rate volatility and the evolving blue economy affect the financial performance of Nigeria's shipping industry. The theory underscores the need for stable macroeconomic policies and strategic investments to mitigate currency risks and unlock the full potential of shipping as a driver of sustainable economic growth.

2.5 Empirical Review

2.5.1 Exchange Rate Volatility and Shipping Industry Financial Performance in Nigeria

Adewuyi & Adefolami (2021) explored the relationship between exchange rate volatility and port throughput, a key determinant of financial performance in the shipping sector from 2000 to 2020. Using ARDL modeling, they found that exchange rate volatility had both immediate and lagged effects on cargo volume, impacting revenue generation and cost structures of shipping companies. The study emphasized that stable exchange rate regimes are essential to harness the economic potential of Nigeria's blue economy.

Adeyemo, et al., (2020) focused on the relationship between exchange rate volatility and the financial performance of firms in the transport and logistics sector, which includes shipping companies from 2005 to 2019. The employed panel data regression analysis to assess the effect of exchange rate volatility on the financial performance of transport and logistics firms. The study found that exchange rate volatility negatively affects profitability, as fluctuations in the

exchange rate increase the cost of doing business for shipping firms. The study highlighted that firms often struggle to manage the financial risks associated with currency fluctuations, leading to reduced profitability and potential bankruptcy in extreme cases.

Ahmad & Wazir (2017) investigated the impact of exchange rate volatility on the financial performance of shipping companies in Pakistan from 2006 to 2016. The study utilized time series econometric analysis, particularly autoregressive distributed lag (ARDL**)** models. Their findings suggest that exchange rate volatility has a significant negative impact on the financial stability of shipping companies, particularly in terms of revenue generation and operational costs.

Akpan & Essien (2018) conducted a study spanning the period 2010 to 2017 on the dynamics of transport costs in Nigeria, with a specific focus on the effects of exchange rate fluctuations on logistics and shipping operations. The researchers adopted a quantitative approach, using time-series econometric analysis of import data, exchange rate trends, and sectoral cost indices. Supplementary data were also gathered from port authorities and maritime service providers. Their findings revealed that over 70% of the inputs used in Nigeria's transport sector including spare parts, heavy equipment, and petroleum products were imported and denominated in U.S. dollars. As a result, naira depreciation significantly increased the cost of transport services, particularly affecting the affordability of maritime logistics, vessel maintenance, and shipping operations.

Alege et al. (2016) conducted a macroeconomic study on the impact of exchange rate volatility on investment and sectoral productivity in Nigeria, covering the period from 1981 to 2014. The study employed econometric modeling techniques, specifically a vector autoregressive (VAR) framework and generalized method of moments (GMM), to assess how fluctuations in the naira

affected key economic sectors. Their findings showed that persistent exchange rate instability significantly dampens investment confidence and reduces sectoral productivity, especially in import-dependent sectors such as transportation, and maritime logistics

Alizadeh & Nomikos (2007) conducted a quantitative study analyzing the impact of exchange rate fluctuations on tanker freight rates, using data from 1985 to 2005. The researchers employed a Vector Error Correction Model (VECM) to examine the long-run and short-run dynamics between exchange rate movements and freight market performance. Their findings showed that freight markets are highly sensitive to exchange rate changes, particularly in emerging market economies where shipping transactions are typically conducted in foreign currencies (such as USD).

Asongu et al. (2020) conducted a cross-country panel study spanning 2010 to 2018 involving African coastal states to analyze the impact of sustainable marine policies and currency stability on maritime economic outcomes. Using panel data econometric techniques, including fixed and random effects models, the study examined how governance quality and exchange rate stability influence the performance of maritime sectors across different countries. Their findings reveal that the implementation of sustainable marine policies, combined with currency stability, significantly enhances economic outcomes by promoting environmental sustainability and improving the financial performance of maritime industries.

Botteboom & Rodrigue (2020) conducted a global review study on exchange rate volatility on financial performance in the shipping industry, synthesizing empirical and theoretical research covering the period from 2000 to 2020. Their work employed a meta-analytical and comparative methodological approach, drawing from case studies, industry data, and economic models across

major shipping regions (Asia, Europe, North America, and selected developing economies). Their findings highlighted that shipping sector performance is increasingly influenced by a triad of macroeconomic, technological, and regulatory factors:

Chang et al. (2018) conducted a regional empirical study to assess the impact of exchange rate volatility on container freight rates and shipping firm performance in South Korea and Taiwan**,** two major maritime economies in East Asia. The study covered the time period from 2000 to 2016. Using a dynamic panel model, specifically the Generalized Method of Moments (GMM) estimator, the authors examined how fluctuations in the exchange rate particularly depreciation against the U.S. dollar affected freight rates, cargo volumes, and financial indicators such as return on assets (ROA) for shipping companies. Finding revealed that Currency depreciation led to higher import costs, which in turn reduced shipping volumes as trade slowed.

Eze & Uchenna (2021) conducted a firm-level financial analysis to examine the effects of exchange rate volatility on the profitability of Nigerian shipping companies. The study covered the period from 2013 to 2020 and focused on five major shipping firms listed on the Nigerian Exchange Group (NGX). Using panel regression analysis, the researchers assessed the relationship between foreign exchange losses and profit margins, drawing data from audited financial statements, annual reports, and industry disclosures. Their findings revealed that foreign exchange losses driven by naira depreciation were consistently among the top contributors to profit margin erosion. The study emphasized that operating expenses increased significantly for shipping lines with dollar-denominated obligations, including vessel leases, insurance premiums, and bunker fuel procurement.

Ezeaku et al. (2018) conducted a sectoral analysis covering the period from 2000 to 2016 to examine the impact of exchange rate volatility on the performance of key Nigerian shipping industries. Using econometric models with a focus on time-series analysis, the study found that shipping firms are particularly vulnerable to unpredictable exchange rate fluctuations, which lead to higher operating costs, increased uncertainty, and reduced profit margins**.** The findings highlight the significant financial challenges faced by shipping companies in managing currency risks within Nigeria's volatile macroeconomic environment.

Glen & Martin (2005) conducted a comprehensive study examining the impact of foreign exchange volatility on the financial performance of shipping firms listed on the London and Singapore stock exchanges. The research covered a 10-year period from 1994 to 2004 and employed panel econometric techniques, particularly regression analysis, to investigate the relationship between exchange rate fluctuations and key performance indicators such as return on equity (ROE). The findings revealed a statistically significant negative correlation between foreign exchange volatility and ROE in shipping companies operating across multiple currency zones. Firms that lacked exposure management strategies were more vulnerable to profit erosion during currency shocks.

Hoffmann & Kumar (2010) conducted a regional empirical study assessing the impact of exchange rate fluctuations on port performance in Latin America and the Caribbean. The study covered data from 1995 to 2008 and utilized cointegration and error correction models (ECM) to analyze the long-run and short-run dynamics between exchange rate movements and port throughput. Their findings indicated that a 1% depreciation in local currency was associated with a 0.6% decline in port throughput. This decline was attributed to the rising cost of imports, which discouraged trade activity and led to reduced volume of cargo handled at ports. Consequently,

port authority revenues were negatively affected, and shipping lines experienced reduced economies of scale, impairing profitability.

Hummels et al. (2007) conducted a comprehensive global study on the relationship between international trade costs, logistics, and exchange rate volatility, focusing on how currency fluctuations influence the cost structures of traded goods. The study analyzed data from 1990 to 2005, covering 90 countries, including developing economies in sub-Saharan Africa. Using panel regression modeling, the authors examined how exchange rate depreciation influences freight pricing behavior and shipping demand. Their findings revealed that when local currencies depreciate, shipping firms often increase freight rates to offset the potential value erosion caused by foreign exchange losses. This is particularly common in long-haul and containerized shipping.

Ijjo & Olaoluwa (2019) analyzed the effect of exchange rate fluctuations on the shipping industry in Nigeria from 2008 to 2018. The authors employed time-series econometric analysis**,** specifically using Ordinary Least Squares (OLS) regression and GARCH models to assess the impact of exchange rate volatility on the financial performance of Nigerian shipping firms. Their results revealed a strong negative relationship between exchange rate volatility and the financial performance of Nigerian shipping companies. The researchers found that Nigerian shipping firms were adversely affected by exchange rate volatility due to the increase in the cost of imported goods and services necessary for their operations.

Kilian & Zhou (2019) conducted a panel data study covering 28 OECD countries to analyze how exchange rate shocks are transmitted to freight rates and revenues in the maritime shipping sector. The study covered the period from 1995 to 2017, focusing on two major shipping segments: dry bulk carriers and container liners. Using panel regression analysis and structural vector

autoregression (SVAR) models, the researchers evaluated how short-term and long-term exchange rate fluctuations influenced the pricing behavior, freight rate volatility, and corporate earnings of shipping firms. Finding showed that Short-term exchange rate volatility was found to be more disruptive to dry bulk carriers compared to container shipping lines.

Lee et al. (2020) conducted a microeconomic study analyzing firm-level data from 160 shipping companies spanning Europe and Asia between 2010 and 2018. The study aimed to assess how foreign exchange risk affects the profitability of shipping firms operating in multiple currency environments. Using panel regression models with firm fixed effects, combined with data on currency fluctuations and firms' financial statements, the authors evaluated the relationship between exchange rate volatility and key financial indicators such as working capital requirements**,** access to external credit**,** and earnings before interest and taxes (EBIT**)**. Findings: A high degree of exchange rate volatility significantly increased the working capital needs of shipping firms due to cash flow uncertainties.

Obadan & Omoruyi (2021) conducted an evaluative study on the impact of exchange rate instability on Nigeria's transport infrastructure projects between 2015 and 2020**.** The study utilized a mixed-methods approach combining **a**nalysis of project financial records**,** government budget reports**,** and interviews with key stakeholders involved in major infrastructure developments. Finding revealed that Periods of exchange rate volatility contributed to significant delays in funding disbursements for flagship projects such as the Lagos-Ibadan railway**,** Lekki Deep Seaport**,** and various port terminal upgrades.

Ojo & Olajide (2019) investigated how exchange rate volatility influenced the operational strategies of Nigerian shipping companies from 2010 to 2018. Qualitative analysis combined

with case studies of Nigerian shipping companies, focusing on their operational responses to exchange rate volatility, particularly the use of hedging strategies. Their study found that shipping companies often adopt hedging strategies to mitigate the adverse effects of currency fluctuations. However, despite these efforts, exchange rate volatility still resulted in financial strain and challenges in managing operational costs, as these strategies did not fully shield companies from currency risks.

Okene, et al. (2024) examined Effects of Exchange Rate Volatility on Maritime Trade Sector in Nigeria. The objective of this study is to examine the effects of exchange rate volatility on maritime trade volume in Nigeria. Maritime trade volume (proxied by seaborne exports and seaborne imports) act as the independent variable while exchange rate volatility serves as the independent variable with money supply depth and total government expenditure acting as control variables. The study used the GARCH modeling technique combined with the ARDL bounds testing approach to examine the secondary time series data sourced from Nigeria Ports Authority and CBN Statistical Bulletin for the period 1995 to 2022. The findings of the study indicate that exchange rate volatility has no significant effect on maritime trade volume both in the short-run and long-run and it was recommended that the government of Nigeria should diversify the economy and encourage the domestic production of goods that are currently imported as this will revitalize the real sector and stabilize the exchange rate.

Okonkwo & Ugochukwu (2021) examined the impact of exchange rate dynamics on the profitability of Nigerian shipping firms over the period 2012 to 2020. The study employed panel regression analysis using financial data from a sample of listed shipping companies. Consequently, finding revealed that volatility adversely affected the financial performance of shipping firms, emphasizing the need for effective exchange rate risk management strategies.

Olayemi & Okpara (2021) investigate the effects of the naira's persistent volatility on the cost structure and profitability of logistics firms involved in desalination-related supply chains in Nigeria, analyzing data from 2012 to 2020. Employing a quantitative econometric methodology, which includes regression analysis of import costs, exchange rate fluctuations, and firm profitability metrics, the study demonstrates that currency instability significantly increases the import costs of desalination equipment and marine chemicals. This dynamic reduces the profitability of shipping firms, as they face the challenge of fixed contract rates while input costs fluctuate, leading to an erosion of profit margins. The findings highlight the critical impact of macroeconomic instability on the financial viability of maritime logistics linked to desalination projects.

Olayiwola et.al. (2019) conducted a sector-specific analysis on how macroeconomic instability influences shipping firms' financial outcomes in Nigeria from 2018 to 2024. Econometric analysis focused on the impact of macroeconomic instability, specifically foreign exchange fluctuations, on shipping firms' financial performance in Nigeria. Their finding revealed that naira depreciation against the U.S. dollar and euro adversely affects input costs (e.g., spare parts, bunker fuel, insurance premiums) and ultimately reduces profitability. Their study concluded that foreign exchange risk is a major determinant of financial instability within the Nigerian maritime sector.

Onwuka (2022) investigated the impact of exchange rate fluctuations on Nigeria's fish import bill from 2012 to 2021. The study utilized a GARCH (1,1) model to analyze the volatility and dynamic relationship between the naira exchange rate and the cost of importing frozen fish and aquaculture inputs, including feeds and hatchery equipment. Consequently, the study noted a

reduction in maritime trade volumes related to aquaculture, reflecting a dampened demand for shipping services in this sector.

Osho & Fagbamila (2022) examined the effect of exchange rate fluctuation economic factors on financial performance of multinational companies in Nigeria. It specifically examined the effect of nominal exchange rate, real exchange rate, exchange rate as well as exchange rate fluctuations on the financial performance of listed multinational oil and gas firms in Nigeria performance of deposit money banks in Nigeria. Secondary sources of data were employed to extract useful information from the Audited Annual Reports of the eight (8) oil and gas firms sampled were selected through purposive sampling technique for the investigation for the periods 2006-2020. Correlation and regression analysis were used to test the hypothesis. Findings revealed that nominal exchange rate and interest spread rate have positive and statistically significant relationships with return on asset. The study concluded that exchange rate fluctuation economic factors have strong statistical relationship with the financial performance of listed oil and gas companies in Nigeria.

Oyekunle et.al. (2021) examined how exchange rate volatility affected the competitiveness of shipping companies in Nigeria from 2012 to 2023. Analytical study assessing exchange rate volatility effects on Nigerian shipping companies' competitiveness (likely using econometric or statistical analysis, though exact methods not specified). The study concluded that while exchange rate fluctuations could be detrimental to the financial performance of shipping companies in the short term, a depreciating naira could, in some instances, make Nigerian shipping services more competitive in international markets.

Silva & Amaral (2019) conducted a longitudinal case study examining the interaction between exchange rate regimes, fisheries policy, and maritime transport in Portugal from 2005 to 2018. The researchers employed a mixed-methods approach, combining quantitative analysis of export and shipping cost data with policy review and stakeholder interviews (including port authorities, exporters, and shipping firms). Their analysis focused on refrigerated shipping services supporting Portugal's fish export industry. The authors emphasized that long-term demand for shipping services from the fisheries sector is contingent on sustained macroeconomic support and logistics infrastructure development in shipping sector.

Stopford (2009) In his seminal work *"Maritime Economics"*, Martin Stopford provides a comprehensive analysis of how macroeconomic variables, particularly exchange rate fluctuations, affect the financial performance and investment behavior in the global shipping industry. The study analyzed historical shipping data spanning multiple decades, primarily from the 1970s to the early 2000s, focusing on major shipping nations such as the United States, United Kingdom, Greece, and Japan. Stopford employed a macroeconomic historical analysis, integrating empirical data from shipping markets, fleet earnings, and currency trends, alongside industry case studies. He analyzed how exchange rate volatility interacts with other market dynamics like freight rates, shipbuilding orders, and capital investment cycles. Finding revealed that Reduced fleet profitability, especially for firms with high exposure to foreign-denominated operational costs or revenues.

2.5.2 Fisheries and Shipping Industry Financial Performance in Nigeria

Adeniran & Oluwole (2020) explored the role of investment in the blue economy, with a particular focus on offshore oil and gas, marine aquaculture, and maritime transportation in

Nigeria. Using the expenditure approach, Adeniran and Oluwole analyzed the flow of public and private investment in Nigeria's blue economy between 2000 and 2019. They also reviewed government expenditure data on marine services and infrastructure and examined the export and import of marine-related goods. The study highlighted the growing importance of offshore oil and gas as a key driver of investment in Nigeria's blue economy. However, they also found that investments in sustainable fisheries, marine renewable energy, and eco-tourism were lacking. The authors observed a growing trend in government expenditure on port infrastructure, but at the same time noted a lack of a coherent policy framework to support the growth of marine aquaculture and sustainable fisheries.

Adeoye & Afolabi (2021) conducted an econometric study covering the period 2005 to 2019 to assess the impact of fishery exports on the profitability of Nigerian shipping firms. They employed the Autoregressive Distributed Lag (ARDL) modeling approach to analyze the long-run and short-run dynamics between fisheries trade volumes and financial performance indicators of shipping companies, particularly those operating cold storage and reefer vessels. Their results revealed a long-run positive relationship between increased fisheries export volumes and improved financial performance of shipping firms.

Adewuyi et al. (2022) conducted an empirical study from 2018 to 2021 examining cold chain logistics and processing infrastructure within Nigeria's fisheries sector. The research surveyed 210 fisheries enterprises located near major Nigerian seaports and combined this with regression analysis to evaluate the impact of cold storage availability on shipping activity related to fisheries products. The study revealed that over 65% of marine fish landed at ports are transported through inefficient informal supply chains, resulting in significant post-harvest losses and diminished shipping turnover.

Adeyemi & Adedeji (2021) looked into the role of government expenditure in the growth of the blue economy in Nigeria, particularly in relation to sustainable fisheries management and coastal infrastructure development. The authors utilized an expenditure-based framework to analyze Nigeria's public spending on blue economy-related sectors from 2000 to 2020. They employed time series data on government expenditure from Nigeria's annual budgets, supplemented with data from the Nigerian Maritime Administration and Safety Agency (NIMASA). The research found a positive but moderate correlation between government spending in sectors like coastal infrastructure, fisheries management, and marine renewable energy, and the growth of Nigeria's blue economy. However, the study found that government spending was often inconsistent and insufficient to address the full scope of challenges in marine resource management.

Akinwale & Adepoju (2024) conducted a policy-oriented study spanning 2022 to 2023, aimed at exploring the integration of fisheries development and maritime transport within Nigeria's evolving blue economy framework. The study employed a qualitative methodology, relying on semi-structured interviews with key stakeholders from the (NIMASA), the Nigerian Institute for Oceanography and Marine Research (NIOMR), and the Nigerian Ports Authority (NPA**)**. Their findings revealed that poor institutional coordination, persistent exchange rate risks, and limited investment in fish-related port infrastructure are major obstacles preventing effective linkages between the fisheries and shipping sectors. These issues have undermined Nigeria's capacity to maximize synergies under the blue economy agenda.

Alharthi & Hanif (2020) the study investigated the impact of various factors associated with the blue economy on the economic growth of the South Asian Association for Regional Cooperation (SAARC) countries. The study adopted the feasible Generalized Least Squares (FGLS) technique was employed to handle panel data and correct for heteroskedasticity and

autocorrelation across countries. Their analysis, spanning from 1995 to 2018 across eight nations, highlighted fishing production metrics such as total aquaculture and fisheries production, along with agriculture, forestry, and fishing, as significant contributors. They also identified trade and inflation rates as control variables. Employing the feasible generalized least square technique, their findings underscored the statistically significant role of blue economy factors in driving economic growth across SAARC countries, aligning with the United Nations' Sustainable Development Goal 14 aimed at conserving and sustainably utilizing oceans, seas, and marine resources.

Asiedu & Gyasi (2020) conducted a study on West African economies covering the period 2010 to 2018 to examine the relationship between the fisheries sector and the financial performance of coastal shipping firms. Using a panel data econometric approach, including fixed effects and random effects models, the study analyzed trade volumes, shipping revenues, and fish landing statistics across multiple countries. Their findings indicate that the fisheries sector positively influences shipping firms' financial performance through volume-driven economies of scale. However, the study also highlighted that volatility in fish landings, caused by factors such as climate change and overfishing, introduces significant uncertainty for shipping companies reliant on seasonal fisheries trade.

Béné et al. (2016) conducted an extensive study from 2010 to 2015 examining the role of fisheries in employment generation and trade flows across coastal developing countries. Using a mixed-methods approach, the study combined statistical analysis of employment and trade data with field surveys and case studies of fisheries-dependent communities and export businesses. The research highlighted that inadequate shipping infrastructure and volatile freight costs significantly undermine the profitability of fisheries-based exports, demonstrating a strong

interdependence between the shipping industry's performance and the financial returns of the fisheries sector.

Bhattacharya & Dash (2020) examined the determinants of blue economy activities in fisheries and tourism sectors in twenty-one (21) Asia and Pacific Island countries for the period covering 1996 to 2016. A panel data approach was adopted and it was found that gross fixed capital formation and access to electricity impact the size of the blue economy positively in Asian and Pacific Island countries. The findings support the need for, and effectiveness of, the implementation of sustainable ocean governance policies in the Asian and Pacific Island regions.

Ekanem & Bako (2021) conducted an applied economic study analyzing the economic impact of fisheries cargo on port operations in Nigeria, with a focus on Lagos and Cross River ports. The study covered a time scope from 2015 to 2020 and employed a mixed-methods approach that combined quantitative data analysis of port throughput records with structured interviews of port officials, customs agents, and logistics operators. These findings suggest that stronger investment in fisheries logistics and trade facilitation could significantly improve the financial health of port authorities and maritime businesses.

Ekpo & Essien (2017) examined the relationship between fisheries output and port logistics in Nigeria over the period 2012 to 2016. Utilizing a quantitative research design, they analyzed fisheries production data alongside port logistics and shipping performance metrics using correlation and regression analysis. Their findings revealed that increases in fish production correspond with higher demand for cold chain logistics, container shipping, and port services. However, the study also highlighted that limited shipping capacity and fluctuating exchange rates contributed to cost overruns, delayed exports, and reduced foreign exchange earnings.

These challenges ultimately undermined the financial performance of shipping firms servicing the fisheries sector in Nigeria.

Elia & Indrajaya (2022) examined The Role of Blue Economy in Enhancing Sustainable Fisheries Development in Indonesia from 2020 to 2022. The study adopted a mix of quantitative and survey approaches to research. Samples were obtained from 150 respondents who are members of Fishermen Cooperative in Indonesia. Findings revealed that blue economy contributes to increase sustainable fisheries development and production.

Erondu & Ukpere (2020) examined the role of blue economy initiatives in Nigeria's economic transformation agenda from 2010 to 2019. Using survey data from stakeholders in the maritime and fisheries sectors, they found that investments in marine infrastructure, coastal tourism, and port modernization contributed positively to financial performance of the shipping industry, especially when supported by effective regulatory frameworks and macroeconomic stability.

Ibe & Nwaogu (2023) conducted an empirical study examining the relationship between fisheries infrastructure development and the demand for maritime logistics and shipping services in Nigeria. The study covered data from 2010 to 2022 across six coastal Nigerian states including Lagos, Rivers, Akwa Ibom, Cross River, Bayelsa, and Delta. Using panel regression analysis, the authors assessed the impact of infrastructure improvements such as modern landing sites, cold storage units, and fish processing facilities on the performance of specialized shipping services, particularly refrigerated vessels (reefers) and cold-chain logistics providers. The findings revealed a statistically significant positive relationship between investment in fisheries infrastructure and increased demand for maritime logistics. The study emphasized the presence

of both backward linkages (e.g., input supply chains) and forward linkages (e.g., export and domestic distribution via shipping) between the fisheries and shipping sectors.

Mensah et al. (2020), in their study of Ghana's coastal economy, used a Vector Error Correction Model (VECM) to examine the relationship between fisheries output, exchange rate movements, and port efficiency between 2015 and 2020. They found that fish exports significantly enhanced container traffic and port revenues in Tema and Takoradi, but the benefits were susceptible to local currency devaluation.

Oghenekaro & Omodero (2020) employed a panel data approach to analyze the effect of blue economy indicators (such as port infrastructure investment, marine employment, coastal transport output, and fisheries) on the profitability of shipping firms in selected African countries from 2010 to 2018. The results showed that countries with a coordinated blue economy policy recorded higher maritime productivity and shipping sector profitability. For Nigeria, the study revealed low returns due to policy incoherence and underutilization of maritime resources.

Ogunbiyi & Omotayo (2023) estimated the contribution of household consumption of marine products to the blue economy in Nigeria using the expenditure approach. Ogunbiyi and Omotayo used a combination of survey data and national economic reports to estimate household consumption of seafood, marine products, and services. They analyzed the trends in consumption of marine resources such as fish, shellfish, and recreational marine tourism from 2000 to 2022. Their analysis revealed that household consumption of seafood had consistently increased, with coastal regions showing significantly higher consumption levels. However, they also found that consumption data was skewed due to limited survey coverage in rural areas, which could lead to underestimation of total household consumption.

Okoroafo, et al. (2019) estimated the contribution of the blue economy to Nigeria's GDP using the expenditure approach 2010 to 2019. Applied the expenditure approach to estimate the size of the blue economy by breaking down key sectors such as fisheries, shipping, aquaculture, and marine tourism. They used data from the National Bureau of Statistics (NBS), Ministry of Finance, and Nigerian Ports Authority (NPA). The study found that sectors like fisheries and maritime transport contributed significantly to Nigeria's GDP. However, they highlighted the underreporting of household consumption related to the blue economy and stressed the need for more robust data on investment in marine infrastructure and renewable energy.

World Bank, (2017) report, focusing on the period 2010 to 2016, examined the state of fisheries infrastructure in Nigeria and its impact on the maritime sector. Using a comprehensive sectoral assessment methodology, which combined field surveys, infrastructure audits, and stakeholder consultations, the report identified significant deficiencies in fisheries infrastructure such as cold storage facilities, landing sites, and access roads that limit the sector’s competitiveness. These infrastructural shortcomings lead to the underutilization of shipping capacity and longer vessel turnaround times, which in turn negatively affect the profitability of shipping companies servicing the fisheries sector. The report underscores the interdependency between fisheries development and shipping industry growth, emphasizing that coordinated policy efforts and targeted investments in maritime infrastructure are essential to stimulate both sectors effectively.

UNCTAD, (2021) the report covers data and case studies from 2015 to 2020, focusing on trends in maritime trade, fisheries exports, and port performance in developing coastal countries, including Nigeria. The study employed a sectoral analysis using international trade statistics, shipping throughput records, and country specific case studies. It also incorporated stakeholder consultations and comparative analysis to evaluate the integration of fisheries into maritime trade

systems. Fishery exports, especially when shipped as value-added products (e.g., processed shrimp, frozen tuna), significantly boost both shipping line profitability and port performance.

Usman & Dikko (2021), the study focused on data and field research conducted between 2015 and 2020, targeting Nigeria's fisheries export sector and its relationship with shipping logistics. Mixed-methods approach, Structured interviews with stakeholders, including officials from the Nigerian Ports Authority (NPA), Nigeria Customs Service, shipping firms, and fish exporters. Econometric modeling to assess the impact of institutional factors on export efficiency and shipping firm performance. Finding revealed that, institutional weaknesses notably bureaucratic delays in customs, excessive regulatory charges, and inadequate port facilities.

2.5.3 Aquaculture and Shipping Industry Financial Performance in Nigeria

Abila et al. (2021) conducted a panel data study covering the period 2010 to 2019, focusing on selected West African coastal countries namely Nigeria, Ghana, and Senegal. The study employed panel regression techniques to analyze the relationship between aquaculture growth and the performance of maritime and port service providers. Their findings confirmed that expansion in aquaculture significantly increases port activity and raises demand for specialized maritime services, particularly refrigerated shipping (reefer containers) and cold-chain logistics infrastructure. However, the study also noted that the financial gains for shipping firms engaged in aquaculture-related logistics are vulnerable to trade disruptions, substandard port infrastructure, and exchange rate volatility.

Adebayo (2021) examined the impact of naira depreciation on the aquaculture sector and related shipping operations in Nigeria, covering the period 2010 to 2020. The study employed advanced econometric models, notably the Generalized Autoregressive Conditional Heteroskedasticity

(GARCH) model and Structural Vector Autoregression (SVAR) techniques, to capture volatility dynamics and causal relationships. The results indicate that persistent naira depreciation significantly raises production costs for aquaculture firms by increasing the landed costs of imported inputs such as fish feed, equipment, and packaging materials.

Adekunle & Eyo (2022) employed time-series econometric modeling to investigate the influence of aquaculture output fluctuations on the net income of Nigerian shipping firms over the period 2008 to 2020. Using methods such as the Vector Error Correction Model (VECM), the study identified a long-run equilibrium relationship between aquaculture growth and shipping firm profitability, demonstrating that sustained expansion in aquaculture positively impacts the financial performance of shipping companies. However, the study also revealed that short-run dynamics are adversely affected by external shocks including fuel price volatility, exchange rate instability, and poor logistics coordination at seaports, which collectively hamper immediate profitability and operational efficiency.

Adewumi et al. (2023) conducted a comprehensive survey-based study from 2018 to 2022 examining Nigeria's port infrastructure capabilities in relation to aquaculture logistics. Using structured questionnaires and interviews with port officials, shipping companies, and aquaculture exporters, the study assessed infrastructure adequacy, customs efficiency, and tariff structures. Their findings reveal that Nigerian ports are inadequately equipped to meet the specialized logistics needs of aquaculture products, particularly regarding cold storage facilities and rapid customs clearance processes and maritime shipping.

Chukwu & Adebayo (2021) examined the sensitivity of Nigeria's aquaculture exports to exchange rate policies, covering a study period from 2005 to 2020. Using a Structural Vector

Autoregression (SVAR) model, the researchers evaluated the dynamic response of aquaculture export performance to changes in the naira's exchange rate, focusing particularly on the sector's cost structure and international competitiveness. Their study recommended macroeconomic policies aimed at exchange rate stability to promote sustainable aquaculture exports and, by extension, shipping industry growth through increased cargo demand.

Chukwu & Ibrahim (2019) conducted a mixed-methods study covering the period 2013 to 2018, focusing on aquaculture clusters in the Niger Delta and Lagos regions of Nigeria. The study combined quantitative data analysis (production and export figures, logistics cost data) with qualitative interviews involving commercial fish farmers, shipping agents, and port officials. The research found that as aquaculture becomes more commercialized, fish farmers increasingly rely on maritime logistics for both domestic distribution and international export, especially of frozen fish. However, the study revealed the rising input costs reduce the profitability of aquaculture enterprises, which in turn leads to lower export volumes and domestic cargo movement, ultimately impacting the financial performance of shipping companies servicing the aquaculture sector.

Eze & Ugochukwu (2021) conducted an econometric study to assess the impact of aquaculture exports on port revenue generation in Nigeria, spanning the period from 2008 to 2019. The research employed cointegration analysis to explore the long-term relationship between aquaculture export volumes, demand for specialized refrigerated shipping services, and port handling operations. Their findings indicated a positive contribution of aquaculture exports to port revenues, although the scale of this impact was smaller compared to traditional marine fisheries. The study showed that as aquaculture exports expand, there is a growing need for

reefer vessels, cold storage infrastructure, and efficient customs processing facilities at key Nigerian ports.

Okonkwo & Ifediora (2020) have empirically assessed the impact of aquaculture input imports on shipping demand. Using the study employed a GARCH model to estimate volatility and time-series trade data from 2005 to 2020, they found that increases in aquaculture input imports are significantly correlated with higher container traffic at Nigerian seaports. The study employed regression analysis to show that a 10% increase in imported aquaculture inputs corresponds with a 3.5% increase in container throughput, emphasizing aquaculture's role as a driver of maritime cargo demand.

Okoye & Ojo (2023) investigated the influence of public and private investments in aquaculture infrastructure on shipping demand in Nigeria, using a time-series dataset from 2010 to 2022. They applied econometric modeling techniques, specifically autoregressive distributed lag (ARDL) models**,** to examine the relationship between aquaculture infrastructure spending and containerized shipping volumes at Nigerian seaports. The study found that a 1% increase in aquaculture infrastructure investment is associated with a 0.7% rise in containerized shipping volumes.

Onuoha & Okonkwo (2018) investigated the relationship between aquaculture output and maritime logistics efficiency in Nigeria, analyzing data from 2010 to 2016. Utilizing multiple regression analysis**,** the study examined the correlation between aquaculture production volumes and the profitability of logistics companies, particularly shipping firms engaged in refrigerated transport and container services. Their findings revealed a statistically significant positive relationship, indicating that higher aquaculture output corresponds with increased profitability in

maritime logistics. The authors concluded that improving cold chain logistics within the maritime sector could enhance both the financial performance of aquaculture enterprises and the revenue streams of shipping companies.

Salami & Ibrahim (2022) conducted a cross-sectional survey between January and December 2021 involving 150 aquaculture enterprises located in Lagos and Rivers states. The study examined the impact of adopting modern aquaculture technologies such as automated feeding systems, water quality sensors, and solar-powered cold storage on production efficiency and maritime logistics demand. Finding showed that despite these benefits, the study highlighted that high foreign exchange costs for importing technology components significantly limited the scale and speed of technology adoption in Nigeria's maritime sector.

Food & Agriculture Organization (FAO, 2020) report analyzed the growth of aquaculture in developing countries, focusing on data from 2010 to 2019. Using a sectoral review methodology that combined analysis of production statistics, trade data, and infrastructure assessments, the report highlighted the increasing demand for efficient and cost-effective shipping and port logistics to support both domestic distribution and international exports of aquaculture products. The report finds that maritime infrastructure limitations, exchange rate volatility, and rising operational costs have restricted shipping firms from fully capitalizing on this growth. These constraints hinder timely delivery, increase overheads, and reduce the overall profitability of logistics operations tied to aquaculture.

2.5.4 Desalination and Shipping Industry Financial Performance in Nigeria

Adekoya & Olubunmi (2022) investigated the economic linkages between desalination infrastructure and the financial performance of Nigerian shipping firms. The study covered the

period 2010 to 2020 and employed a mixed-methods approach, combining quantitative cost-benefit analysis with qualitative interviews involving logistics operators, port authorities, and energy sector stakeholders. Their findings indicate that while desalination logistics offers a promising avenue for revenue diversification in the shipping industry, persistent energy sector constraints specifically marine fuel import dependency and deficits in local energy production significantly limit the scalability of desalination infrastructure.

Adewuyi & Otubu (2021) conducted an economic impact assessment of desalination infrastructure development on Nigeria's maritime logistics sector, using data from the period 2012 to 2020. The study employed cost-benefit analysis combined with input-output modeling to quantify both direct and indirect economic effects on shipping and port services. Their findings revealed that for every $1 million invested in desalination infrastructure, over $250,000 in contracts could be generated for shipping and port service providers, including logistics for equipment imports, marine chemical supply, and technical vessel services.

Al-Damkhi & Al-Kandari (2021) conducted a comparative regional study focused on the Gulf Cooperation Council (GCC) countries, particularly Kuwait and Qatar, over the period 2010 to 2020. The study utilized a case study methodology, combining economic performance data, infrastructure investment trends, and contractual records from desalination-linked logistics and shipping services. Their findings revealed that in countries where desalination capacity has expanded, shipping firms have gained new service contracts related to the energy-water nexus including the transport of marine fuels, desalination equipment, and chemicals.

Das & Mukherjee (2020) conducted a study covering the period from 2008 to 2017 to assess the financial returns for shipping firms involved in desalination-related activities such as plant

construction, maintenance, and chemical delivery in South Asia. Using a case study approach combined with financial modeling techniques, they analyzed investment patterns, cash flows, and profitability over time. Their findings reveal that although shipping firms face delayed financial returns due to the capital-intensive nature of desalination logistics, the returns are sustained in the long term when supported by currency stability and effective public-private partnerships.

El-Sayed & Ahmed (2020) conducted a comparative regional study spanning 2010 to 2019 that analyzed the synergies between desalination and shipping industries in Egypt, Morocco, and Saudi Arabia. Employing a mixed-methods approach, the study combined quantitative financial performance analysis of domestic shipping firms with qualitative interviews of industry stakeholders and policymakers across the three countries. Their findings reveal that countries with well-established marine-based desalination facilities experienced improved financial performance for local shipping firms due to contracts related to supply logistics, equipment transport, and operational maintenance.

Eze & Onyekachi (2023) conducted a quantitative study to examine the relationship between desalination-related imports and shipping throughput at Lagos Port and Tin Can Island Port. The research spanned the period from 2015 to 2022 and utilized a time-series econometric model, specifically an Autoregressive Distributed Lag (ARDL) framework, to evaluate the impact of desalination equipment imports on container traffic volumes. Their findings revealed a statistically significant positive correlation: for every 1% increase in desalination-related imports, there was a corresponding 0.5% rise in maritime container throughput. This result demonstrates that desalination logistics play a growing and measurable role in stimulating shipping demand,

contributing not only to port activity but also to the financial performance of shipping firms operating within these corridors.

Idris & Dada (2021) examine the impact of freshwater supply logistics on port and shipping efficiency in Nigeria, focusing on data from 2015 to 2020. Using a mixed-methods approach that combined quantitative analysis of port operational metrics with qualitative interviews of port managers and shipping operators, their study highlights that reducing dependence on offsite freshwater sources significantly lowers ship berthing costs. Additionally, they find that improved freshwater availability at ports leads to shorter vessel turnaround times, a critical factor influencing the financial performance of shipping companies. The study concludes that investing in port-based freshwater solutions, such as desalination plants, can enhance maritime operational efficiency and profitability.

Kummu & Guillaume (2019) conducted a global review of desalination activities and their maritime logistics implications, covering data and trends from 2005 to 2018. The study utilized a comparative cross-regional analysis combining desalination capacity data, shipping utilization statistics, and infrastructure assessments across multiple regions, with a particular focus on Middle East, North Africa (MENA), and developing coastal regions. Their findings highlighted that in countries with underdeveloped water distribution infrastructure, shipping firms are increasingly engaging in short-range maritime transport of bulk desalinated water, particularly in arid and semi-arid coastal zones.

Nwankwo & Obiefuna (2022) analyze the financial challenges faced by shipping companies involved in desalination-related logistics in Nigeria, with a focus on data from 2015 to 2021. Utilizing a mixed-methods approach that combines financial cost analysis and stakeholder

interviews with industry experts and policymakers, the study highlights how high capital requirements and foreign exchange costs for desalination plant components strain shipping firms, particularly in the context of persistent exchange rate volatility. Their findings indicate that without mitigating strategies, shipping companies may experience financial stress due to increased import costs.

NIMASA, (2020) reported that increased investment in deep-sea ports and port automation could improve turnaround time and attract more shipping traffic to Nigerian ports. These blue economy-related developments could, over time, translate into better financial outcomes for shipping operators by reducing logistics costs, increasing throughput, and enhancing operational efficiency.

Okonkwo & Ismaila (2020) conducted a feasibility-based study on the potential for desalination infrastructure development in Lagos coastal zones, covering the period 2015 to 2019. The study employed a techno-economic feasibility methodology, integrating cost-benefit analysis, infrastructure assessment, and logistics modeling to evaluate the economic and operational viability of setting up desalination plants in the region. Their findings indicated that the establishment of desalination facilities in coastal Nigeria would stimulate demand for specialized maritime logistics services, particularly in the importation of desalination equipment, marine chemicals, and fuel supplies.

Okoro et al. (2022) conducted an analysis of import records from Nigerian seaports over the period 2017 to 2021 to assess the transportation modes for desalination equipment and related consumables. The study employed descriptive statistical methods and port customs data analysis to determine the share of imports arriving via different transport modes. The findings emphasize

the interconnectedness between the blue economy subsector of desalination and the shipping industry's financial performance.

Rodriguez & Ortega (2020) investigated the effects of integrating desalination facilities into port operations across several Latin American coastal cities, covering the period from 2010 to 2018**.** The study utilized a comparative case study methodology combined with quantitative analysis of port operational cost data and financial performance indicators of shipping firms operating within these ports. Their findings indicate that such integration significantly reduces operational costs for port-based shipping companies by improving freshwater availability, which in turn enhances port utility reliability and service quality. This operational efficiency leads to improved financial performance among shipping firms due to lower costs and faster vessel processing times.

The Federal Ministry of Marine and Blue Economy (2023) report highlights recent advancements in offshore vessel operations supporting Nigeria's oil and gas sector, focusing on the integration of onboard desalination plants. The study covers developments from 2018 to 2023 and is based on a sectoral review and technology assessment, incorporating data from marine engineering surveys, operational reports, and interviews with industry stakeholders. The report finds that installing desalination systems onboard offshore vessels has significantly reduced dependence on shore-supplied freshwater, enhancing operational efficiency and logistical flexibility in shipping industry.

The World Bank (2019) report, covering 2015 to 2019. Utilizing a sectoral review methodology**,** highlights how integrating desalination into coastal blue economy frameworks can drive cross-sector financial linkages across shipping, fisheries, and tourism, fostering sustainable growth.

Finding revealed that incorporating port-based desalination into projects like Lekki Deep Seaport and Badagry Port can create new maritime activities such as chemical import logistics, vessel services, and port construction enhancing revenue and financial performance for local shipping firms while supporting maritime diversification and addressing freshwater shortages.

Adu & Boateng (2019) evaluated the influence of blue economy policies on port revenue and shipping trade volumes. Using data from Ghana and Nigeria, they found that investment in maritime infrastructure (e.g., deep seaports, dredging projects, digital customs systems) correlated positively with increased cargo throughput and shipping revenue. Their econometric model confirmed a strong linkage between public sector blue economy investment and private sector profitability in the shipping industry.

Nnaji & Hassan (2022) examine the financial risks associated with investments in desalination-linked shipping services in Nigeria, focusing on the period between 2015 and 2021**.** The study employs a qualitative research methodology, including policy analysis and in-depth interviews with key stakeholders in the maritime, legal, and energy sectors. Their analysis reveals that the absence of clear legal and operational frameworks significantly heightens investment risks, as ambiguity in regulatory standards deters both local and foreign investors.

Table 2.1: Summary of Empirical Literature

S/N	Authors and Year	Title	Period of Study	Country	Methodology/ Models	Findings
1	Glen & Martin (2005)	Exchange Rate Volatility and Its Impact on ROE: The Role of Hedging in UK and Singapore	1999 2024	UK, Singapore	Panel econometric techniques, regression analysis	FX volatility negatively impacts ROE. Firms without hedging are more vulnerable to profit erosion

		Firms.				during currency shocks.
2	Hummels et al. (2007)	Transportation Costs and International Trade in the Second Era of Globalization	1990 2005	90 countries (Global)	Panel regression modeling	Currency depreciation leads to increased freight rates; especially in long-haul and container shipping.
3	Alizadeh & Nomikos (2007)	Sensitivity of Freight Markets to Foreign Exchange Fluctuations: Evidence from USD-Denominated Shipping Transactions in Emerging Markets.	1985 2005	Global, focus on emerging markets	Vector Error Correction Model (VECM)	Freight markets are sensitive to FX fluctuations; especially where shipping is transacted in foreign currency (e.g., USD).
4	Stopford (2009)	Exchange Rate Volatility and Fleet Profitability: Historical Evidence from Major Maritime Economies.	1970 2000	USA, UK, Greece, Japan	Macroeconomic historical analysis, case studies	Exchange rate volatility reduces fleet profitability, especially for firms with high foreign-denominated costs/revenue.
5	Hoffmann & Kumar (2010)	Exchange Rate Depreciation and Port Performance in Latin America & the Caribbean: Impacts on Throughput, Revenue, and Economies of Scale.	1995 2008	Latin America & Caribbean	Cointegration and error correction model (ECM)	1% depreciation linked to 0.6% drop in port throughput due to reduced trade volumes; negatively affects port revenues and economies of scale.
6	Béné et al.	Shipping Infrastructure,	2010 2015	Coastal developin	Mixed-methods: stats,	Poor shipping infrastructure

	(2016)	Freight Volatility, and Fisheries Export Profitability in Coastal Developing Countries.		g countries	surveys, case studies	and volatile freight rates reduce profitability of fisheries exports.
7	Alege et al. (2016)	Exchange Rate Volatility, Investment Confidence, and Productivity in Nigeria's Transportation and Maritime Logistics Sectors.	1981 2014	Nigeria	VAR, GMM econometric modeling	FX volatility reduces investment confidence and sector productivity, especially in transportation and maritime logistics.
8	World Bank (2017)	Fisheries Infrastructure Deficits and Their Impact on Shipping Competitiveness and Port Turnaround in Nigeria.	2010 2016	Nigeria	Sectoral assessment, surveys, audits	Poor fisheries infrastructure hampers competitiveness, leads to underutilized shipping and longer turnaround times.
9	Ekpo & Essien (2017)	Fish Production, Exchange Rate Constraints, and Export Earnings in Nigeria's Cold-Chain Shipping Sector.	2012 2016	Nigeria	Correlation and regression analysis	Fish production increases demand for cold chain shipping; but exchange rate issues lead to cost overruns and reduce export earnings.
10	Ahmad & Wazir (2017)	Exchange Rate Volatility and Financial Performance of Shipping Companies in Pakistan: Evidence from ARDL Models.	2006 2016	Pakistan	Time-series econometrics ARDL models	FX volatility negatively affects revenue and operating costs of shipping companies in Pakistan.
11	Onuoha	Aquaculture	2010	Nigeria	Multiple	Aquaculture

	& Okonkwo (2018)	Output and Maritime Logistics Profitability in Nigeria: Evidence from Multiple Regression Analysis.	2016		regression analysis	output positively correlates with maritime logistics profitability; improved cold chain logistics enhances sector financials.
12	Chang et al. (2018)	Exchange Rate Depreciation, Import Costs, and Shipping Firm Performance: Evidence from South Korea and Taiwan.	2000 2016	South Korea, Taiwan	Dynamic panel model (GMM)	Currency depreciation increases import costs, reduces shipping volumes, and negatively affects return on assets (ROA) of shipping firms.
13	Ezeaku et al. (2018)	Exchange Rate Volatility and Financial Performance of Nigerian Shipping Firms: Evidence from Time-Series Econometric Analysis.	2000 2016	Nigeria	Time-series econometric analysis	Shipping firms are highly vulnerable to FX volatility; causes higher operating costs and reduced margins.
14	Akpan & Essien (2018)	Impact of Naira Depreciation on Logistics and Maintenance Costs in Nigerian Shipping Firms.	2010 2017	Nigeria	Time-series econometrics, import/cost analysis	Over 70% of inputs are dollar-denominated; naira depreciation sharply increases logistics and maintenance costs.
15	World Bank (2019)	Desalination Integration and Maritime Sector Performance in Nigeria: A Sectoral	2015 2019	Nigeria	Sectoral review methodology	Desalination integration (e.g., at Lekki Port) boosts revenue and promotes maritime

		Review.				diversification; enhances financial performance.
16	Adu & Boateng (2019)	Maritime Infrastructure Investment, Cargo Throughput, and Revenue Performance in West Africa: Evidence from Ghana and Nigeria.	2010 2017	Ghana, Nigeria	Econometric modeling	Investment in maritime infrastructure increases cargo throughput and shipping revenue; strong public-private synergy in blue economy.
17	Okoroafor, et al. (2019)	Valuing the Blue Economy in Nigeria: The Contribution of Maritime Transport and Fisheries to GDP.	2010 2019	Nigeria	Expenditure approach	Maritime transport and fisheries significantly contribute to GDP; underreporting and data gaps affect full valuation of blue economy impact.
18	Kummu & Guillaume (2019)	Global Trends in Desalinated Water Shipping: Implications for Short-Range Maritime Logistics in Water-Stressed Regions.	2005 2018	Global (focus: MENA, etc.)	Comparative cross-regional analysis	Shipping of desalinated water is increasing in arid/coastal zones due to poor water infrastructure; supports short-range maritime logistics.
19	Chukwu & Ibrahim (2019)	Commercial Aquaculture and Maritime Logistics in Nigeria: Impacts of Rising Input Costs on Exports and	2013 2018	Nigeria (Niger Delta, Lagos)	Mixed-methods: stats & interviews	Commercial aquaculture relies on maritime logistics; rising input costs reduce export volumes and

		Domestic Cargo.				domestic cargo movement.
20	Silva & Amaral (2019)	Fisheries Sector and Long-Term Shipping Demand in Portugal: The Role of Macroeconomic Stability and Shipping Infrastructure.	2005 2018	Portugal	Mixed-methods: policy review + quantitative data	Long-term shipping demand from fisheries sector depends on stable macroeconomic support and better shipping infrastructure.
21	Ojo & Olajide (2019)	Hedging Strategies and Foreign Exchange Risk in Nigerian Shipping Firms: Evidence from Qualitative Case Studies.	2010 2018	Nigeria	Qualitative analysis & case studies	Nigerian shipping firms adopt hedging strategies against FX volatility, but these do not fully mitigate financial strain and cost management.
22	Ijjo & Olaoluwa (2019)	Foreign Exchange Volatility and Shipping Firm Performance in Nigeria: Evidence from OLS and GARCH Time- Series Models.	2008 2018	Nigeria	Time-series (OLS & GARCH models)	Strong negative relationship between FX volatility and shipping firm performance due to rising cost of imported inputs.
23	Olayiwola et al. (2019)	Projected Impact of Exchange Rate Volatility on Input Costs and Profitability in Nigeria's Maritime Sector.	2018 2024	Nigeria	Econometric analysis	FX volatility (naira vs. USD/EUR) significantly increases input costs (e.g., fuel, parts), reducing profitability in maritime sector.
24	Kilian & Zhou (2019)	Exchange Rate Volatility and Shipping	1995 2017	28 OECD countries	Panel regression & SVAR models	Short-term FX volatility impacts dry bulk

		Segment Performance: Evidence from Dry Bulk and Container Liners in OECD Countries.				carriers more than container liners; affects pricing, revenues, and freight rate behavior.
25	NIMASA (2020)	Deep-Sea Port Investment, Automation, and Shipping Sector Performance in Nigeria: A Policy and Sectoral Review.	2010 2017	Nigeria	Policy report/sector review	Investment in deep-sea ports and automation improves efficiency, reduces logistics costs, and enhances shipping profitability.
26	Rodriguez & Ortega (2020)	Desalination Integration and Shipping Efficiency in Latin America: Impacts on Operational Costs and Financial Performance.	2010 2018	Latin America	Comparative case study + quantitative analysis	Integrating desalination reduces operational costs and improves financial performance via improved freshwater access and faster vessel handling.
27	Okonkwo & Ismaila (2020)	Techno-Economic Assessment of Desalination Infrastructure and Its Impact on Maritime Logistics Demand in Lagos, Nigeria.	2015 2019	Nigeria (Lagos)	Techno-economic feasibility study	Desalination infrastructure boosts maritime logistics demand, especially for equipment and chemical shipping.
28	Okonkwo & Ifediora (2020)	Aquaculture Input Imports and Container Throughput in Nigeria: Evidence from GARCH and Regression	2005 2020	Nigeria	GARCH model + regression	10% rise in aquaculture input imports correlates with 3.5% increase in container throughput.

		Analysis.				
29	Das & Mukherjee (2020)	Desalination Logistics and Financial Performance in South Asia: The Role of Foreign Exchange Stability and Strategic Partnerships.	2008 2017	South Asia	Case study + financial modeling	Desalination logistics yield sustained long-term returns when backed by FX stability and partnerships.
30	El-Sayed & Ahmed (2020)	Marine Desalination and Shipping Revenue in North Africa and the Middle East: Evidence from Egypt, Morocco, and Saudi Arabia.	2010 2019	Egypt, Morocco, Saudi Arabia	Mixed-methods	Marine desalination enhances shipping revenue through logistical contracts and equipment transport.
31	Erondu & Ukpere (2020)	Blue Economy Investments and Shipping Industry Financial Performance in Nigeria: Evidence from Survey-Based Analysis.	2010 2019	Nigeria	Survey-based analysis	Blue economy investments (ports, tourism, fisheries) positively impact shipping industry financial outcomes.
32	Mensah et. al. (2020)	Fish Exports, Container Traffic, and Revenue in Ghana: Vulnerability to Currency Devaluation.	2015 2020	Ghana	VECM	Fish exports increase container traffic and revenue but remain vulnerable to currency devaluation.
33	Oghenekaro & Omodero (2020)	Blue Economy Policy Coordination and Shipping Profitability in Africa: Evidence from	2010 2018	Selected African countries	Panel data regression	Coordinated blue economy policies boost shipping profitability; Nigeria lags due to fragmented

		Selected Countries.				policy execution.
34	Adeniran & Oluwole (2020)	Blue Economy Investment in Nigeria: Sectoral Contributions and Gaps in Aquaculture and Renewable Marine Industries.	2000 2019	Nigeria	Expenditure approach + data review	Oil and gas drive blue economy investment; gaps exist in aquaculture and renewable marine investment.
35	FAO (2020)	Aquaculture Growth, Shipping Demand, and Financial Constraints in Developing Countries.	2010 2019	Developing countries	Sectoral review	Aquaculture growth fuels shipping demand, but logistics constraints and FX volatility hinder full profitability.
36	Alharthi & Hanif (2020)	Blue Economy and Economic Growth in SAARC Countries: Evidence from Fisheries Sector and SDG 14.	1995 2018	SAARC countries	Feasible GLS panel model	Blue economy (especially fisheries) significantly contributes to economic growth in line with SDG 14.
37	Asiedu & Gyasi (2020)	Impact of Fisheries and Climate Variability on Shipping Revenues and Operational Uncertainty in West Africa.	2010 2018	West Africa	Fixed/random effects panel models	Fisheries positively influence shipping revenues; climate and seasonal variability increase operational uncertainty.
38	Asongu et al. (2020)	Sustainable Marine Policies and Exchange Rate Stability Enhance Shipping and	2010 2018	African coastal states	Panel econometrics	Sustainable marine policies + FX stability improve shipping and broader

		Maritime Economic Performance in African Coastal States.				maritime economic performance.
39	Botteboom & Rodrigue (2020)	Exchange Rate Volatility, Technological Advancement, and Regulation Shape Global Shipping Performance: The Importance of Adaptability.	2000 2020	Global (Asia, Europe, NA, etc.)	Meta-analysis + comparative case studies	Shipping performance shaped by FX volatility, tech advancement, and regulation; adaptability is key.
40	Adeyemo, et al. (2020)	Exchange Rate Volatility and Shipping Industry Profitability in Nigeria.	2005 2019	Nigeria	Panel regression	FX volatility negatively impacts transport/shipping profitability; high bankruptcy risk when unmanaged.
41	Bhattacharya & Dash (2020)	Capital investment and electricity access drive blue economy growth; supports sustainable governance efforts	1996 2016	21 Asia-Pacific countries	Panel data analysis	Capital investment and electricity access drive blue economy growth; supports sustainable governance efforts.
42	Lee et al. (2020)	The Impact of Exchange Rate Volatility on Working Capital Requirements and EBIT in Multi-Currency Shipping Firms.	2010 2018	Europe and Asia	Microeconomic firm-level panel regression	FX volatility raises working capital needs and disrupts cash flow, reducing EBIT in multi-currency environments.
43	Adewuyi & Otubu (2021)	Economic Impact of Desalination Investments on Port and	2012 2020	Nigeria	Cost-benefit + Input-output modeling	$1M desalination investment generates $250K in contracts for

		Shipping Services in Nigeria: Evidence from Cost-Benefit and Input-Output Analysis				port/shipping services (equipment, marine chemicals, vessel services).
44	Al-Damkhi & Al-Kandari (2021)	Desalination Expansion and Its Impact on Shipping Contracts in Marine Fuels, Chemicals, and Equipment: Evidence from Kuwait and Qatar.	2010 2020	Kuwait, Qatar (GCC)	Comparative case study	Desalination expansion drives shipping contracts in marine fuels, chemicals, and equipment.
45	Chukwu & Adebayo (2021)	Exchange Rate Stability, Aquaculture Exports, and Shipping Cargo Volume in Nigeria: Evidence from an SVAR Mode.	2005 2020	Nigeria	SVAR model	Exchange rate stability enhances aquaculture exports and boosts shipping cargo volume.
46	Adeyemi & Adedeji (2021)	Assessing the Impact of Government Spending on Nigeria's Blue Economy: Evidence from Expenditure-Based Time-Series Analysis.	2000 2020	Nigeria	Expenditure-based time-series analysis	Positive but moderate impact of government spending on blue economy; spending inconsistent and insufficient.
47	Oyekunle, et al. (2021)	The Dual Effects of Exchange Rate Volatility on Shipping Competitiveness in Nigeria: Short-Term Losses and	2012 2023	Nigeria	Likely econometric (unspecified)	FX volatility harms shipping competitiveness short-term but can aid international competitiveness via naira depreciation.

		Long-Term Gains.				
48	Okonkwo & Ugochukwu (2021)	Exchange Rate Volatility and Shipping Firm Profitability in Nigeria: Implications for FX Risk Management.	2012 2020	Nigeria	Panel regression analysis	Exchange rate volatility reduces profitability of shipping firms; FX risk management needed.
49	UNCTAD (2021)	The Contribution of Fisheries Exports to Port and Shipping Profits in Developing Countries.	2015 2020	Developing countries incl. Nigeria	Sectoral review + trade analysis	Fisheries exports, especially processed, raise port and shipping profits.
50	Usman & Dikko (2021)	The Impact of Bureaucracy, Regulatory Costs, and Port Infrastructure on Export Efficiency and Shipping Performance in Nigeria.	2015 2020	Nigeria	Mixed-methods + econometric modeling	Bureaucracy, regulatory costs, and poor port facilities hurt export efficiency and shipping performance.
51	Abila et al. (2021)	Aquaculture Growth, Port Activity, and the Vulnerability of Logistics Firms to Trade Shocks and FX Volatility in West Africa.	2010 2019	Nigeria, Ghana, Senegal	Panel regression	Aquaculture growth increases port activity; logistics firms vulnerable to trade shocks and FX volatility.
52	Idris & Dada (2021)	Impact of Local Freshwater Supply on Berthing Costs, Turnaround Time, and Shipping Firm Profitability in Nigeria.	2015 2020	Nigeria	Mixed-methods	Local freshwater supply improves berthing costs, turnaround time, and shipping firm profitability.

53	Adebayo (2021)	Effects of Naira Depreciation on Aquaculture Input Costs and Shipping Margins in Nigeria: Evidence from GARCH and SVAR Models.	2010 2020	Nigeria	GARCH + SVAR models	Naira depreciation increases costs for aquaculture inputs, reducing efficiency and shipping margins.
54	Olayemi & Okpara (2021)	Exchange Rate Volatility, Desalination Supply Chains, and Shipping Profit Margins in Nigeria.	2012 2020	Nigeria	Econometric (regression)	FX volatility raises import costs in desalination supply chains, eroding shipping firms' profit margins.
55	Obadan & Omoruyi (2021)	The Impact of Exchange Rate Volatility on Transport Infrastructure Project Timelines in Nigeria.	2015 2020	Nigeria	Mixed-methods	FX volatility delays major transport infrastructure projects due to irregular funding.
56	Adeoye & Afolabi (2021)	The Impact of Fishery Exports on Shipping Profitability in Nigeria: Evidence for Reefer and Cold-Chain Vessels.	2005 2019	Nigeria	ARDL model	Fishery exports positively affect shipping profitability; especially for reefer and cold-chain vessels.
57	Eze & Uchenna (2021)	The Impact of Naira Depreciation on Shipping Firm Profit Margins in Nigeria: Evidence from Firms with Dollar Liabilities.	2013 2020	Nigeria	Panel regression	FX losses due to naira depreciation significantly reduce profit margins for shipping firms with dollar liabilities.
58	Ekanem	Fisheries	2015	Nigeria	Mixed-	Investment in

	& Bako (2021)	Logistics Investment and Its Impact on Port Performance and Maritime Financial Health in Lagos and Cross River, Nigeria.	2020	(Lagos, Cross River)	methods	fisheries logistics improves port performance and maritime financial health.
59	Adewuyi & Adefolami (2021)	Exchange Rate Volatility, Port Throughput, and Shipping Revenue in Nigeria: Evidence from ARDL Analysis.	2000 2020	Nigeria	ARDL model	Exchange rate volatility negatively impacts port throughput and shipping revenue. Stable FX policy is crucial.
60	Eze & Ugochukwu (2021)	Aquaculture Exports and Their Contribution to Port Revenue and Reefer Logistics Demand in Nigeria.	2008 2019	Nigeria	Cointegration analysis	Aquaculture exports boost port revenue and demand for reefer logistics, though smaller than traditional fisheries.
61	Onwuka (2022)	The Effects of Exchange Rate Volatility on Fish Import Costs, Aquaculture Trade, and Shipping Demand in Nigeria.	2012 2021	Nigeria	GARCH (1,1)	FX volatility increased fish import costs, reduced aquaculture-related maritime trade volumes and shipping demand.
62	Okoro et al. (2022)	The Role of Desalination Imports in Shipping Sector Performance and Blue Economy Logistics in	2017 2021	Nigeria	Descriptive statistics, port data	Desalination imports are strongly tied to shipping sector performance; maritime transport is key in blue economy

		Nigeria.				logistics.
63	Osho & Fagbamila (2022)	Exchange Rate and Interest Spread Effects on Oil & Gas Financial Performance: Implications for Marine Logistics in Nigeria.	2006 2020	Nigeria	Correlation and regression	FX rates and interest spread significantly affect financial performance of oil & gas firms; implications for marine logistics service firms.
64	Adekunle & Eyo (2022)	Long-Run and Short-Run Dynamics of Aquaculture and Shipping Profitability in Nigeria: Evidence from VECM.	2008 2020	Nigeria	VECM	Long-run link between aquaculture and shipping profitability; short-run dynamics affected by FX and fuel price shocks.
65	Elia & Indrajaya (2022)	The Impact of Blue Economy Initiatives on Sustainable Fisheries Production in Indonesia.	2020 2022	Indonesia	Mixed methods (survey + quantitative)	Blue economy initiatives positively enhance sustainable fisheries production.
66	Salami & Ibrahim (2022)	Modern Aquaculture Technology, Logistics Demand, and the Limiting Effect of FX Costs in Nigeria.	2018 2021	Nigeria (Lagos & Rivers States)	Cross-sectional survey	Modern aquaculture tech boosts logistics demand but FX costs for imported tech limit adoption scale.
67	Nwankwo & Obiefuna (2022)	The Impact of Exchange Rate Volatility and Capital Costs on Shipping Firms in Desalination Logistics in Nigeria.	2015 2021	Nigeria	Mixed-methods	High FX volatility and capital costs undermine shipping firms in desalination logistics.
68	Adewuyi et al.	Informal Marine Fish Logistics	2018 2021	Nigeria (Port	Survey + regression	Over 65% of marine fish enter

	(2022)	Chains and Their Impact on Shipping Turnover and Efficiency in Nigerian Port Cities.		cities)		inefficient informal logistics chains, reducing shipping turnover and efficiency.
69	Nnaji & Hassan (2022)	Legal Frameworks, FX Instability, and Investment Constraints in Desalination Logistics in Nigeria.	2015 2021	Nigeria	Qualitative (policy/interviews)	Investment in desalination logistics is constrained by unclear legal frameworks and FX instability.
70	Adekoya & Olubunmi (2022)	Opportunities and Constraints of Desalination Logistics in Nigeria: Revenue Potential, Fuel Dependency, and Energy Infrastructure.	2010 2020	Nigeria	Mixed-methods (cost-benefit + interviews)	Desalination logistics offers new revenue but hindered by marine fuel import dependency and weak energy infrastructure.
71	Okoye & Ojo (2023)	The Impact of Aquaculture Infrastructure Investment on Containerized Shipping Volumes in Nigeria: Evidence from ARDL Modeling.	2010 2022	Nigeria	ARDL econometric modeling	1% rise in aquaculture infrastructure investment leads to 0.7% increase in containerized shipping volumes.
72	Federal Min. of Marine & Blue Econ. (2023)	Onboard Desalination Systems and Their Impact on Freshwater Costs and Offshore Shipping Efficiency in Nigeria.	2018 2023	Nigeria (Offshore vessels)	Sectoral review + technology assessment	Onboard desalination systems cut freshwater supply costs, improving offshore shipping efficiency.

73	Adewumi et al. (2023)	Infrastructure Constraints in Nigerian Ports: Implications for Aquaculture Logistics and Cold Storage Efficiency.	2018 2022	Nigeria	Survey + interviews	Nigerian ports lack infrastructure for aquaculture logistics; cold storage and customs inefficiency are major constraints.
74	Eze & Onyekachi (2023)	The Effect of Desalination Imports on Maritime Throughput and Shipping Demand in Lagos and Tin Can Ports, Nigeria: Evidence from ARDL Time Series Analysis.	2015 2022	Nigeria (Lagos, Tin Can Ports)	ARDL time series model	1% increase in desalination imports leads to 0.5% increase in maritime throughput; desalination drives measurable shipping demand.
75	Ogunbiyi & Omotayo (2023)	Rising Seafood Consumption and Data Gaps in Marine Product Demand in Nigeria: Evidence from Household Surveys.	2000 2022	Nigeria (Households)	Survey + expenditure approach	Seafood consumption rising, especially in coastal regions; rural data gaps may underreport total marine product demand.
76	Ibe & Nwaogu (2023)	Fisheries Infrastructure and Maritime Logistics Demand in Nigeria: Evidence from Six Coastal States.	2010 2022	Nigeria (6 coastal states)	Panel regression	Fisheries infrastructure strongly linked to maritime logistics demand; cold-chain shipping services benefit most.
77	Akinwale & Adepoju (2024)	Institutional Gaps and FX Risk in Nigeria: Implications for Fisheries–	2022 2023	Nigeria	Qualitative interviews	Institutional gaps and FX risk weaken linkages between

		Shipping Linkages in the Blue Economy.				fisheries and shipping in Nigeria's blue economy policy framework.
78	Okene, et al. (2024)	Exchange Rate Volatility and Maritime Trade Volume in Nigeria: Evidence from GARCH and ARDL Bounds Testing.	1995 2022	Nigeria	GARCH + ARDL bounds testing	FX volatility has no significant impact on maritime trade volume; recommends domestic production to stabilize exchange rate and revitalize shipping sector.

Source: Researcher's Compilation (2025).

2.6 Gaps in Literature

Despite extensive research on the interactions between exchange rate volatility, fisheries, aquaculture development, desalination logistics, and the financial performance of Nigerian shipping firms, several gaps remain in the existing literature.

Firstly, although some studies (such as Nnaji & Hassan, 2022; Akinwale & Adepoju, 2024) highlight the negative impact of weak legal and institutional coordination on maritime and fisheries sector linkages, these governance factors are rarely incorporated explicitly into quantitative economic models. This indicates a need for empirical research that integrates regulatory environment variables into econometric frameworks to better assess their direct impact on shipping financial performance and trade volumes.

Secondly, much of the existing literature focuses on data ending around 2020 or 2021. For example, (Adekunle & Eyo, 2022; Okoro et al., 2022), with limited investigations that

incorporate the most recent developments up to 2023 and beyond. In light of rapid technological progress, shifting exchange rate regimes, and emerging blue economy policies, contemporary longitudinal studies that apply causal inference methods could yield deeper insights into the sector's evolving dynamics.

Thirdly, while, (Okene et al. 2024: Okoro et al. 2022) underscore the negative effects of Nigeria's high import dependence and exchange rate volatility on maritime logistics costs, there is scanty empirical research exploring how strengthening domestic production of aquaculture inputs and desalination components could help mitigate these vulnerabilities and enhance the resilience of the shipping sector. Although several studies such as (Salami & Ibrahim, 2022; Adewumi et al., 2023) acknowledge infrastructure inadequacies and the high costs associated with importing technology, there are few quantitative analyses linking these factors to shipping demand elasticity or cost structures. Research quantifying the economic benefits of infrastructure upgrades such as improvements in cold storage capacity, modern landing sites, and automated logistics systems remains limited.

Fourthly, most existing analyses rely heavily on aggregate industry or port-level data, with insufficient focus on firm-level case studies or panel data that examine how individual shipping companies respond to macroeconomic shocks like exchange rate volatility and input price volatility. Access to such micro-level data could enrich understanding of the heterogeneity in firm resilience and risk management strategies within the maritime sector.

Furthermore, the literature primarily concentrates on fisheries, aquaculture, and desalination subsectors. Despite some discussion of sustainability in fisheries development, aquaculture development and issues pertaining to desalination, there is inadequate consideration of environmental and climate change factors within analyses of shipping and maritime logistics

performance, particularly in the Nigerian coastal context (Elia & Indrajaya, 2022). These gaps limit the ability to formulate comprehensive policies aimed at promoting a sustainable blue economy.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methods and procedures that was used in this study. The various areas that were discussed here include, research design, population and sample size, sampling techniques, method of data collection, model specification, and operationalization of study variables, and method of data analysis.

3.2 Research Design

This study adopts the time series research design. The rationalization for using this research design is based on the fact that a single country (Nigeria) is the focus of the study with analysis over a period of time. The time series analysis can also offer grounds to examine relationships between an outcome and explanatory variables. This effectively allows a researcher to establish the real sequence of events and also allow a researcher to gain insight into the cause-and-effect

relationships between two or more variables. More so, this research design allows a researcher to source for a number of variables extending over a long period of time without necessarily influencing the outcomes of those variables due to the fact that the data already occurred and hence, are not manipulated.

3.3 Population and Sample Size of the Study

The study centered on the effect of exchange rate volatilities, and, blue economy on financial performance of shipping industry in Nigeria for the period 1990 to 2024. In view of this, the study population is the Nigerian shipping industry. The rationale for focusing this study on Nigeria lies not only in the scarcity of research on the subject within the Nigerian context but also in the country's heavy reliance on oil exports as the primary source of revenue which takes place through the shipping industry. Also, the country relies heavily on imported goods and services as well which also occur in the shipping industry. Given the volatile nature of crude oil prices in the international markets and the volatile nature of import prices (most especially now that there is trade war affecting cost of imports and exports through rising tariff amongst the super powers in the global market place), it becomes essential to examine this issue within the Nigeria setting. Additionally, the Nigeria economy itself serves as the sample size as the study utilizes macroeconomic system wide variables, particularly in relation to the impact of exchange rate volatility and the proxies for blue economy. The population of the study is considered to be manageable and therefore, it was decided that the entire population should be studied. The population of the study therefore, is used as the sample.

3.4 Sources of Data

Data for the study was sourced from secondary sources. Specifically, the shipping industry financial performance data, blue economy data, inflation rate, trade freedom, and labour force

were sourced from both the World Bank development Indicator and the Central Bank of Nigeria Statistical Bulletin for the year 1990 to 2024. Meanwhile, exchange rate volatility was derived using the GARGH (1,1) model. The shipping industry financial performance proxies whose data were sourced are container throughput revenue, shipping costs, and port revenue, while, blue economy proxies that was sourced are fisheries, aquaculture, and desalination. These were controlled by inflation rate, trade freedom, and labour force respectively.

3.5 Theoretical Framework

The model specification is grounded in the Traditional Flow Theory, supported by the Balance of Payments (BoP) Theory, to analyze how exchange rate movements affect the blue economy and the financial performance of Nigeria's shipping industry. The blue economy which includes fisheries, aquaculture, marine tourism, and offshore energy is fundamentally dependent on international trade and the movement of goods and services, making it highly sensitive to volatility in exchange rates.

According to the Traditional Flow Theory, exchange rates respond to trade flows, particularly the balance between exports and imports. When Nigeria experiences trade deficits, the demand for foreign currency rises relative to supply, leading to depreciation of the naira. This depreciation increases the cost of importing shipping-related goods and services, such as maritime equipment, port logistics, and insurance most of which are priced in foreign currencies. As these import costs rise, shipping costs (SHPC) increase, which compresses profit margins and weakens the financial sustainability of shipping firms. At the same time, adverse exchange rate conditions can reduce container throughput revenue (CTP) and port revenue (POR) by discouraging trade volumes and amplifying operational uncertainty.

The model captures these macroeconomic dynamics by regressing key shipping financial performance indicators including container throughput revenue, shipping costs, and port revenue on variables such as exchange rate (EXR), exchange rate-related risk factors (EXRF), inflation rate (IFR), and other operational indicators. This approach reflects how fluctuations in trade flows, mediated through exchange rate volatilities, directly affect the maritime trade and logistics sectors tied to the blue economy.

Complementing this trade-focused framework, the Balance of Payments Theory provides a broader macroeconomic explanation for exchange rate volatility in Nigeria. Persistent trade imbalances particularly heavy reliance on imports and declining export revenues exerts downward pressure on the naira. This not only raises the cost of imported maritime inputs but also undermines the competitiveness of Nigerian exports, affecting shipping demand and financial outcomes across the sector.

In conclusion, the model is well-anchored in the Traditional Flow Theory, which explains the transmission of exchange rate volatility into the financial performance of the shipping industry via trade flow disruptions, rising costs, and declining revenues. This framework highlights how macroeconomic instability, expressed through exchange rate volatility and inflation dynamics, hampers the development of Nigeria's blue economy by constraining maritime trade, reducing port activity, and weakening investment in shipping infrastructure.

3.6 Model Specification

In alignment with the study of Kanu and Nwadiubu (2020)**,** who examined Exchange Rate Volatility and International Trade in Nigeria*,* this study retains the core analytical framework involving the regression of international trade components against exchange rate volatility and other relevant macroeconomic variables. Specifically, their model specified trade volume (TRADE VOL) as a function of the real effective exchange rate (REER), later decomposed into export and import trade components, as follows:

$$EXPT = \alpha_0 + \alpha_1 REER + e_t \quad (3.1)$$

$$IMPT = \alpha_0 + \alpha_1 REER + e_t \quad (3.2)$$

Where:

EXPT = Growth rate of Export trade

IMPT = Growth rate of Import trade

REER = Real Effective Exchange Rate

$\mathbf{e}_t$ = Error term

However, the present study diverges from this framework in a critical way: rather than analyzing aggregate international trade data (exports and imports), it focuses specifically on the financial performance of the Nigerian shipping industry**.** This performance is operationalized through three key dimensions:

1. Container Throughput Revenue (CTP)
2. Shipping Costs (SHPC)
3. Port Revenue (POR)

To better capture the dynamic interactions between exchange rate variables and the shipping sector, these financial indicators are each regressed on a set of exchange rate-related explanatory variables. This approach results in twelve distinct models**,** grouped into four categories based on the nature of exchange rate volatility or blue economy operational variable being considered.

3.6.1 Justification for the Modification

The modifications introduced in this study are primarily driven by the need to tailor the analytical framework to the specific dynamics of the shipping industry. While, Kanu and Nwadiubu, (2020) focused on general trade flows such as exports and imports, the present study

concentrates on the shipping industry a vital component of international trade logistics that is particularly sensitive to exchange rate volatilities. This sector-specific approach necessitates a decomposition of financial performance into distinct operational indicators.

Furthermore, the study expands the set of explanatory variables beyond those used in the earlier model. The inclusion of Exchange Rate Volatility (EXRV), Fisheries (FSH), Aquaculture (AQT), and Desalination (DLNT) captures the diverse impacts of exchange rate volatility on the broader water-related sectors. Specifically, EXRV represents the direct effects of exchange rate volatility; FSH reflects the sensitivity of fisheries to international market dynamics; AQT serves as an indicator of trade and production activity within aquaculture; and DLNT captures the influence of macroeconomic factors on the operational efficiency of desalination processes. In addition, the decomposition of financial performance (the dependent variable) into three distinct and unique dependent variables like Container Throughput Revenue (CTP), Shipping Costs (SHPC), and Port Revenue (POR) enhances the policy relevance of the study. This granularity provides practical insights for policymakers and stakeholders by identifying which specific components of the shipping sector are most affected by currency volatility and inflationary pressures.

3.7 Estimation Technique for Exchange Rate Volatility

To determine the volatility of the naira exchange rate during the study period, this research will employ the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) modeling framework. GARCH models are well-suited for capturing time-varying volatility in financial and macroeconomic time series, making them particularly appropriate for modeling exchange rate volatility, which are known to exhibit volatility clustering and leptokurtic distributional properties.

Specifically, the study utilizes the GARCH (1,1) model, which is among the most commonly used specifications in volatility analysis due to its parsimonious structure and empirical robustness. The GARCH (1,1) model is represented in equation (3.3, 3.4 & 3.5)

$$r_t = \mu + \varepsilon_t \quad (3.3)$$

The equation implies that, the return on the exchange rate at time **t** (denoted as r_t) is equal to a constant average return (μ) plus a random error term (ε_t), which represents the unpredictable fluctuations or shocks in the exchange rate at that time.

In other words, the equation states that each period's return consists of a predictable part (the average return) and an unpredictable part (the random shock).

$$\varepsilon_t \sim N(0, h_t) \quad (3.4)$$

The error term ε_t is normally distributed with a mean of zero and a time-varying variance h_t.
This means that the random shocks in the exchange rate returns are normally distributed around zero, but their variance (or volatility) is not constant, it changes over time and is represented by h_t.

$$h_t = \alpha_0 + \alpha_1 + \beta_1 h_{t-1} \quad (3.5)$$

The conditional variance h_t depends on a constant α_0, the previous period's squared error ε_{t-1}^2 and the previous period's variance h_{t-1}. This means that the volatility of exchange rate returns at time t is not fixed it depends on a constant value, the size of the shock in the previous period, and the volatility from the previous period. In other words, volatility changes over time based on past shocks and past volatility.

Where:

r_t = the return (or log difference) of the exchange rate at time *t*,

μ = is the constant mean,

ε_t = is the error term,

h_t = represents the conditional variance,

α_0>0, α_1≥0, and β_1 ≥0 are parameters to be estimated.

This model effectively captures both the autoregressive nature of volatility and the effect of past shocks, allowing for accurate estimation of exchange rate volatility over time.

After estimating the volatility series, the study investigates the impact of exchange rate volatility, and the blue economy on the financial performance of the shipping industry in Nigeria using the Autoregressive Distributed Lag (ARDL) model. The ARDL modeling approach, developed by Pesaran and Shin (1999), is well-suited for analyzing relationships among variables that are a mix of I(0) and I(1), provided none are integrated of order two [I(2)].

Hence, the modified model is decomposed into twelve (12) models. They are expressed as follows:

CTP= F (EXRV, IFR, TRF, LAB) (3.6)

SHPC= F (EXRV, IFR, TRF, LAB) (3.7)

POR= F (EXRV, IFR, TRF, LAB) (3.8)

CTP= F (FSH, IFR, TRF, LAB) (3.9)

SHPC= F (FSH, IFR, TRF, LAB) (3.10)

POR= F (FSH, IFR, TRF, LAB) (*3*.11)

CTP= F (AQT, IFR, TRF, LAB) (3.12)

SHPC= F (AQT, IFR, TRF, LAB) (3.13)

POR= F (AQT, IFR, TRF, LAB) (3.14)

CTP= F (DLNT, IFR, TRF, LAB) (3.15)

SHPC= F (DLNT, IFR, TRF, LAB) (3.16)

POR= F (DLNT, IFR, TRF, LAB) (3.17)

Econometrically, the models stated above will be re-modified in ARDL form and unit root form:

ARDL Form

Model One: Exchange Rate Volatility and CTP

$$\Delta CTP_t = \alpha_0 + \alpha_1 \Delta CTP_{t-1} + \sum_{i=0}^{m} \Delta EXRV_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.18)$$

Model Two: Exchange rate Volatility and SHPC

$$\Delta SHPC_t = \alpha_0 + \alpha_1 \Delta SHPC_{t-1} + \sum_{i=0}^{m} \Delta EXRV_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.19)$$

Model Three: Exchange rate Volatility and POR

$$\Delta POR_t = \alpha_0 + \alpha_1 \Delta POR_{t-1} + \sum_{i=0}^{m} \Delta EXRV_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.20)$$

Model Four: FSH and CTP

$$\Delta CTP_t = \alpha_0 + \alpha_1 \Delta CTP_{t-1} + \sum_{i=0}^{m} \Delta FSH_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.21)$$

Model Five: FSH and SHPC

$$\Delta SHPC_t = \alpha_0 + \alpha_1 \Delta SHPC_{t-1} + \sum_{i=0}^{m} \Delta FSH_{t-1+} \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.22)$$

Model Six: FSH and POR

$$\Delta POR_t = \alpha_0 + \alpha_1 \Delta POR_{t-1} + \sum_{i=0}^{m} \Delta FSH_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.23)$$

Model Seven: AQT and CTP

$$\Delta CTP_t = \alpha_0 + \alpha_1 \Delta CTP_{t-1} + \sum_{i=0}^{m} \Delta AQT_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.24)$$

Model Eight: AQT and SHPC

$$\Delta SHPC_t = \alpha_0 + \alpha_1 \Delta SHPC_{t-1} + \sum_{i=0}^{m} \Delta AQT_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.25)$$

Model Nine: AQT and POR

$$\Delta POR_t = \alpha_0 + \alpha_1 \Delta POR_{t-1} + \sum_{i=0}^{m} \Delta AQT_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.26)$$

Model Ten: DLNT and CTP

$$\Delta CTP_t = \alpha_0 + \alpha_1 \Delta CTP_{t-1} + \sum_{i=0}^{m} \Delta DLNT_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.27)$$

Model Eleven: DLNT and SHPC

$$\Delta SHPC_t = \alpha_0 + \alpha_1 \Delta SHPC_{t-1} + \sum_{i=0}^{m} \Delta DLNT_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.28)$$

Model Twelve: DLNT and POR

$$\Delta POR_t = \alpha_0 + \alpha_1 \Delta POR_{t-1} + \sum_{i=0}^{m} \Delta DLNT_{t-1} + \sum_{k=0}^{0} X_k \Delta IFR_{t-k} + \sum_{j=0}^{P} X_j \Delta TRF_{t-j} + \sum_{k=0}^{Q} X_k \Delta LAB_{t-k} + \mu t - \quad (3.29)$$

Where:

$EXRV_t$, = Exchange Rate Volatility

CTP_t, = Container Throughput Revenue

$SHPC_t$, = Shipping Cost

POR_t, = Port Revenue

FSH_t, = Fisheries

AQT_t, = Aquaculture

$DLNT_t$, = Desalination

IFR_t = Inflation Rate

LAB = Labour Force

TRF = Trade Freedom

t = stands for time.

α_0 = represent short run coefficients

α_i = represent the long-term coefficients

While, the short-term analysis relates to the adjustment process and immediate effect of the independent variables on the dependent variables, the long-term analysis discloses the speed of adjustment towards equilibrium in the long term.

Re-modifying in unit root form, the general unit root (Augmented Dickey-Fuller-type) model is displayed below in eqn. (3.30).

$$\Delta Y_t = a + \beta Y_{t-1} + \gamma 1 \Delta X_{1,t} + \gamma 2 \Delta X_{2,t} + \ldots + \varepsilon_t \quad (3.30)$$

Where:

Δ = denotes the first difference operator,

Y_{t-1} = is the lagged level of the dependent variable,

α = is a constant,

ϵt = is the error term

Justification for re-modifying in unit root form and using Augmented Dickey-Fuller-type

In time series econometrics, it is critical to understand the stationarity properties of the variables used in a model. Stationarity refers to a situation where a variable's statistical properties like mean, variance, and autocorrelation are constant over time.

The Autoregressive Distributed Lag (ARDL) approach is flexible in allowing the inclusion of variables that are either stationary at level [I(0)] or stationary after first differencing [I(1)], but not variables that are integrated of order two [I(2)]. Including I(2) variables would violate the assumptions of the ARDL bounds testing approach and could lead to spurious regression results where the model appears statistically significant but actually reflects meaningless relationships.

Therefore, before estimating the ARDL models, it is essential to test for the order of integration of each time series variable. This is where re-modifying the model into unit root form becomes necessary. It allows the researcher to assess whether the series are stationary and determine the appropriate transformation (i.e., differencing) needed to stabilize them.

Rationale for Using the Augmented Dickey-Fuller (ADF) Test

The Augmented Dickey-Fuller (ADF) test is a widely used method for checking whether a time series variable has a unit root that is, whether it is non-stationary. The ADF test helps determine whether a variable is:

- I(0) – stationary at level,
- I(1) – stationary after first differencing,
- or I(2) – which would make it unsuitable for ARDL modeling.

The ADF model extends the basic Dickey-Fuller test by including lagged differences of the variable to account for serial correlation in the residuals. This makes the test more robust and reliable, especially when working with economic and financial time series data.

Furthermore, expressing in unit root form, we have;

Model One: Exchange Rate Volatility and CTP

$$\Delta CTP_t = a_1 + \beta_1 CTP_{t-1} + \gamma 11 \Delta EXRV_t + \gamma 12 \Delta IFR_t + \gamma 13 \Delta TRF_t + \gamma 14 \Delta LAB_t \ldots + \varepsilon_{1t} \quad (3.31)$$

Model Two: Exchange rate Volatility and SHPC

$$\Delta SHPC_t = a_2 + \beta_2 SHPC_{t-1} + \gamma 21 \Delta EXRV_t + \gamma 22 \Delta IFR_t + \gamma 23 \Delta TRF_t + \gamma 24 \Delta LAB_t \ldots + \varepsilon_{2t} \quad (3.32)$$

Model Three: Exchange rate Volatility and POR

$$\Delta POR_t = a_3 + \beta_3 POR_{t-1} + \gamma 31 \Delta EXRV_t + \gamma 32 \Delta IFR_t + \gamma 33 \Delta TRF_t + \gamma 34 \Delta LAB_{t \ldots} + \varepsilon_{3t} \quad (3.33)$$

Model Four: FSH and CTP

$$\Delta CTP_t = a_4 + \beta_4 CTP_{t-1} + \gamma 41 \Delta FSH_t + \gamma 42 \Delta IFR_t + \gamma 43 \Delta TRF_t + \gamma 44 \Delta LAB_t \ldots + \varepsilon_{4t} \quad (3.34)$$

Model Five: FSH and SHPC

$$\Delta SHPC_t = a_5 + \beta_5 SHPC_{t-1} + \gamma 51 \Delta FSH_t + \gamma 52 \Delta IFR_t + \gamma 53 \Delta TRF_t + \gamma 54 \Delta LAB_t \ldots + \varepsilon_{5t} \quad (3.35)$$

Model Six: FSH and POR

$$\Delta POR_t = a_6 + \beta_6 POR_{t-1} + \gamma 61 \Delta FSH_t + \gamma 62 \Delta IFR_t + \gamma 63 \Delta TRF_t + \gamma 64 \Delta LAB_t \ldots + \varepsilon_{6t} \quad (3.36)$$

Model Seven: AQT and CTP

$$\Delta CTP_t = a_{67} + \beta_7 CTP_{t-1} + \gamma 71 \Delta AQT_t + \gamma 72 \Delta IFR_t + \gamma 73 \Delta TRF_t + \gamma 74 \Delta LAB_t \ldots + \varepsilon_{7t}$$

(3.37)

Model Eight: AQT and SHPC

$$\Delta SHPC_t = a_8 + \beta_8 SHPC_{t-1} + \gamma 81 \Delta AQT_t + \gamma 82 \Delta IFR_t + \gamma 83 \Delta TRF_t + \gamma 84 \Delta LAB_t + \varepsilon_{8t} \quad (3.38)$$

Model Nine: AQT and POR

$$\Delta POR_t = a_9 + \beta_9 POR_{t-1} + \gamma 91 \Delta AQT_t + \gamma 92 \Delta IFR_t + \gamma 93 \Delta TRF_t + \gamma 94 \Delta LAB_t \ldots + \varepsilon_{9t}$$

(3.39)

Model Ten: DLNT and CTP

$$\Delta CTP_t = a_{10} + \beta_{10} CTP_{t-1} + \gamma 101 \Delta DLNT_t + \gamma 102 \Delta IFR_t + \gamma 103 \Delta TRF_t + \gamma 104 \Delta LAB_t + \varepsilon_{10t} \quad (3.40)$$

Model Eleven: DLNT and SHPC

$$\Delta SHPC_t = a_{11} + \beta_{11} SHPC_{t-1} + \gamma 111 \Delta DLNT_t + \gamma 112 \Delta IFR_t + \gamma 113 \Delta TRF_t + \gamma 114 \Delta LAB_t + \varepsilon_{11t} \quad (3.41)$$

Model Twelve: DLNT and POR

$$\Delta POR_t = a_{12} + \beta_{12} POR_{t-1} + \gamma 121 \Delta DLNT_t + \gamma 122 \Delta IFR_t + \gamma 123 \Delta TRF_t + \gamma 124 \Delta LAB_t \ldots + \varepsilon_{12t}. \quad (3.42)$$

Where:

Symbol	Meaning
Δ	First difference operator. For example, $\Delta CTP_t = CTP_t - CTP_{t-1}$. This is used to transform non-stationary variables into stationary ones.
CTP_t	Container Throughput Revenue
$EXRV_t$	Exchange Rate Volatility
CTP_t	Container Throughput Revenue
$SHPC_t$	Shipping Cost
POR_t	Port Revenue
FSH_t	Fisheries
AQT_t	Aquaculture
$DLNT_t$	Desalination
IFR_t	Inflation Rate
LAB	Labour Force
TRF	Trade Freedom
$\mathbf{a_1}$	Constant term (intercept) for Model One.
$\boldsymbol{\beta_1}$	Coefficient of the lagged dependent variable (CTP_{t-1}), representing how past values of container throughput revenue influence current changes.
$\boldsymbol{\varepsilon_{1t}}$	Error term (random disturbance) for Model One. Captures all other factors affecting ΔCTP_t that are not included in the model.

γ_{11}	The coefficient of the change in Exchange Rate Volatility ($\Delta EXRV_t$) in Model One. The first "1" indicates the model number (Model One), and the second "1" indicates it corresponds to the first explanatory variable (EXRV).
γ_{12}	Coefficient for the change in Inflation Rate (ΔIFR_t) in Model One. The "1" is the model, and "2" is the second explanatory variable.
γ_{13}	Coefficient for the change in Trade Freedom (ΔTRF_t) in Model One.
γ_{14}	Coefficient for the change in Labour Force (ΔLAB_t) in Model One.

Note:

- The first digit in γ_{11}, γ_{12}, etc., refers to the model number (Model One).
- The second digit refers to the position/order of the explanatory variable in that model.

3.8 Measurement of Variables

Table 3.1 highlights the variables, their measurement and various sources of data.

Table 3.1: Variables, Measurement and Source of Data

S/N	Study Variables	Description/Measurement	Sources of Data	Research Studies that have used the Measurement
Dependent Variables				
Financial Performance of Shipping Industry				
1	Container through put revenue (CTP)	Total Throughput = Total Containers Handled.	World Bank Development Indicator.	Allen & McAleer, (2020)
2	Shipping Cost (SHP)	Total Shipping Cost/ Total Shipped.	Drewry Shipping Consultants (Drewry's World Container Index) Freights (digital freight forwarding platforms also provide this data) BIMCO (International	Allen & McAleer, (2020)

			Shipping Association)	
3	Port revenue (POR)	Number of container ships calling at the ports.	UNCTAD (United Nations Conference on Trade and Development).	Kanu & Nwadiubu, (2020)
	Independent Variables			
	Blue Economy			
4	Fisheries (FSH)	Total fisheries production (Metric ton).	World Bank Data (2023)	Kanu & Nwadiubu, (2020)
5	Aquaculture (AQT)	Aquaculture production (metric ton).	World Bank Data (2023).	Kanu & Nwadiubu, (2020)
6	Desalination (DLNT)	Annual fresh water withdrawals. Total (billion cubic meters)	World Bank Data (2023).	Kanu & Nwadiubu, (2020).
7	Exchange Rate Volatility (EXRV)	GARCH Model (1,1) $r_t = \mu + \varepsilon_t$ $\varepsilon_t \sim N(0, h_t)$ $h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$	GARCH Model 1(1)	Francq & Zakoian, (2019)
	Control Variables			
8	Inflation Rate (IFR)	Consumer price Index.	CBN Statistical Bulletin (2023)	Ahmad & Wazir, (2017)
9	Trade Freedom (TRF)	Trade weighted average tariff rate.	Heritage foundation's index of Economic freedom, (2023).	Gwartney et.al. (2024)
11	Labour Force (LAB)	The total number of people employed or unemployed.	World Bank Development Index (2023)	Abodie et.al. (2023)

Source: Researcher's Compilation, (2025)

3.9 Method of Data Analysis

The estimation technique adopted the Autoregressive Distributed Lag Model (ARDL). The essence of adopting this technique was to capture the effects of exchange rate volatility on performance of shipping industry in Nigeria from 1990 to 2024. Allen and McAleer (2020) further stressed that,

this technique is attractive as it represents the simplest method available for modeling combined short-run and long-run relationships among variables. Furthermore, this estimation technique used the bounds testing framework, which was applied to both stationary and non-stationary time series vectors, or combinations of both, as long as none of the data series is of the I (2)) integration order. Before conducting the main econometric analysis, the study began with a series of preliminary tests to understand the characteristics and relationships of the data. First, descriptive statistics were computed for all variables to summarize their key features. These statistics included the mean, which showed the average value over the study period, and the median, which helped to identify the central tendency when the data distribution was skewed. The standard deviation is calculated to measure the variability or dispersion of the data around the mean. Additionally, the minimum and maximum values indicated the range of the data, helping to identify any potential outliers. Measures of skewness and kurtosis are also examined to assess the symmetry and peakedness of the data distribution, respectively. These descriptive statistics provided important insights into the data's distribution and variability, which are crucial for selecting appropriate modeling techniques and interpreting the results.

Next, a correlation matrix was generated to examine the pairwise linear relationships among the variables. The correlation coefficients indicate the strength and direction of these relationships, with values close to +1 suggesting a strong positive association, values near -1 indicating a strong negative association, and values around zero showing no linear relationship. Understanding these correlations helps identify possible multicollinearity issues, where explanatory variables are highly correlated with each other, which can affect the reliability of regression estimates. Moreover, analyzing the correlations between variables such as exchange rate volatility, blue economy indicators, and the performance of the shipping industry provided

theoretical support for the relationships to be tested in the main econometric models. Together, these preliminary tests served as important diagnostic tools that guided the specification of the econometric models and enhance the robustness and validity of the study's empirical findings.

Additionally, the regression models were subjected to a series of diagnostic tests to ensure their adequacy and reliability. The Heteroskedasticity test was used to check whether the variance of the error terms was constant across observations, which is an important assumption in regression analysis. To detect any multicollinearity among the explanatory variables, the study calculated the Variance Inflation Factors (VIF), as high multicollinearity can distort coefficient estimates and reduce the precision of the model. Furthermore, the Ramsey RESET test was employed to identify potential specification errors or omitted variable bias, helping to confirm that the model is correctly specified and that important explanatory variables have not been left out. These diagnostic tests collectively enhance the robustness and credibility of the regression results. The statistical package that was used to run the second-order integrated analysis is Econometric E-Views version 13.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter focuses on the analysis of the data for the study. In particular, empirical tools are employed in estimating the effects of exchange rate volatility and the blue economy on the development and performance of the shipping industry in Nigeria within a time series framework. This empirical analysis involves the interpretation of the estimated models from the previous chapter as well as the tests of hypotheses. In particular, both statistical and econometric tools are employed to demonstrate the empirical relationships in the study. The characteristics of the dataset are initially described using summary statistics and trend analysis, while the coefficients that explain the main relationships of the study are estimated using econometric framework and analysis. The econometric analysis is performed in line with the objectives of the study, with particular focus on the dynamic relationships among the variables. Hence, as described in chapter three, the autoregressive distributed lags (ARDL) technique is used for the analysis. This implies that the time series characteristics of the dataset are initially tested applying both the unit root and cointegration tests.

4.2 Descriptive Statistics

Table 4.1 presents the descriptive statistics for the variables in the study. The major variables in the descriptive statistics are stated in terms of their annual changes in order to derive better perspectives of their behaviour. For the shipping industry variables, average annual growth in container throughput is 6.35% which is moderate and indicates that expansion in container handling volumes over the sample period has not been too drastic. This suggests that the ports in

Nigeria have experienced steady and positive growth on average. The moderate growth however masks significant volatility in cargo throughput over the period with a high standard deviation of 13.79% which is nearly twice the mean value. This shows significant volatility annually or periodic swings in throughput growth, although most of the swings have been largely positive as shown by the positive skewness at 1.91. The J-B statistic fails to reject normality which suggests the data is reasonably symmetric despite the tails, meaning that the dataset have no outliers that can generate estimation issues for the models used in the study. This supports reliable mean-based forecasting for throughput growth.

Table 4.1: Descriptive Statistics

Variable	Mean	Max.	Min.	Std. Dev.	Skew.	Kurt.	J-B	Prob.
CTPG	6.35	59.32	-17.63	13.79	1.91	8.55	2.41	0.30
PORG	30.20	218.63	-65.55	50.17	1.65	7.37	3.41	0.49
SHPCG	1.52	40.23	-37.24	13.97	0.33	5.28	3.96	0.14
EXRTV	43.42	1023.0	-55.00	175.92	5.30	30.02	1308.71	0.00
AQTG	11.00	109.13	-71.57	28.68	0.80	7.16	4.70	0.10
DLNTR	3.55	31.28	-20.88	10.96	0.30	3.45	1.91	0.38
FSHG	4.20	30.18	-19.76	10.22	0.18	3.37	3.33	0.19
IFR	19.02	72.84	5.39	15.96	2.05	6.37	43.47	0.00
LABG	3.18	15.60	2.12	2.23	5.28	29.85	2.21	0.33
TRF	4.81	6.57	1.84	1.48	-0.76	2.23	3.93	0.14

Source: Author's computation, 2025, using Eview 13.

Average growth in port revenue (PORG) is 30.20 percent which is the highest average annual growth rate among the shipping industry indicators. This indicates robust revenue expansion for Nigerian ports over the years even when throughput has not increased sharply. This high mean underscores the financial potential of shipping industry and overall maritime sector in Nigeria. The standard deviation of 50.17 is also high which suggests high level of variability in port

revenue growth annually with growth ranging from a staggering 218.63 percent (perhaps during oil export booms) to -65.55 percent. Average annual growth in shipping cost (SHPCG) is very low at 1.52 percent, although the maximum growth rate of 40.23 percent indicates that there were periods of very high costs of shipping. The low mean is beneficial for trade competitiveness, although it can also reflect price inelasticity of services. The standard deviation is high at 13.97 which shows that shipping costs have not been stable over the years. The J-B statistics for both variables do not reject normality.

Average rate of volatility of exchange rate over the study period is 43.42 with a high standard deviation of 175.92. This shows that on average the naira exchange rate had volatility of over 40 standard deviation points from the mean trend over a given period. The large standard deviation also shows that these volatilities were also very widely varied over the years with period of significant intensity followed by lesser periods of stability. The skewness and kurtosis for the exchange rate volatility series are also very large and show significant shocks and disparities in the system. Given the wide nature of shocks and swings in the exchange rate, the Jarque Berra statistic for the variable is significant and shows heterogeneity across years in relation to exchange rate movement in Nigeria.

For the blue economy variables, average annual growth in aquaculture output (AQTG) is 11.00 percent, which is high (higher than average overall output or real GDP growth over the same period. This indicates that the aquaculture sector in Nigeria has expanded significantly over the years and it has become a key pillar for the blue economy. The average growth is larger than global aquaculture average of 5-7 percent. This suggests great potential of the sector for job creation and export diversification over time. The standard deviation is high at 28.68 which indicates variability over time. Average growth in desalination (DLNTR) is 3.55 percent with a

standard deviation of 10.96 which is high. This average growth rate reflects limited investment in desalination in the country as well as technological barriers in the sector. Average growth rate of fisheries output (FSHG) is 4.20 percent which indicates that this sector is also growing at a moderate rate in Nigeria. Although this average aligns with global trends, it lags behind growth in aquaculture. The standard deviation of 10.22 is over twice the mean rate which also indicates vulnerability in the annual growth in fisheries output in Nigeria. The J-B statistics for the three blue economy variables show that they are normally distributed.

In terms of the control variables in the study, inflation rate is 19.02 percent which is high and shows that inflation has been a persistent macroeconomic challenge in Nigeria over the years. The maximum of 72.84 percent also shows that there were periods of hyper-inflation in the country. Average labour force growth is 3.18 percent which is relatively high, considering that average output growth over the same period is not as large as that. The low standard deviation also shows that labour force growth has been high over the years. Average score for the index of international trade freedom (TRF) is however higher than the median score. Given that the possible score ranges from 1 to 7, the average for Nigeria is relatively moderate. This shows that barriers to international trade have been relatively low in Nigeria.

The initial patterns of relationships among the main variables of the study are indicated in the correlation matrix in Table 4.2. The focus is on the correlation matrix showing the relationship among the shipping industry and the blue economy variables. Among the shipping industry variables, CTP and POR are strongly positively correlated at 0.68. This indicates that higher container throughput significantly boosts port revenue. In contrast, CTP has a weak negative correlation with SHPC at -0.25. This shows that throughput growth does not consistently drive-up shipping costs. Also, POR and SHPC show a moderate positive correlation of 0.434 implying

that there is positive linkage between shipping costs and port revenue where higher revenues align with rising costs. EXRTV exhibits weak to moderate relationship with the shipping industry performance variables. This suggests that exchange rate volatility may indirectly amplify activity or costs in the sector.

Table 4.2: Correlation Matrix

Variable	CTP	POR	SHPC	EXRTF	AQT	DLNT	FSH	IFR	LAB	TRF
CTP	1									
POR	0.68 0.00	1								
SHPC	-0.25 (0.15)	0.43 (0.01)	1							
EXRTV	0.21 0.23	0.68 0.00	0.41 0.01	1						
AQT	0.85 0.00	0.74 0.00	0.04 0.84	0.22 0.20	1					
DLNT	0.92 0.00	0.76 0.00	-0.08 0.64	0.21 0.24	0.93 0.00	1				
FSH	0.91 0.00	0.77 0.00	-0.03 0.87	0.23 0.18	0.97 0.00	0.99 0.00	1			
IFR	-0.41 0.02	-0.05 0.79	0.46 0.01	0.14 0.43	-0.26 0.13	-0.42 0.01	-0.36 0.03	1		
LAB	0.87 0.00	0.93 0.00	0.16 0.35	0.49 0.00	0.88 0.00	0.92 0.00	0.93 0.00	-0.23 0.19	1	
TRF	0.78 0.00	0.31 0.07	-0.62 0.00	0.10 0.55	0.54 0.00	0.68 0.00	0.64 0.00	-0.66 0.00	0.55 0.00	1

Source: Author's computation, 2025, using Eview 13.

Among the blue economy factors, all the variables of AQT, DLNT and FSH display very strong positive correlations with each other ranging from 0.93 to 0.99. This demonstrates that there is strong interconnectedness among the blue economy components in Nigeria. These variables also show strong positive correlations with CTP (at 0.85 for AQT, 0.92 for DLNT, 0.91 for FSH) and POR (at 0.74 for AQT, 0.76 for DLNT, 0.77 for FSH). Thus, growth in aquaculture, desalination, and fisheries are significantly associated with higher port activity and revenue. However, their correlations with SHPC are negligible and mostly negative this shows minimal association of

blue economy factors with shipping costs. Exchange rate volatility (EXRTV) has generally positive and moderate correlations with AQT, DLNT, and FSH at values between 0.21 and 0.23. This imply that exchange rate volatility directly influences blue economy growth in Nigeria.

Further analysis of the relationships among the blue economy and shipping industry variables is performed to determine whether indirect relationship exists among the variables. In Figure 4.1, the scatterplot for the relationship between shipping cost and port revenue is shown. The chart reveals a non-monotonic and U-shaped relationship between shipping cost and port revenue in Nigeria. This pattern indicates that port revenue does not change linearly with shipping costs but instead reaches a minimum at intermediate cost levels with higher revenues at both low and high ends of the cost spectrum. Specifically, the U-shaped relationship depicted in the chart shows initial decline in port revenue as shipping costs rise. At very low shipping costs, ports attract a high volume of traffic due to affordability. In this case cost-sensitive shippers tend to handle bulk commodities to ensure lower costs which suggests that revenue remains high because the large throughput compensates for potentially slim margins.

As shipping costs continue to increase, demand becomes more elastic (the curve is flatter). In this case, shippers tend to seek cheaper alternatives (like neighboring ports) and this leads to a drop in cargo volume. In Nigeria, inefficiencies like congestion and high turnaround times exacerbate this, causing revenue to decline. Further increases in shipping costs beyond a threshold point are shown to appear and shift the port's focus toward lesser price-sensitive position. The reduced volume due to higher costs is offset by higher per-unit revenue from premiums or specialized services. This leads to a revenue rebound for the ports. Higher costs may also signal investments in port infrastructure or efficiency which (although it increases operational costs) attract premium clients willing to pay more. The U-shape of the relationship

between shipping costs and port revenue therefore mirrors a transition from elastic demand to inelastic demand for port services in Nigeria.

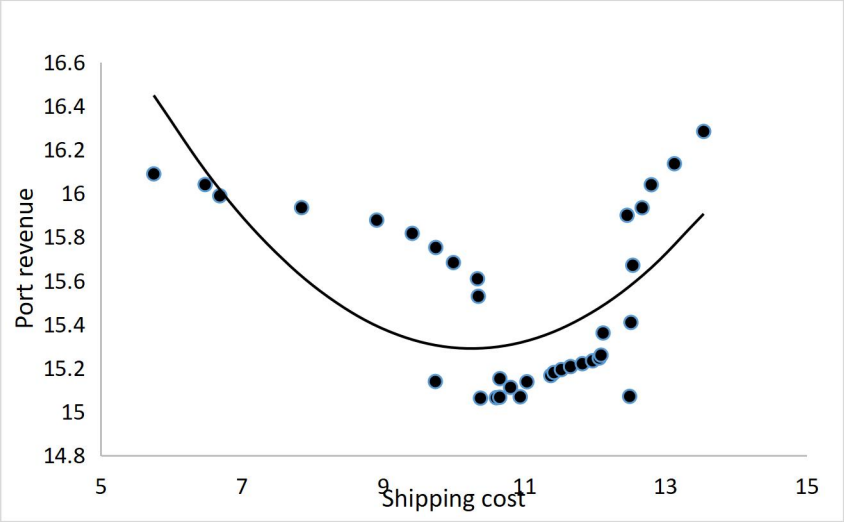


Fig. 4.1: Port revenue and shipping cost

In terms of the relationship between cargo throughput and port revenue, the scatterplot in Figure 4.2 Shows that a linear relationship exists. Thus, there is a linear or direct path in terms of how increase in cargo throughput affects port revenue. The upward-sloping trend line indicates that as cargo throughput increases, there is a corresponding and direct increase in port revenue in Nigeria.

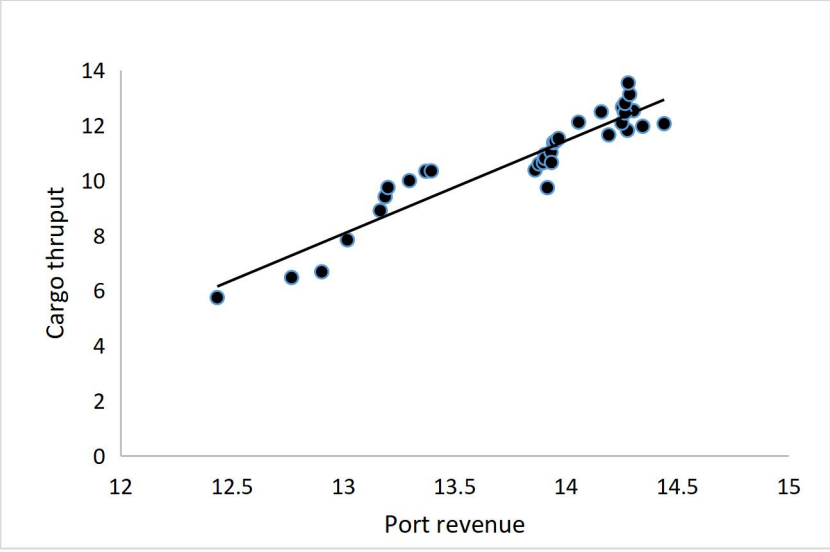


Fig. 4.2: Cargo throughput and port revenue

The relationship between cargo throughput and shipping costs is also shown in the scatterplot in Figure 4.3. The relationship is also non-linear with a U-shaped structure. This is similar to the relationship between shipping cost and port revenue. The chart shows that as shipping costs continue to increase over time, cargo throughput initially decreases. The decrease is however reversed after a threshold is reached. Beyond this threshold, further increases in shipping costs tend to lead to higher cargo throughput in the Nigerian port system.

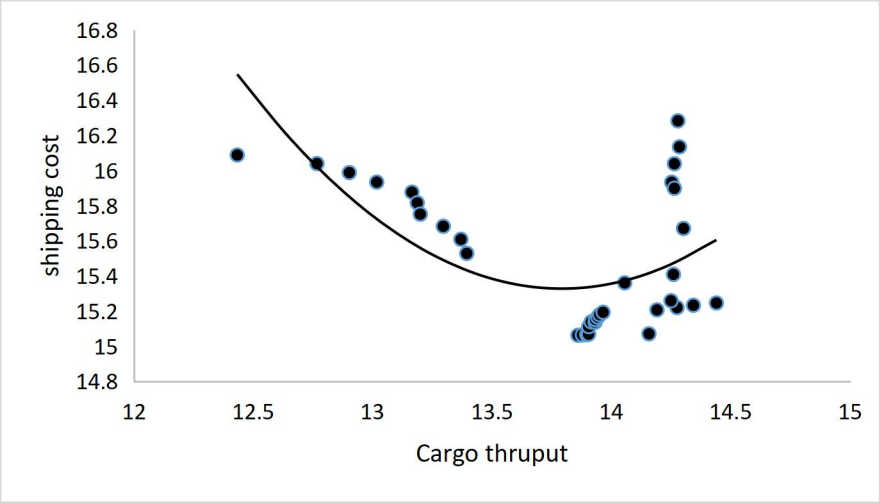


Fig. 4.3: Cargo throughput and shipping cost

The scatterplot for the relationship between aquaculture production and fishery production is presented in Figure 4.4. A linear relationship is shown between the two variables which indicates that as one blue economy factor increases, the other is also increasing. In particular, the trend equation shows that for every one percent increase in aquaculture production in Nigeria, fishing output also increases by up to 0.33 percentage point.

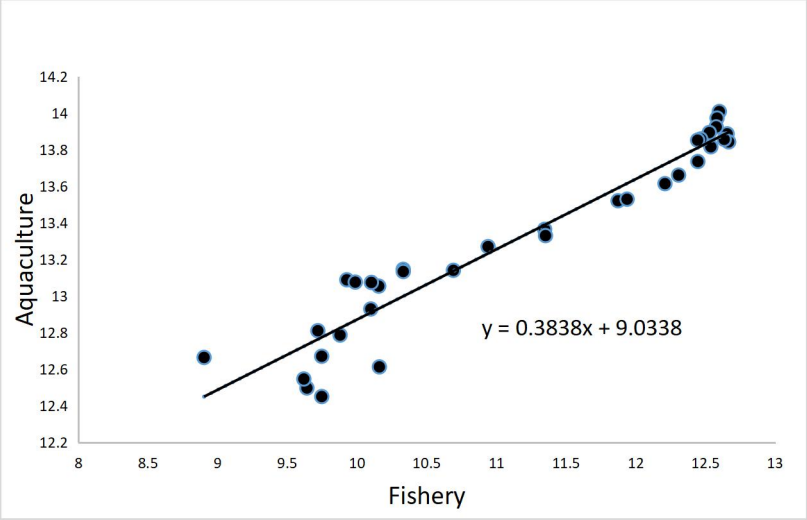


Fig. 4.4: Aquaculture and fishery

A linear relationship is also observed for the relationship between desalination and fishery, and between desalination and aquaculture as shown in Figures 4.5 and 4.6 respectively. This shows that an increase in one of the variables effectively stimulates increase in the other. In both cases, the slope of the linear function is positive and greater than 1.0. This shows that increase in desalination leads to a more than proportionate increase in both fishery output and aquaculture in Nigeria. This shows the central role of the component of desalination within the blue economy system in Nigeria.

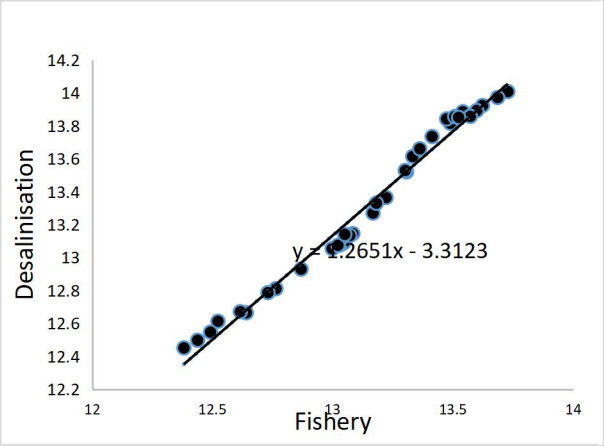


Fig. 4.5: Desalination and fishing

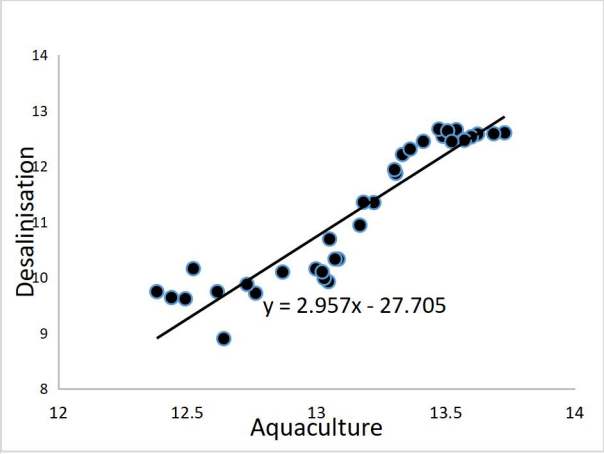


Fig. 4.6: Desalination and aquaculture

4.3 Unit Root and Cointegration Analysis

The unit root test for the variables is used to examine the level of stationarity of the time series used in the empirical analysis. This test is important because non-stationary time series are non-mean reverting and analysis based on such data may result in spurious regression relationships. In this study, the Augmented Dickey Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests of unit roots (test of the stationarity of the datasets) are employed. The ADF test has the advantage of being an indirect approach to testing unit roots with particular focus on stationarity processes of the dataset. On the other hand, the KPSS presents a deeper outcome by directly testing for unit roots. The results of the unit root tests are presented in Table 4.3.

Table 4.3: Unit Root Test for Variables

Variable	ADF Test		KPSS		Order of Integration
	Levels	*First Difference*	*Levels*	*First Difference*	
CTP	-1.649	-4.792	0.656	0.291	I(1)
SHPC	0.02	-3.429	0.654	0.205	I(1)
POR	-3.189	-6.487	0.758	0.334	I(1)
EXRTV	2.573	-3.162	0.394	0.305	I(0)
FSH	-0.651	-6.04	0.650	0.160	I(1)
AQT	-1.841	-1.365	0.598	0.157	I(1)
DLNT	-1.088	-5.583	0.659	0.135	I(1)
IFR	-2.137	-4.668	0.591	0.187	I(1)
LAB	-1.269	2.986	0.582	0.229	I(0)
TRF	-1.543	-7.031	0.6182	0.272	I(1)

*Note: * and ** indicate signifies at 5 and 1 percent levels respectively.* Source: Author's computation, 2025.

It is seen from Table 4.3 that the ADF test results for all the variables (except EXRTV and IFR) have insignificant ADF statistics when the variables are in levels. All the variables however have significant ADF coefficients after first differences. This shows that all the variables (apart from EXRTV) are integrated at order one (i.e., I[1]) while the variables EXRTV and IFR are integrated of zero (i.e., I[0]). Thus, the variables exhibit mixed stationarity status. These results

are also demonstrated by the KPSS test outcomes. Note that the hypotheses for KPSS are reversed to indicate that coefficients that are significant suggest non-stationarity.

From the unit root tests, it is seen that the integration status of the variables is mixed (some variables are I(1) while others are I(0)). Thus, all variables in the model are not integrated of the same order, which implies that the normal cointegration test may not generate adequate estimates. In the study, the Bounds cointegration test procedure within the ARDL approach to cointegration is employed for the cointegration test. The results of the Bounds cointegration test are reported in Table 4.4. The test evaluation is based on the estimated F-statistic values for each of the equations which are tested against the critical values for the lower (I0 Bounds) and upper (I0 Bounds) based on their critical F-values.

Table 4.4: Bounds Cointegration Test

Test Statistic	Value	Significance	I(0)	I(1)
Eqn: with EXRTV				
F-statistic	3.805	10%	2.08	3
K	5	5%	2.39	3.38
		1%	3.06	4.15
Eqn: with FSH				
F-statistic	4.571	10%	2.08	3
K	5	5%	2.39	3.38
		1%	3.06	4.15
Eqn: with AQT				
F-statistic	4.510	10%	2.08	3
K	5	5%	2.39	3.38
		1%	3.06	4.15
Eqn: with DLNT				
F-statistic	6.318	10%	2.75	3.79
K	5	5%	3.12	4.25
		1%	3.93	5.23

Source: Author's computation, 2025

From the results in Table 4.4, it is seen that the computed F-statistics for the models are between 3.8 and 6.32 while the 5 percent critical values for the I(0) and I(1) bounds are between 2.39 and 4.25 (note that the F statistic of 6.32 for DLNT variable is greater than the I(1) critical value of

4.25). This shows that the F-statistics values are all greater than both the I(0) and I(1) values in the critical test outcomes at the 5 percent level. Therefore, the estimated F-statistics pass the significance test at the 5 percent level. The null hypothesis of no cointegration is rejected for each equation, stating that a long run relationship actually exists among the combination of variables for each of the equations. This further establishes the robustness of the ARDL estimation framework used in the study.

4.4 Regression Analysis

4.4.1 GARCH Estimation of Exchange Rate Volatility

The volatility in the naira exchange rate is estimated using the GARCH estimation framework to generate volatilities. The results from the GARCH estimates are presented in Table 4.5. From the mean result, it is seen that the lag of exchange rate plays a critically significant role in current exchange rate outcomes. This shows that past exchange rates tend to influence current exchange rates outcomes in Nigeria. The variance equations of the GARCH estimations also contain important indicators that highlight the pattern of volatilities in exchange rates in the country. The mean term in the result (ω) is negative and significant at the 5 percent level. This indicates a baseline negative contribution to the log of conditional variance. Thus, in the absence of other effects the volatility of the exchange rate tends to be lower than a reference level of zero. This also shows that the naira exchange rate has a general tendency to spiral upwards at any given time.

Table 4.5: EGARCH Results for Exchange Rate Volatility

Variable	*Coeff*	*t-stat*	*Prob.*
Constant	0.498	3.324	0.001
$exrt_{t-1}$	0.906	30.769	0.000
Variance Equation			
ω	-1.784	-2.123	0.038
α	1.437	2.150	0.030
γ	-0.685	-1.134	0.257
β	0.668	2.366	0.018
Adj. R-sq.		0.967	
D-W stat		1.838	

Source: Author's computation, 2025, using Eview 13.

The coefficient of α is positive and significant in the estimate. This shows that the magnitude of past standardised exchange rate shocks significantly increases current volatility. A larger absolute shock in the previous period increases the current rate of volatility of the naira exchange rate by up to 1.437 units. This also indicates that exchange rate volatility in Nigeria is highly responsive to the size of past shocks in the currency value. The asymmetry parameter (γ) is negative but not significant. This shows that there is no strong evidence of a leverage effect in terms of exchange rate movements over time. The lack of a significant leverage effect suggests that both positive and negative exchange rate shocks have similar impacts on current volatility. The coefficient of β is significant and positive. This shows that past volatility influences current volatility. Thus, there is evidence of persistence in exchange rate volatility in Nigeria. The results from the GARCH estimates also have very impressive goodness of fit outcomes. The adjusted R-squared is very high at 96.7%. This shows that the model captures most of the dynamics in the exchange rate series. Thus, the use of the model to generate volatility in the study is justified.

4.5 Analysis of the ARDL Results

In the section the processes for the analysis of regression results are outlined. These involve initially estimation of the ARDL models for the study. The initial analysis involves the test for lag length for the ARDL estimates.

4.5.1 Lag Length Selection

Generally, cointegration-based analyses (such as the ARDL) are susceptible to variations and instability on the basis of their lag structures. The lag-induced instability is more serious for autoregressive estimations that require dynamic interpretation (Greene, 2011). Hence, given that the collection of variables in the study is assumed to be cointegrated, the lag selection test is also performed to determine the maximum lag that can generate optimum values for the coefficients in the ARDL estimation. In the lag selection, optimality of the model was determined using both the Akaike Information Criterion (AIC) and Schwarz–Bayesian Criterion (SC). The optimum lag length is determined by considering the minimum AIC and SC values for each lag length, with those with the least selected values selected. The results shown in Table 4.6 indicates that the second lag is the optimal lag for the model with EXRTV, while the third lag is optimal for the other models. The estimations of the ARDL models are performed based on the selected optimal lags.

Table 4.6: Lag Length Selection Criteria

No of Lags	**Model with EXRTV**		**Model with FSH**		**Model with AQT**		**Model with DLNT**	
	AIC	*SC*	*AIC*	*SC*	*AIC*	*SC*	*AIC*	*SC*
0	2.803	2.063	2.741	3.008	2.165	2.376	5.455	5.986
1	1.943	1.228	2.419	2.129	1.911	1.682	4.814	4.237
2	1.764*	-2.184*	2.262	2.407	1.787	1.902	4.501	4.790
3	1.983	-1.939	1.440*	1.847*	1.031*	0.973*	2.866*	2.137*
4	2.187	-1.823	1.788	2.002	1.413	1.582	3.558	3.984

Source: Author's computation using Eview 13.

4.5.2 Regression Analysis (ARDL Results)

In this section, the models that were specified in the previous Chapter are estimated and the results are reported and analysed. As stated earlier, the Autoregressive Distributed Lag (ARDL) estimation framework was used in the empirical model determination. This modeling procedure therefore estimates both short-run dynamics and long-run equilibrium relationships between the social welfare variables on the one hand, and the public sector budget deficit indicators. The results of the estimation of the effects of exchange rate volatility on the shipping industry financial performance (measured as container throughput, shipping cost, and port revenue) are presented in Table 4.7. The models are well-specified since they all exhibit impressive diagnostic indicators. The adjusted R-squared values for the three equation estimates range from 0.474 to 0.494. This indicates that about 47-49% of the variation in the shipping industry performance indicators is explained by the regressors. The Durbin-Watson statistics (around 2) suggest no significant autocorrelation in the residuals, supporting the reliability of the inferences.

Table 4.7: Results for Exchange Rate Volatility and Shipping Industry Financial Performance

Variable	*Container thruput*		*Shipping cost*		*Port revenue*	
	Coeff.	**Prob.**	**Coeff.**	**Prob.**	**Coeff.**	**Prob.**
Short Run ARDL Result						
ΔEXRTV			-0.001	0.000		
ΔLAB			10.572	0.000		
ΔIFR					-0.003	0.532
ΔTRF	0.080	0.001			0.030	0.733
ΔTRF_{t-1}	0.059	0.012			0.229	0.017
ECM_{t-1}	-0.490	0.000	-0.286	0.000	-0.410	0.000
Long Run ARDL Result						
EXRTV	-0.643	0.074	-0.099	0.057	-0.849	0.503
IFR	0.001	0.818	0.004	0.589	0.015	0.476
LAB	1.582	0.000	2.059	0.029	4.961	0.003
TRF	0.138	0.003	-0.170	0.096	-0.061	0.790
Constant	-3.363	0.344	-6.393	0.494	-46.525	0.005
Adj. R-sq.	0.494		0.490		0.474	
D-W stat	2.006		2.128		2.566	

Source: Author's computation, 2025, using Eview 13.

The short run results, which capture the temporal effects of the explanatory variables, are reported in the upper panel of the regression Table 4.7. For the container throughput estimates, no short-run coefficients are provided for the exchange rate volatility variable. This is from the parsimonious estimates generated from E-Views 13 computer output. These values are left out because they do not contribute to the efficiency of the estimation of the given equation as opined by Stock & Watson (2020). This shows that exchange rate volatility has no observed effects on container throughput in Nigeria in the short run. Thus, container throughput exhibit limited immediate responsiveness to changes in the exchange rate. The coefficient of current and lagged trade freedom (TRF) is both significant and positive, indicating that trade freedom significantly increases container thruput in the short run. In the shipping cost equation, the short run results reveal that exchange rate volatility has a significant negative effect. This shows that instability of the exchange rate, especially via depreciation, significantly increases short run patterns of shipping costs in Nigeria. The exchange rate volatility variable only appears on the shipping cost estimates in the short run. Refer to the explanation of parsimonious efficient estimates. The E-views selects the parsimonious estimates based on efficiency and the maximum lags supplied. This is observed in the study of Stock & Watson (2020). This shows that volatility in the naira is only reflected on shipping costs in the short run.

The coefficient of the error correction mechanism (ECM_{t-1}) is negative and highly significant ($p = 0.000$) across all the models. This confirms the presence of a stable long-run relationship that ensures that equilibrium is always restored in the long run. The value of the coefficients implies adjustment speeds of 49 percent for container throughput, 28.6 percent for shipping cost, and 41 percent for port revenue per period towards equilibrium after any short-run deviations. This

indicates that adjustment for shipping costs is relatively lower than the other measures of shipping industry performance.

It should be noted that the short-run effects highlight adjustment process and immediate responses. Hence, the long-run coefficients are of primary interest in the study since they reflect sustainable policy-relevant outcomes in Nigeria's blue economy and shipping sector. The results of the long run estimates which show the long-term equilibrium level results are reported in the lower panel of Table 4.7. In the result, the coefficient of exchange rate volatility (EXRTV) is only significant at the 10 percent level for the container throughput (-0.643) and the shipping cost (-0.099) models. The coefficient is however insignificant in the port revenue model. This result indicates that exchange rate volatility has no significant effect on the trends of port revenue in the long run. Exchange rate volatility however has marginally significant negative effects on both throughput and shipping cost. Specifically, an increase in exchange rate volatility tends to reduce container throughput in the long run. This indicates that increased instability of the naira exerts subtle but persistent erosion of shipping volumes in Nigeria over time. This can be directly linked to high uncertainty levels generated by unstable exchange rate. Indeed, the naira has faced frequent and deep fluctuations over the years. The result reveals that volatility in exchange rate tends to deter trade predictability and stifles the shipping industry and overall blue economy growth in Nigeria.

The result also shows that a percentage hike in the naira volatility lowers shipping costs. This outcome is essentially counterintuitively and may reflect adaptive behaviours in the shipping industry in Nigeria. However, this outcome is plausible given that exchange rate volatility tends to depress demand which then forces cost-cutting among exporters and importers. For the control variables, the coefficients of labour and trade freedom trading are both significant in the

throughput and cost equations. Thus, labour significantly improves container throughput which empahises Nigeria's labour-intensive shipping sector. Increased freedom of international trade (limited tariffs and barriers) is also show to increase throughput and shipping costs. This also reflects the benefits of reduced tariffs and barriers in enhancing the shipping industry in Nigeria over time.

The results of the impact of fisheries production (FSH) on the three key indicators of Nigeria's shipping industry performance are presented in Table 4.8. The models also report impressive goodness of fit indicators. The adjusted R-squared values (0.647 for container throughput, 0.381 for shipping cost, and, 0.710 for port revenue) are relatively high and indicate that the models explain a substantial portion of variation in the dependent variables. The throughput and port revenue models particularly perform well in terms of predictive capacity. The Durbin-Watson statistics for the estimates are all close to 2.0 and confirm the absence of significant autocorrelation. This also supports the reliability of the results. The F-statistic values are significant at the 6 percent level and reveal that the regressors are jointly significant with the respective dependent variables.

Table 4.8: Results for Fisheries Production and Shipping Industry Financial Performance

Variable	*Container thruput*		*Shipping cost*		*Port revenue*	
	Coeff.	**Prob.**	**Coeff.**	**Prob.**	**Coeff.**	**Prob.**
Short run						
ΔFSH	0.341	0.079	0.085	0.685		
ΔFSH_{t-1}	0.968	0.000	0.384	0.120		
ΔFSH_{t-2}	1.070	0.000				
ΔIFR	-0.001	0.516				
ΔIFR_{t-1}	0.005	0.005				
ΔIFR_{t-2}	0.006	0.001				
ΔLAB)	-6.072	0.000			5.940	0.000
ΔLAB_{t-1}	27.447	0.000				
ΔTRF	0.057	0.012				
ECM_{t-1}	-0.466	0.000	-0.317	0.000	-0.428	0.000
Long run						
FSH	-1.375	0.202	-0.937	0.303	-0.446	0.740
IFR	-0.007	0.462	0.011	0.242	0.017	0.295
LAB	4.683	0.050	--	--	0.811	0.577
TRF	0.214	0.012	-0.185	0.055	-0.136	0.347

Constant	-19.468	0.112	8.910	0.000	
Adj. R-sq.	0.647		0.381		0.710
D-W stat	2.290		1.999		2.328
F-stat.	12.83		7.553		8.731

Source: Author's computation using Eview 13.

The long-run coefficients which represent equilibrium elasticities are reported in the lower segment of Table 4.8. For the container throughput estimates, the coefficient of -1.375 for fisheries output (FSH) is not significant. This shows that increases in fisheries production do not affect long run performance of throughput in the shipping industry in Nigeria. The negative coefficient of FSH in the SHP model at -0.937 even though it is insignificant is concerning for the blue economy. It suggests that growth of the fisheries sub-sector has the capacity to crowd out other cargo activities which are likely to reduce overall throughput. The coefficient of -0.446 for fisheries output is also insignificant in the shipping cost and port revenue equations. These clearly show that fisheries production does not affect the performance of the shipping industry in the long run in Nigeria.

For the short run estimates, the result reveals that fisheries output has a significant positive effect on container throughput both for the first and second lags at 0.968 and 0.730 respectively. This shows that increase in fisheries production significantly improves throughput in the shipping sector in the short run. Thus, although the short run effect of fisheries on container throughput is generally insignificant and likely negative, there is clear evidence that the short run impacts are strongly positive. All the other coefficients have significant short run effect on throughput. The coefficient of fisheries is insignificant in the short run result for shipping cost and does not appear in the parsimonious short run port revenue model. This shows that there is no short run relationship between fisheries output and either shipping cost and port revenue. These results indicate that, as a blue economy variable, fisheries production does not have strong dynamic relationship with the performance of the shipping industry in Nigeria. The error correction

mechanism (ECM_{t-1}) is negative and highly significant (p = 0.000) across all models. The coefficients are -0.466 for container throughput, -0.317 for shipping cost, and -0.428 for port revenue. This shows that there is long run stability in the models.

The ARDL results for the impact of aquaculture production (AQT) on the three key indicators of Nigeria's shipping industry are presented in Table 4.9. The adjusted R-squared values of 0.494 for container throughput, 0.647 for shipping cost, and 0.893 for port revenue indicate moderate to high explanatory power of the models. The Durbin-Watson statistics which range from 1.751 to 2.649. This value lies in the grey area of between 1.64 and 2.81 and therefore suggest no significant autocorrelation in the estimated models, Asteriou & Hall (2021). The container throughput model has an F-statistics value of 5.061 while that of port revenue model is 17.195. These confirm the joint significance of regressors in the models.

The short-run coefficients capture immediate responses of the shipping industry variables to changes in aquaculture production and other control variables. In the results in Table 4.9, the container throughput model shows that the coefficient of AQT (0.029) is not significant which shows that aquaculture production has negligible immediate impact on throughput in Nigeria. The coefficients of current and lagged AQT which are -0.407, 0.705, and 0.343 are however significant and mostly negative in the shipping cost model which shows that aquaculture initially reduces costs but increases them over time in the short run. The coefficients of the first and second lags of AQT (which are -1.469 -0.353 respectively) are also significant in the port revenue equation. The negative lagged effects show that aquaculture reduces port revenue in the short run in Nigeria. The short run results therefore that aquaculture production exert mixed effects on the shipping industry in Nigeria. For the control variables, the coefficients of inflation

and trade freedom index are mostly significant in the short run which show that inflation is a critical factor in explaining short run changes in shipping industry performance in Nigeria.

The coefficient of the error correction term for each of the models is negative and highly significant at the 1 percent level. This shows long run stability in each of the estimates that indicate that after any short-term shock in the system, long run stability will always be restored. While the adjustment speeds to long run are moderate for the container throughput and the shipping cost models at 5.18 and 4.99 percent respectively in the first year, that of port revenue is explosive. The ECM for port revenue suggests rapid over-adjustment linked to volatile revenue dynamics in Nigeria.

Table 4.9: Results for Aquaculture Production and Shipping Industry Financial Performance

Variable	*Container thruput*		*Shipping cost*		*Port revenue*	
	Coeff.	**Prob.**	**Coeff.**	**Prob.**	**Coeff.**	**Prob.**
Short run						
ΔAQT	0.029	0.582	-0.407	0.022	-0.319	0.215
ΔAQT_{t-1}			0.705	0.001	-1.469	0.002
ΔAQT_{t-2}			0.343	0.003	-0.353	0.041
ΔIFR	-0.001	0.338	0.001	0.684	0.003	0.370
ΔIFR_{t-3}			-0.004	0.028	-0.012	0.003
ΔIFR_{t-2}			-0.006	0.009		
ΔLAB	-0.818	0.133	8.058	0.002	3.873	0.285
ΔLAB_{t-1}			-19.48	0.166	-113.27	0.001
ΔLAB_{t-2}			76.21	0.000	-116.89	0.001
ΔTRF	0.056	0.035			-0.050	0.414
ΔTRF_{t-1}					0.261	0.001
ΔTRF_{t-2}					0.248	0.008
ECM_{t-1}	-0.518	0.000	-0.499	0.000	-1.417	0.000
Long run						
AQT	0.116	0.700	-1.625	0.088	1.900	0.001
IFR	-0.004	0.800	0.008	0.408	0.015	0.022
LLAB	0.883	2.187	-67.29	0.115	86.68	0.001
TRF	0.127	0.372	-0.008	0.940	-0.088	0.301
Constant	3.651	0.793	372.44	0.000	-132.46	0.000
Adj. R-sq.	0.494		0.647		0.893	

D-W stat	1.751	2.649	2.488
F-Stat.		5.061	17.195

Source: Author's computation, 2025, using Eview 13.

The long-run coefficients which show the stable relationships among the variables are reported in the lower panel of Table 4.9. In the container throughput result, the coefficient of aquaculture fails the significance test at the 5 percent level. This shows a weak and irrelevant effect of aquaculture production on container throughput in the shipping industry. This weak relationship was also observed for the fisheries effects, indicating that fisheries and aquaculture are not potent factors that help to shape container throughput in Nigeria in the long run. Indeed, the result shows that aquaculture's blue economy potential is not effectively harnessed for long run port activities in Nigeria.

In the shipping cost model, the coefficient of AQT is slightly significant (at the 10 percent level) and is negative. This shows that aquaculture exerts a marginally significant negative effect on shipping costs in Nigeria in the long run. The elasticity of effect is 1.625 percentage point which is a substantial elasticity. It reveals that aquaculture tends to foster cost efficiencies in the shipping industry over time. The coefficient of AQT in the long run estimates for port revenue is significant at the 1 percent level and positive. This shows that with a 1 percent increase in aquaculture production, port revenue is boosted by about 1.9 percentage points. This reflects strong financial health for maritime infrastructure reinvestment that this blue economy indicator provides. The coefficient shows a highly elastic response of long-term port revenue to aquaculture development in Nigeria.

Finally, the results for the effect of the blue economy component of desalination (DLNT) on the shipping industry performance indicators are reported in Table 4.10. The models also exhibit

impressive goodness of fit outcomes. The adjusted R-squared values are all high at 0.739 for container throughput, 0.337 for shipping cost, 0.926 for port revenue estimates. These indicate that the models possess strong explanatory power. The Durbin-Watson statistics also sufficiently close to 2.0 to suggests that the models are relatively free of autocorrelation. The F-statistics for the estimates are 6.848, 9.387, and 6.83 and they are all significant and indicates that there is joint significance of regressors in the model.

Table 4.10: Results for Desalination and Shipping Industry Financial Performance

Variable	*Container thruput*		*Shipping cost*		*Port revenue*	
	Coefficient	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
Short run						
ΔDLNT	-0.835	0.004			3.485	0.001
$\Delta DLNT_{t-1}$	1.715	0.000			3.514	0.001
$\Delta DLNT_{t-2}$	1.412	0.000			4.033	0.001
ΔIFR	-0.006	0.007			-0.001	0.844
ΔIFR_{t-1}	0.012	0.000			0.013	0.014
ΔIFR_{t-2}	0.007	0.000			0.006	0.134
ΔIFR_{t-3}					-0.010	0.012
ΔLAB	-7.094	0.000	2.279	0.031	14.137	0.003
ΔLAB_{t-1}	19.723	0.021			49.598	0.022
ΔLAB_{t-2}	24.245	0.015			24.958	0.385
ΔLAB_{t-3}					138.76	0.001
ΔTRF	0.126	0.000			0.037	0.445
ΔTRF_{t-1}					-1.057	0.000
ΔTRF_{t-2}					-0.805	0.000
ΔTRF_{t-3}					-0.583	0.000
ECM_{t-1}	-0.486	0.000	-0.262	0.000	-1.627	0.000
Long run						
DLNT	-6.618	0.051	0.393	0.792	-2.111	0.217
IFR	-0.032	0.081	0.001	0.944	-0.016	0.196
LAB	3.797	0.512	-10.932	0.281	6.075	0.027
TRF	0.399	0.004	-0.305	0.006	0.588	0.021
Constant	26.73	0.000	33.61	0.000	-31.24	0.011
Adj. R-sq.	0.739		0.337		0.926	
D-W stat	2.825		1.884		2.948	
F-Stat.	6.848		9.387		6.83	

Source: Author's computation using Eview 13.

In the short run estimates, the coefficient of DLNT does not appear in the shipping cost model. As explained earlier these are the E-Views parsimonious estimates where the omitted coefficients are inefficient in the model estimation. Their inclusion weakens the efficiency of the estimation as suggested by Stock & Watson (2020) and they clearly do not contribute anything to the explained segment of the models. This shows that desalination does not have relationship with shipping costs. However, the coefficient is significant and mainly positive for the container throughput and port revenue models. This shows that desalination (which is a measure of infrastructural support in the blue economy) significantly promote both container throughput and port revenue in the short run in Nigeria. Only labour is significant in the shipping cost model which shows that central role of labour in driving short run shipping costs in Nigeria. Most of the control variables are significant in the long run estimates for container throughput and port revenue models, which show that in the short run, inflation rate, labour and trade freedom are important in promoting the shipping industry performance in Nigeria. The short-run dynamics therefore reveal that desalination exerts mixed effects on the shipping industry performance within the immediate period. The long-run estimates are however more stable and policy-relevant particularly for desalination. The coefficient of the error correction term is also significant in all three equations and also possess the expected negative signs. This shows that the models are stable and long run adjustments occur smoothly over time.

The long run estimates of the effects of desalination are shown in the lower panel of Table 4.10. In the container throughput result, the coefficient of desalination which is -6.618 is negative and slightly significant (at the 10 percent level). This shows that desalination has marginal negative effect on container through put. The result suggests that desalination acts as a significant drag on long terms container throughput performance in Nigeria. It shows that there are severe

challenges in integrating desalination into the shipping industry in Nigeria and that desalination in the country tends to compete with traditional cargo handling for port resources or lead to diversion of investment from throughput-enhancing infrastructure in the country over time.

In the shipping cost and port revenue models, the coefficient of desalination (which is 0.393) is insignificant. This result shows that desalination does not affect operational expenses nor financial health in the shipping industry in the long run. The result therefore clearly reveal that desalination has very limited integration into shipping logistics and revenue drive in the long run in Nigeria. The coefficient of 2.111 for desalination is also insignificant for the port revenue model. The coefficient of the index for freedom of international trade is consistently significant and positive in all the regressions. This reveals that policies that promote freedom of international trade significantly enhance overall shipping industry performance in the long run in Nigeria.

4.5.3 Post-Estimation Robustness Tests

The tests for structural stability of each of the equations estimated in the results stability based on the CUSUM of squares test are presented in Figure 4.7. The CUSUM of squares lines are expected to completely lie in between the dotted 5 percent significance lines (red lines). The results show that the CUSUM-square lines for the result for the two model estimates are all circumscribed within the dotted 5 percent bound lines. This shows that the estimations are stable within the analysis for the four equations. The influences of structural breaks are fully taken into cognisance with the model specification and estimation procedure. These stable estimates are therefore reliable for making policy conclusions and recommendations.

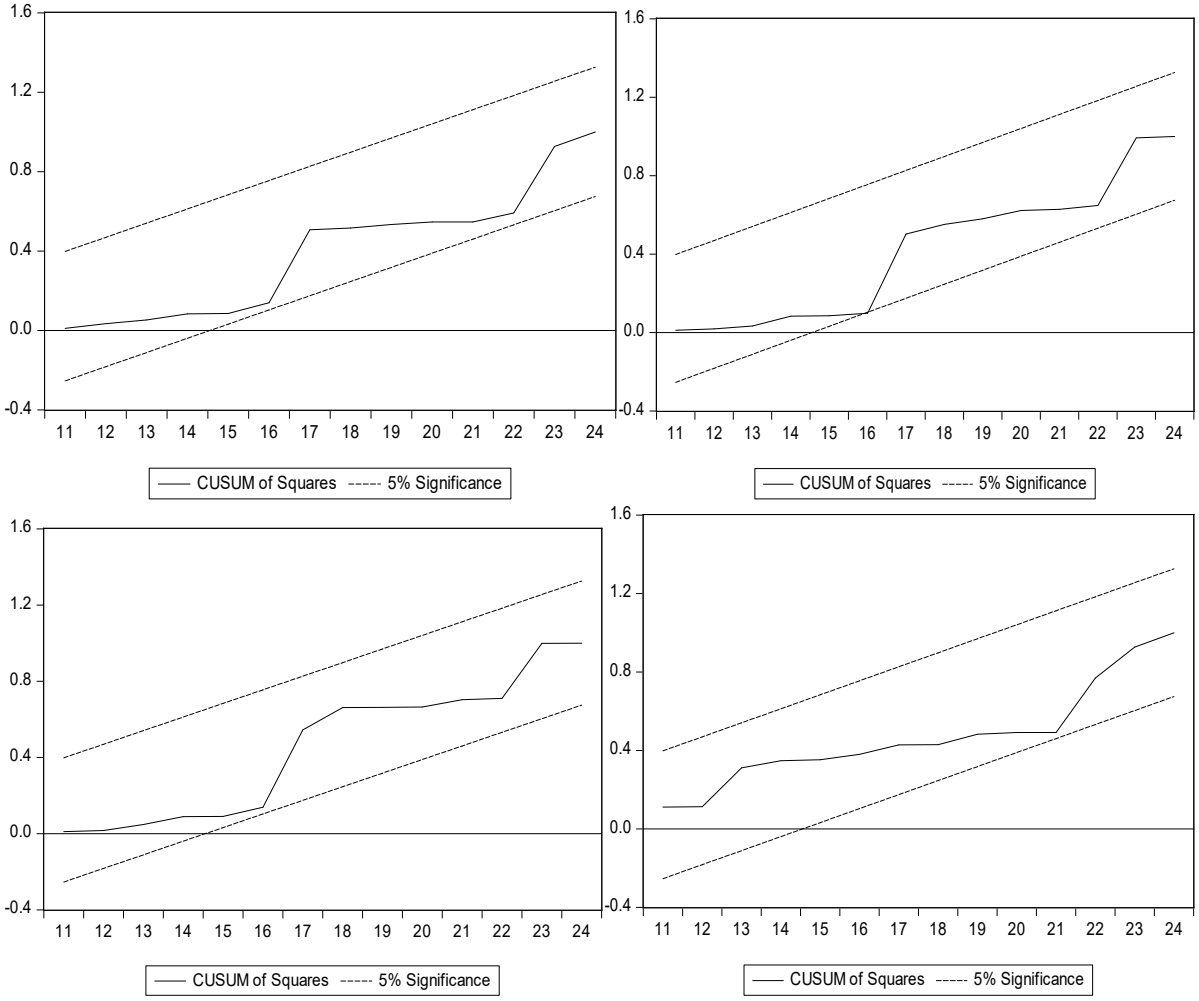


Fig. 4.7: CUSUM Test for Stability

Source: Author's computation using Eview 13.

Given that dynamic analysis was conducted, there is need to also evaluate the estimated models to ascertain the overall reliability of the models. This is based on plotting the normal distribution of the estimated residuals of the model. The plot of normality from the histograms for the six models are presented in Figure 4.8. The results from the plots for the models suggest that the residuals of the estimates are well concentrated at the middle. The Jarque-Bera tests of normality also fail the significance test for each of the equations at the 5 percent level. This shows that the null hypothesis of normal distribution of the residuals cannot be rejected. Thus, it is shown that the estimates used in the analysis are well specified and stable for long run implications.

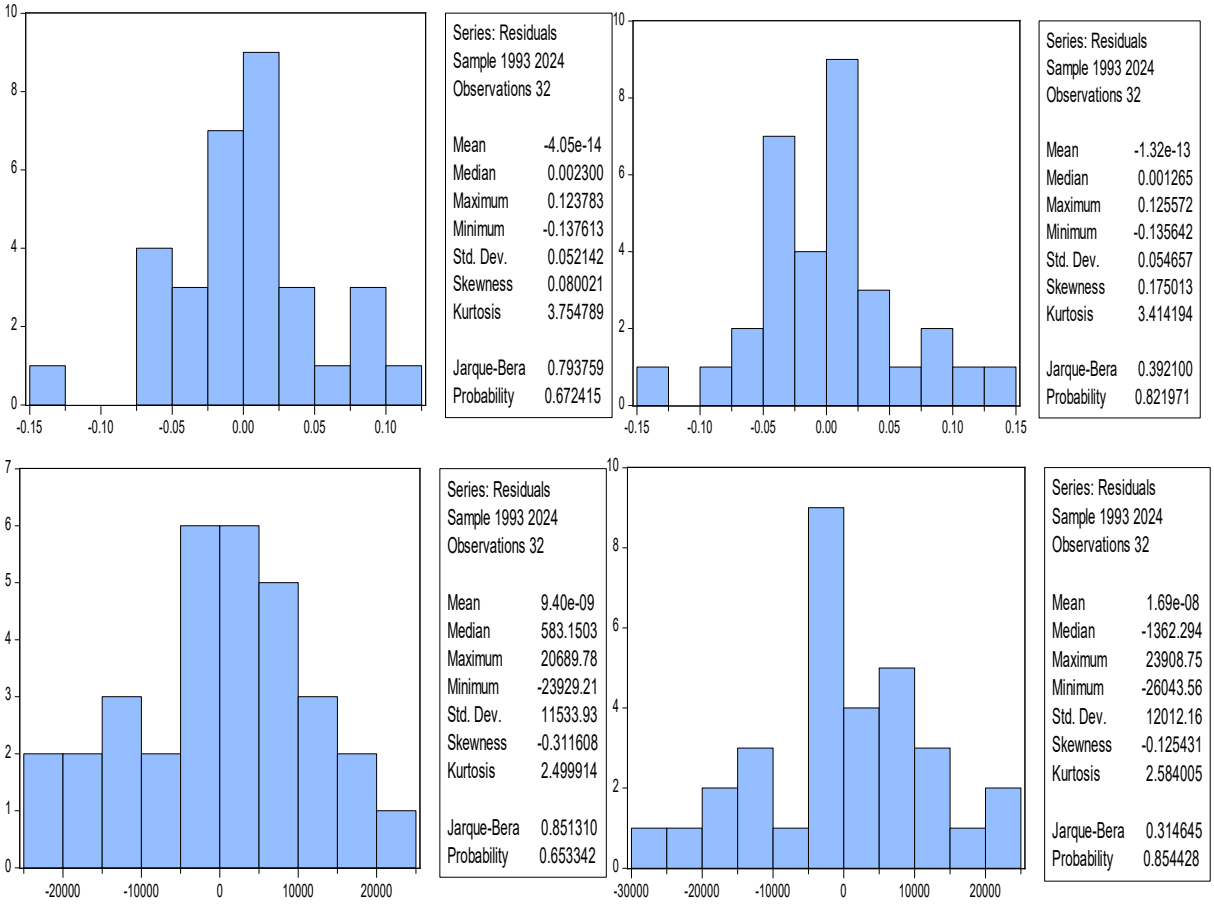


Fig. 4.8: Normality Test for Stability

Source: Author's computation using Eview 13.

Because of the high correlation coefficients among most of the independent variables in the models, the variance inflation factor (VIF) test is conducted to examine the status of multicollinearity in the estimated models. The results for the VIF for all the results are reported in Table 4.9. It is expected that the VIF coefficients be less than 10 in order to ensure absence of multicollinearity among the variables. In the result, none of the VIF coefficients is higher than 10. Thus, each of the coefficients for the variables follows the expected outcomes. This result shows that there is no risk of multicollinearity in the results for the study.

Table 4.11: Results for Multicollinearity Test

Variable	Centred VIF
EXRTV	0.214
FSH	10.94
AQT	5.364
DLNT	4.422
LAB	8.078
TRF	4.114
IFR	2.151

Source: Author's computation, 2025, using Eview 13.

4.5.4 Test of Hypotheses

The test of hypotheses are based on the coefficient estimates of the long run results since they are the stable relationships.

H_{01}: *Exchange rate volatility (EXRTV) has no significant effect on the financial performance of the shipping industry in Nigeria.*

The results in Table 4.7 shows that

- Container throughput: Coeff. = –0.643, p = 0.074 → significant at 10%, negative effect.
- Shipping cost: Coeff. = –0.099, p = 0.057 → significant at 10%, negative effect.
- Port revenue: Coeff. = –0.849, p = 0.503 → not significant.

Based on this outcome, the null hypothesis is rejected for container throughput and shipping cost (exchange rate volatility significantly reduces performance), but accepted for port revenue. The results therefore show that exchange rate volatility consistently worsens financial performance in terms of container throughput and shipping cost.

H_{02}: *Fisheries production (FSH) has no significant effect on the financial performance of the shipping industry in Nigeria.*

The results in Table 4.8 shows that

- Container throughput: Coeff. = –1.375, p = 0.202 → not significant.

- Shipping cost: Coeff. = –0.937, p = 0.303 → not significant.
- Port revenue: Coeff. = –0.446, p = 0.740 → not significant.

Based on this outcome, the null hypothesis is accepted which indicates that fisheries production does not significantly affect financial performance in the long run.

H_{03}: *Aquaculture production (AQT) has no significant effect on the financial performance of the shipping industry in Nigeria.*

The results in Table 4.9 shows that

- Container throughput: Coeff. = 0.116, p = 0.700 → not significant.
- Shipping cost: Coeff. = –1.625, p = 0.088 → significant at 10%, negative effect.
- Port revenue: Coeff. = 1.900, p = 0.001 → significant at 1%, positive effect.

Based on this outcome, the null hypothesis is rejected for shipping cost (negative effect) and port revenue (positive effect), but accepted for container throughput. It is therefore demonstrated that aquaculture generally exerts significant mixed effects on the performance of the shipping industry in Nigeria.

H_{04}: *Desalination (DLNT) has no significant effect on the financial performance of the shipping industry in Nigeria.*

The results in Table 4.10 shows that

- Container throughput: Coeff. = –6.618, p = 0.051 → significant at 10%, negative effect.
- Shipping cost: Coeff. = 0.393, p = 0.792 → not significant.
- Port revenue: Coeff. = –2.111, p = 0.217 → not significant.

Based on this outcome, the null hypothesis is rejected for container throughput (negative effect), but accepted for shipping cost and port revenue. This shows that desalination significantly has a general significant effect on the financial performance of the shipping industry in Nigeria.

4.6 Discussion of Findings

The empirical findings of the study reveal several interesting outcomes. First, the study has shown that exchange rate volatility has significant marginally and negative long-run effects on container throughput and shipping costs in Nigeria. These results tend to align with theoretical expectations and previous empirical findings that show that currency instability increases transaction costs and intensifies uncertainty in international trade (Ojo & Olajide, 2019; FAO, 2020; Osho & Fagbamila, 2022; Okene et al, 2024). Essentially, exchange rate instability indirectly reduces cargo volumes and forces adaptive cost reductions in the maritime industry through local sourcing or other efficiency measures. The counterintuitive cost-relief mechanism of exchange rate volatility tends to suggest that exchange rate volatility hinders export performance in emerging industries by amplifying risk aversion among traders (Osho & Fagbamila, 2022; Akinwale & Adepoju, 2024). This implies the capacity of exchange rate volatility to lower shipping activities and reduce overall costs over time.

In terms of the blue economy factors, the study has demonstrated that fisheries have consistently negative but insignificant long-run effects on the fishing industry factors. This shows that growth in fisheries production does not robustly translate into shipping gains over time as also shown by Adewumi et al. (2023). Most studies however found that fisheries production is good for growing the financial performance of the shipping industry (Adeoye & Afolabi, 2021; Ekanem & Bako, 2021; Ibe & Nwaogu, 2023). Our study therefore shows that increases in fisheries production do not affect long run financial performance of the shipping industry in Nigeria. The insignificant negative effects are a basis for concern with regards to the blue economy in Nigeria. It suggests that growth of the fisheries sub-sector has the capacity to crowd out other cargo activities which are likely to reduce overall throughput. Thus, it reveals that fisheries need to be

integrated into port operations in a more efficient manner that will avoid unnecessary resource competition.

The result also shows that labour force and trade freedom are stronger drivers of container throughput in Nigeria. Moreover, the findings tend to reflect economies of scale in the blue economy in Nigeria. There is evidence that the fisheries production component of the blue economy does not significantly affect the long run performance of the shipping industry in Nigeria. The coefficients of labour and freedom for international trade are also significant and show that these factors are relevant for driving the growth of the shipping sector in Nigeria over time.

From the results in the study, aquaculture emerges as a standout blue economy driver of shipping industry financial performance in Nigeria over time. This result aligns with studies that have positioned aquaculture as a leading emerging sub-sector that can act as a panacea for shipping industry expansion and diversification in Nigeria (Onuoha & Okonkwo, 2018; Chukwu & Ibrahim, 2019; Eze & Ugochukwu, 2021; Okoye & Ojo, 2023). In particular, Eze and Ugochukwu (2021) offered interesting perspectives on how aquaculture exports tend to boost port revenue and demand for port import and export logistics in Nigeria. The result of our study implies that aquaculture tends to foster cost efficiencies in the shipping industry over time. This also tends to demonstrate the capacity of aquaculture in reducing reliance on costly foreign inputs in the blue economy in Nigeria. Thus, aquaculture appears to be a strong cost mitigator in the shipping industry in Nigeria that can offer a key blue economy leverage point for the industry in the long run. The study also revealed strong financial health for maritime infrastructure reinvestment that the blue economy indicator provides (Okoye & Ojo, 2023). Thus, aquaculture is shown as a major revenue driver for the shipping industry in Nigeria in the long run. It also

reflects the blue economy's potential to fund port development over time in Nigeria through boost in aquaculture.

Finally, the study revealed desalination's pronounced negative elasticity with respect to the shipping industry factors as well as the insignificant effects in the long run. This result does not appear to be in line with previous studies. For instance, the Federal Ministry of Marine and Blue Economy (2023) found that onboard desalination systems cut freshwater supply costs, improving offshore shipping efficiency, while Eze and Onyekachi (2023) found that a 1(one) percent increase in desalination growth leads to 0.5 percent increase in maritime throughput which shows that desalination drives measurable shipping demand. The result from our study however shows that these positive effects are likely more of a short-term affair since the estimations reveal strong significant and positive effects of desalination on the shipping industry factors in the short run. For the long run estimates, the findings imply that desalination acts as a significant drag on long terms container throughput performance in Nigeria. This reveals severe challenges in integrating desalination into the shipping industry in Nigeria. This negative coefficient is rather surprising and shows that desalination weakens long run development of port infrastructure in Nigeria. The result therefore suggests that desalination in the country tends to compete with traditional cargo handling for port resources or lead to diversion of investment from throughput-enhancing infrastructure in the country over time. Given that desalination is an emerging component of the blue economy, the result from the study indicates that there may be ongoing potential misallocation or infrastructural bottlenecks in the system that are driving down the operational and overall value of desalination in broadening port infrastructure in the long run.

The study also revealed that desalination has very limited integration into shipping logistics and revenue drive in the long run in Nigeria. The insignificant long run cost impact of desalination in

Nigeria's shipping industry demonstrates that desalination neither burdens nor benefits shipping costs. The insignificant effect of desalination on port revenue may also suggest that the focus of desalination in the long run is majorly on non-revenue-generating activities like domestic water supply. Essentially, it shows that desalination has only a weak contribution to long-term financial sustainability in the shipping industry in Nigeria. These outcomes further reveal further limitation of the role of the blue economy in enhancing the shipping industry in Nigeria (when all the results are considered jointly).

CHAPTER FIVE

SUMMARY OF FINDING, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Finding

In this study, the relationship between exchange rate volatility, the blue economy and the financial performance of the shipping industry in Nigeria was examined. It is argued that the performance and outcomes of the shipping industry are likely to be determined by both external-based factors that drive exchange rate instability and domestic factors that relate to the blue economy. Given that the blue economy is an emerging sector in the Nigerian economy, its role in driving the path of the shipping industry in Nigeria is shown to be critical. The blue economy is represented by three components of fishing production, aquaculture and desalination, while shipping industry financial performance is measured in terms of container through put, shipping costs, and port revenue. Thus, this study evaluated how exchange rate instability and components of the blue economy influence port infrastructure, cost and logistics as well as overall revenue performance. A dynamic framework was devised for the study where the autoregressive distributed lags (ARDL) approach was adopted for the empirical analysis. This implies that both the short run and long run relationships were estimated in the empirical analysis of the study. Data used for the study were annual data covering the period of 1990 to 2024 (34 years). The general outcome of the result reveals that exchange rate and the blue economy matter for sustainable shipping industry financial performance in Nigeria. The specific findings of the study are indicated by main specific objectives of the study, and further granulated into sub-objectives based on the variables used to capture the specific objectives.

i. *The study found that exchange rate volatility has significant effect on the financial performance of the shipping industry in Nigeria. In particular, it was shown that:*

   a) Exchange rate volatility has a significant negative effect on container throughput which suggests that volatility of the exchange rate limits the throughput in Nigerian ports.

   b) Exchange rate volatility has a significant negative effect on shipping cost in Nigeria over time. This indicates that exchange rate depreciation can force shipping cost to fall over time.

   c) Exchange rate volatility has no significant effect on port revenue in Nigeria.

ii. *The study also found that fisheries production has only a limited effect on the financial performance of shipping industry in Nigeria. In particular, it was found that*

   a) Fisheries output has no significant long run effect on container throughput in the long run. The effect was only observed to be valid in the short run, while the long run effects are insignificant and negative.

   b) Fisheries output has no significant effect on shipping cost both in the long run and in the short run.

   c) Fisheries output has no significant effect on port revenue both in the short run and in the long run.

iii. *It was also found that aquaculture production has a mainly significant and positive effect on the financial performance of shipping industry in Nigeria. Particularly, it was found that*

a) Aquaculture production has no significant effect on container throughput in Nigeria in the long run.

b) In the long run, it is found that aquaculture output significantly reduced shipping costs in Nigeria.

c) Aquaculture production has a significant positive effect on port revenue, suggesting that aquaculture production significantly increased port revenues in Nigeria.

iv. *Lastly, the study found that desalination exerts limited effects on the financial performance of shipping industry in Nigeria. In particular, the results showed that*

a) While desalination tends to weaken container throughput in the long run, the short run effects were shown to be positive.

b) Desalination has no significant effect on shipping costs both in the short run and in the long run.

c) Desalination has a significant positive impact on port revenue in the short run, but has no significant effect in the long run.

5.2 Conclusion

The study establishes that exchange rate volatility exerts significant long-run negative effects on Nigeria's shipping industry, particularly by reducing container throughput and shipping activity,

though it also indirectly lowers costs through adaptive efficiency measures. This confirms that currency instability amplifies uncertainty in maritime trade and constrains export performance.

Regarding the blue economy, fisheries production showed consistently negative but insignificant long-run effects, suggesting weak integration into shipping operations and the potential crowding out of other cargo activities. In contrast, aquaculture emerged as a strong driver of shipping industry performance, reducing costs, boosting port revenues, and offering long-term potential to support port reinvestment and infrastructure development. Desalination, however, displayed mixed results: while it provided short-run benefits to shipping operations, it imposed negative and insignificant effects in the long run, highlighting challenges of integration, possible misallocation of resources, and weak contribution to financial sustainability.

Overall, the findings underscore that while exchange rate management is essential, aquaculture holds the greatest promise for strengthening the shipping industry through the blue economy. Conversely, fisheries and desalination currently contribute little to long-term maritime financial performance in Nigeria, reflecting the need for deeper integration and more strategic investment.

5.3 Recommendations

The results from the empirical analysis have provided grounds for highlighting recommendations that are aimed at mitigating the adverse effects of exchange rate volatility while leveraging the blue economy in driving cost-effectiveness, improving revenues and ensuring overall enhancement of the financial performance of the shipping industry in Nigeria.

Firstly, the study finds that exchange rate volatility exerts notable drags on the shipping industry in Nigeria. Based on this the following recommendations are made:

i. The negative effect of exchange rate volatility on container throughput is concerning for Nigeria's shipping industry because it signals reduced trade capacity and blue economy potential. In order to address the effects of exchange rate volatility, policies need to focus on stabilising the naira over time. This will ensure enhanced trade predictability which directly mitigates decline in throughput. Smoothening exchange rate volatility therefore needs to be a major target of the Central Bank of Nigeria (CBN).

ii. Given the negative effects of exchange rate volatility on shipping costs, the monetary authorities also need to promote risk hedging instruments for shipping firms in Nigeria in order to help manage the effects of exchange rate volatility. This can be done by encouraging shipping companies to adopt financial instruments that are directly supported or subsidised by the Bank.

iii. The weak but positive effect of exchange rate volatility in port revenue requires that public-private partnerships be developed between the maritime authorities and banks so as to offer low-cost hedging products that are tailored for maritime operators. This can also help to reduce the effects of uncertainty that can depress the shipping industry financial performance in Nigeria.

Secondly, the study also found that fisheries production only exerts short-term effects on the shipping industry performance. The following recommendations are therefore provided:

i. Given that fisheries output has a significant and negative short run effect on container throughput, there is need to enhance port and overall maritime infrastructure to enhance the integration of the fisheries sub-sector. Adequate investment in dedicated fisheries terminals need to be made in order to improve facilities to handle seafood exports without crowding out other cargo throughput.

ii. Also, no significant relationship was found between shipping cost and fisheries production in Nigeria. Hence, the fisheries logistics in the blue economy also need to be streamlined by developing efficient supply chains for fisheries products as well as reducing transport costs over time. This will further improve the contribution of fisheries to the shipping sector performance.

iii. The insignificant effect of fisheries output on port revenue suggests the need to increase the output and productivity of the fisheries sector, especially the off-shore fishing sub-sector. It is therefore highly recommended that more activity is encouraged by government in this area.

Thirdly, the study found evidence that aquaculture effectively promotes the financial performance of the shipping industry. The major recommendations are as follows:

i. Aquaculture has no significant effect on container throughput in Nigeria in the long run. Hence, there is need for sufficient integration of the aquaculture segment fully into the maritime trade flows in Nigeria. This can be done by developing dedicated port facilities as well as efficiently amplifying the shipping cost-saving potential of the sub-sector in the blue economy.

ii. Given that aquaculture significantly reduces shipping cost in the long run, there is need to integrate aquaculture into shipping services in the country. Increased investment in the shipping sector is therefore required.

iii. There was also evidence that Aquaculture production has a significant positive effect on port revenue, suggesting that aquaculture production significantly increased port

revenues in Nigeria. Thus, there is need to expand the aquaculture sector in Nigeria by creating more points of activities across the coastline of the country.

The fourth finding of the study showed that desalination only exerts limited effect on the financial performance of the shipping sector in Nigeria.

i. In terms of the limited effect of desalination on container throughput, it is recommended that to mitigate competition between desalination infrastructure development and throughput activities. Essentially, dedicated port facilities for desalination-related activities can be developed in order to reduce the competition of the activities with containerized cargo activities. This requires adequate coordination in the maritime industry.
ii. Given that desalination has no significant effect on shipping cost, there is need to address the budgetary costs and efficiency of desalination both by the public and private sectors in Nigeria. The cost of desalination needs to be reduced in order to make it more cost-effective for the shipping industry in the country.
iii. Moreover, the revenue generation capacity of desalination as a blue economy strategy in Nigeria must be significantly pursued. In this case, trade concepts and activities that are related to desalination should be promoted. Moreover, all sorts of inefficiencies in the desalination systems should be trimmed down especially with the application of digital tracking and taxation systems.

5.4 Contribution to Knowledge

The study contributes to the current body of knowledge in the following ways:

The study provided novel insights into the pattern of impacts that the blue economy can have on the shipping industry. This was done by engaging three blue economy proxies which have received limited consideration in previous studies. This study therefore contributes to knowledge by empirically demonstrating the differential long-run effects of blue economy components of fisheries production, aquaculture, and desalination on Nigeria's shipping industry.

The study also deepened understanding of the role of volatility in exchange rate in the shipping industry. New insights were demonstrated by revealing the dual role of exchange rate volatility in the shipping industry in terms of operational deterioration and cost-relief capacity of unstable exchange rates in Nigeria.

By using a dynamic framework, the study also contributed to knowledge by demonstrating that the blue economy factors may exert differing effects on the shipping industry depending on the time horizon being considered. This throws more light on the policy maker’s inter temporal decision-making in relation to optimizing the financial performance of the shipping industry in Nigeria. In particular, the decision makers now have evidence of the necessary policies to undertake in the short run and in the long run-in order to promote the shipping industry. The study shows that in most cases, required policy directions in the short run often differ from those required for the long run management.

5.5 Areas for Further Study

The preliminary analysis of the relationships among variables in the study revealed non-linear relationships among certain variables. Thus, there is need for future studies to explore non-linear relationships and interaction terms among the exchange rate and blue economy factors to better capture any complex dynamics. Although the use of the ARDL estimation captured part of this

dynamics, other methodological and specification approaches that reveal non-linearities may reveal other aspects of the relationships.

The limitation of data has ensured that only selected macro-based evaluation of the blue economy and shipping industry variables are used. Further studies may employ more blue economy variables and more firm-specific or industry-specific dataset to further intensify the expected outcomes. For instance, variables that capture port terminal operations, logistics performance, and other emerging value chains activities move beyond national aggregates to address and reveal operational efficiency, financial health, and competitive dynamics of the shipping industry in the country.

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APPENDICES

DATA

Appendix I:

Data on: Exchange Rate Volatility, Blue Economy, and Shipping Industry Financial Performance in Nigeria.

Years	FSH	AQT	DLNT	POR	SHPC	CTP	IFR	EXRTV	LAB	TRF
1990	300449	25840	274609	314	9703063.15	251021	7.36	2.85	44182.16	2.96
1991	316328	7347	308981	650	9240941.05	350520	13.01	0.65	45539.19	2.9
1992	267705	15365	252340	800	8778818.95	401350	44.59	1.87	46853.34	2.4
1993	318415	17088	301327	2,549	8316696.85	450215	57.17	7.39	48403.59	2.02
1994	255499	17090	238409	7,383	7854574.76	521850	57.03	5.03	49995.64	1.97
1995	281232	15030	266202	12,217	7392452.66	533502	72.84	-0.44	51569.8	1.84
1996	366101	16619	349482	17,051	6930330.56	540325	29.27	0	53048.06	2.44
1997	357484	19491	337993	21,885	6468208.46	595025	8.53	0	54590.2	3.18
1998	412220	24297	387923	30,785	6006086.36	640520	10	0	56197.71	3.3
1999	483482	20458	463024	31,151	5543964.27	656421	6.62	0	57886.64	4.18
2000	477365	21737	455628	32,116	3479651.76	1045800	6.93	64.09	59448.26	4.56
2001	467095	25718	441377	40,217	3486585.82	1065201	18.87	16.52	60989.01	4.93
2002	476544	24398	452146	42,156	3493519.88	1085400	12.88	8.5	62279.32	5.51
2003	511719	30663	481056	56,400	3500453.94	1093255	14.03	9.5	63804.73	5.61
2004	505839	30677	475162	49,200	3654740.00	1094000	15	13.4	65310.72	5.15
2005	509201	43950	465251	16,948	3754520.09	1105500	17.86	-2.5	66926.19	5.67
2006	579537	56355	523182	62,000	3750152.40	1123650	8.23	-2.4	68566.95	5.68
2007	636901	84578	552323	42,274	3804030.64	1125875	5.39	5.05	70237.58	6.4
2008	615507	85087	530420	87,000	3857908.87	1136545	11.58	-1.68	71955.32	6.35
2009	744575	143207	601368	91,000	3911787.11	1145250	12.54	0.23	73675.74	5.58
2010	751006	152796	598210	101,050	3965665.34	1162000	13.74	17.8	75478.33	6.23
2011	817516	200535	616981	115,020	4019543.57	1456000	10.83	3.1	77476.48	6.4
2012	856614	221128	635486	136,010	4073421.81	1583460	12.22	4.2	79576.56	6.48
2013	922652	253898	668754	157,310	4127300.04	1696000	8.5	-0.4	81609.8	6.57
2014	1000061	278706	721355	172,800	4181178.28	1867409	8.05	0.9	83690.1	5.8
2015	1073059	313231	759828	177,200	4235056.51	1544183	9.01	38.8	85977.64	5.59
2016	1027058	316727	710331	182,420	4687446.95	1272000	15.7	118	88619.38	5.57
2017	1041498	306767	734731	265,600	3507969.36	1408000	16.5	45	91313.51	5.76
2018	1212475	296191	916284	270,560	4919395.56	1560000	12.1	0	93991.72	6.01
2019	1169478	291323	878155	277,680	6388843.78	1627142	11.4	-55	96681.96	6.03
2020	1114556	289543	825013	317,000	8311870.76	1548622	13.25	56	99696.28	4.51
2021	1044812	261711	783102	256,280	8030351.17	1566109	16.95	84.47	102509	5.53
2022	1080855	275645	805210	361,000	9233880.29	1566109	18.85	-29.64	105432.6	3.49
2023	1043230	259106	784124	501,000	10165185.25	1599705	24.66	44.87	110183.3	4.43
2024	1036752	253384	746733	758,260	11784483.38	1589455	32.5	1023	127371	5.48

Sources: World Bank Data, (2024); Central Bank of Nigeria (CBN, 2024)

Appendix II

Econometric E-Views version 13 Result Printout

Dependent Variable: LEXRT
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 07/27/25 Time: 17:08
Sample (adjusted): 1986 2023
Included observations: 38 after adjustments
Failure to improve likelihood (non-zero gradients) after 26 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) +
C(5)*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.497995	0.149812	3.324129	0.0009
LEXRT(-1)	0.905756	0.029437	30.76890	0.0000
Variance Equation				
C(3)	-1.784196	0.878653	-2.123114	0.0383
C(4)	1.437447	0.121318	2.150172	0.0301
C(5)	-0.684577	0.603598	-1.134159	0.2567
C(6)	0.668429	0.282570	2.365534	0.0180

R-squared	0.967771	Mean dependent var	4.253968
Adjusted R-squared	0.966876	S.D. dependent var	1.495285
S.E. of regression	0.272142	Akaike info criterion	0.132344
Sum squared resid	2.666206	Schwarz criterion	0.390910
Log likelihood	3.485464	Hannan-Quinn criter.	0.224340
Durbin-Watson stat	1.837666		

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 0, 0, 0, 1, 2)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:06
Sample: 1990 2024
Included observations: 33

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.647903	1.631830	-1.009849	0.3231
LCTP(-1)*	-0.490033	0.135684	-3.611573	0.0015
EXRTF**	-0.000315	0.000152	-2.071063	0.0498
IFR**	0.000410	0.001736	0.235898	0.8156
LLAB**	0.775010	0.228069	3.398136	0.0025
LGR(-1)	-0.156312	0.091432	-1.709593	0.1008
TRF(-1)	0.067848	0.027934	2.428846	0.0234
D(TRF)	0.080396	0.034418	2.335841	0.0286
D(TRF(-1))	0.059294	0.035546	1.668102	0.1089

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRTF	-0.643271	0.343917	-1.875272	0.0735
IFR	0.000836	0.003581	0.233422	0.8175
LLAB	1.581546	0.355301	4.451278	0.0002
TRF	0.138455	0.040833	3.390730	0.0025
C	-3.362837	3.482890	-0.965531	0.3443

ARDL Error Correction Regression
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 0, 0, 0, 1, 2)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:13
Sample: 1990 2024
Included observations: 33

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TRF)	0.080396	0.022040	3.647741	0.0013
D(TRF(-1))	0.059294	0.021747	2.726521	0.0120
CointEq(-1)*	-0.490033	0.084561	-5.795052	0.0000

R-squared	0.541066	Mean dependent var	0.045810
Adjusted R-squared	0.493590	S.D. dependent var	0.110360
S.E. of regression	0.078535	Akaike info criterion	-2.137325
Sum squared resid	0.178866	Schwarz criterion	-1.955930
Log likelihood	39.26586	Hannan-Quinn criter.	-2.076291
Durbin-Watson stat	2.006037		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.804929	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LPOR)
Selected Model: ARDL(1, 0, 1, 0, 0, 2)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:16
Sample: 1990 2024
Included observations: 33

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.06790	9.845214	-1.936768	0.0652
LPOR(-1)*	-0.409838	0.140245	-2.922303	0.0077
EXRTF**	-0.000404	0.000606	-0.666204	0.5119
IFR(-1)	0.006154	0.007706	0.798681	0.4326
LLAB**	2.033047	1.040826	1.953302	0.0631
TRF(-1)	-0.024953	0.090504	-0.275712	0.7852
D(IFR)	-0.003186	0.008738	-0.364595	0.7187
D(TRF)	0.029894	0.139995	0.213533	0.8328
D(TRF(-1))	0.228544	0.139974	1.632764	0.1161

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRTF	-0.098534	0.001448	-0.680498	0.5030
IFR	0.015016	0.020699	0.725487	0.4755
LLAB	4.960609	1.506126	3.293621	0.0032
TRF	-0.060885	0.225780	-0.269664	0.7898
C	-46.52542	14.95659	-3.110697	0.0049

EC = LPOR - (-0.0010*EXRTF + 0.0150*IFR + 4.9606*LLAB + 0.7092*LGR
-0.0609*TRF -46.5254)

ARDL Error Correction Regression
Dependent Variable: D(LPOR)
Selected Model: ARDL(1, 0, 1, 0, 0, 2)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:18
Sample: 1990 2024
Included observations: 33

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IFR)	-0.003186	0.005019	-0.634827	0.5318
D(TRF)	0.029894	0.086454	0.345777	0.7327
D(TRF(-1))	0.228544	0.088884	2.571273	0.0171
CointEq(-1)*	-0.409838	0.061276	-6.688348	0.0000

R-squared	0.523426	Mean dependent var	0.213994
Adjusted R-squared	0.474125	S.D. dependent var	0.428768
S.E. of regression	0.310931	Akaike info criterion	0.614718
Sum squared resid	2.803656	Schwarz criterion	0.796113
Log likelihood	-6.142845	Hannan-Quinn criter.	0.675752
Durbin-Watson stat	2.565862		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.068385	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LSHPC)
Selected Model: ARDL(1, 1, 0, 1, 0, 0)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:18
Sample: 1990 2024
Included observations: 34

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.826117	2.076983	-0.879216	0.3877
LSHPC(-1)*	-0.285658	0.126400	-2.259953	0.0328
EXRTF(-1)	-0.002427	0.000799	-3.037154	0.0055
IFR**	0.001094	0.001870	0.585123	0.5637
LLAB(-1)	0.588183	0.196824	2.988374	0.0062
TRF**	-0.048632	0.041277	-1.178185	0.2498
D(EXRTF)	-0.001066	0.000599	-1.778262	0.0875
D(LLAB)	10.57180	5.401442	1.957218	0.0616

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRTF	-0.849518	0.425921	-1.994435	0.0571
IFR	0.003830	0.007004	0.546808	0.5894
LLAB	2.059050	0.887514	2.320020	0.0288
TRF	-0.170247	0.098397	-1.730209	0.0959
C	-6.392678	9.214131	-0.693791	0.4942

EC = LSHPC - (-0.0085*EXRTF + 0.0038*IFR + 2.0590*LLAB -0.3654*LGR
-0.1702*TRF -6.3927)

ARDL Error Correction Regression
Dependent Variable: D(LSHPC)
Selected Model: ARDL(1, 1, 0, 1, 0, 0)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:19
Sample: 1990 2024
Included observations: 34

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXRTF)	-0.001066	0.000247	-4.324154	0.0002
D(LLAB)	10.57180	1.939615	5.450461	0.0000
CointEq(-1)*	-0.285658	0.050536	-5.652606	0.0000

R-squared	0.520757	Mean dependent var	0.005716
Adjusted R-squared	0.489838	S.D. dependent var	0.140753
S.E. of regression	0.100534	Akaike info criterion	-1.672545
Sum squared resid	0.313319	Schwarz criterion	-1.537866
Log likelihood	31.43327	Hannan-Quinn criter.	-1.626616
Durbin-Watson stat	2.128364		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.681101	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 3, 3, 2, 2, 1)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:22
Sample: 1990 2024
Included observations: 32

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.080302	3.978396	-2.282402	0.0386
LCTP(-1)*	-0.466421	0.179554	-2.597665	0.0211
LFSH(-1)	-0.641481	0.332700	-1.928108	0.0744
IFR(-1)	-0.003069	0.003494	-0.878506	0.3945
LLAB(-1)	2.184089	0.696950	3.133783	0.0073
TRF(-1)	0.099937	0.039360	2.539035	0.0236
D(LFSH)	0.340790	0.264633	1.287783	0.2187
D(LFSH(-1))	0.967938	0.472407	2.048947	0.0597
D(LFSH(-2))	1.070219	0.402604	2.658245	0.0187
D(IFR)	-0.001239	0.003113	-0.398090	0.6966
D(IFR(-1))	0.005136	0.002705	1.899138	0.0783
D(IFR(-2))	0.006140	0.002328	2.636960	0.0195
D(LLAB)	-6.071625	2.125730	-2.856253	0.0127
D(LLAB(-1))	27.44669	11.38050	2.411729	0.0302
D(TRF)	0.057434	0.031278	1.836254	0.0876

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFSH	-1.375325	1.027834	-1.338081	0.2022
IFR	-0.006580	0.008700	-0.756361	0.4620
LLAB	4.682652	2.185840	2.142267	0.0502
TRF	0.214263	0.074409	2.879542	0.0121
C	-19.46802	11.49121	-1.694166	0.1124

EC = LCTP - (-1.3753*LFSH -0.0066*IFR + 4.6827*LLAB -0.8478*LGR +
0.2143*TRF -19.4680)

ARDL Error Correction Regression
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 3, 3, 2, 2, 1)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:23
Sample: 1990 2024
Included observations: 32

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFSH)	0.340790	0.179598	1.897509	0.0786
D(LFSH(-1))	0.967938	0.205815	4.702953	0.0003
D(LFSH(-2))	1.070219	0.212787	5.029526	0.0002
D(IFR)	-0.001239	0.001861	-0.665826	0.5163
D(IFR(-1))	0.005136	0.001555	3.302899	0.0052
D(IFR(-2))	0.006140	0.001370	4.481463	0.0005
D(LLAB)	-6.071625	1.077030	-5.637379	0.0001
D(LLAB(-1))	27.44669	4.053780	6.770642	0.0000
D(TRF)	0.057434	0.019839	2.895023	0.0118
CointEq(-1)*	-0.466421	0.068991	-6.760636	0.0000

R-squared	0.772280	Mean dependent var	0.043010
Adjusted R-squared	0.647034	S.D. dependent var	0.110929
S.E. of regression	0.065904	Akaike info criterion	-2.321241
Sum squared resid	0.086867	Schwarz criterion	-1.771590
Log likelihood	49.13986	Hannan-Quinn criter.	-2.139047
Durbin-Watson stat	2.289886		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.570619	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LSHPC)
Selected Model: ARDL(1, 2, 0, 0, 0)
Case 4: Unrestricted Constant and Restricted Trend
Date: 08/18/25 Time: 09:37
Sample: 1990 2024
Included observations: 33

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.875428	5.058173	1.754671	0.0921
@TREND	0.034445	0.016222	2.123288	0.0442
LSHPC(-1)*	-0.316620	0.140301	-2.256712	0.0334
LFSH(-1)	-0.296802	0.300111	-0.988974	0.3325
IFR**	0.003532	0.002697	1.309687	0.2027
TRF**	-0.058427	0.042358	-1.379346	0.1805
D(LFSH)	0.085496	0.311073	0.274842	0.7858
D(LFSH(-1))	0.384338	0.323314	1.188746	0.2462

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 4: Unrestricted Constant and Restricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFSH	-0.937407	0.889808	-1.053493	0.3026
IFR	0.011157	0.009309	1.198517	0.2424
TRF	-0.184533	0.091609	-2.014340	0.0553
@TREND	0.108789	0.048556	2.240509	0.0346

EC = LSHPC - (-0.9374*LFSH + 0.0112*IFR -0.4017*LGR -0.1845*TRF + 0.1088*@TREND)

ARDL Error Correction Regression
Dependent Variable: D(LSHPC)
Selected Model: ARDL(1, 2, 0, 0, 0)
Case 4: Unrestricted Constant and Restricted Trend
Date: 08/18/25 Time: 09:39
Sample: 1990 2024
Included observations: 33

ECM Regression
Case 4: Unrestricted Constant and Restricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.909873	1.898778	4.692424	0.0001
D(LFSH)	0.085496	0.208258	0.410528	0.6851
D(LFSH(-1))	0.384338	0.238418	1.612034	0.1200
CointEq(-1)*	-0.316620	0.067592	-4.684302	0.0001

R-squared	0.438613	Mean dependent var	0.007368
Adjusted R-squared	0.380538	S.D. dependent var	0.142601
S.E. of regression	0.112235	Akaike info criterion	-1.423230
Sum squared resid	0.365305	Schwarz criterion	-1.241835
Log likelihood	27.48329	Hannan-Quinn criter.	-1.362196
F-statistic	7.552586	Durbin-Watson stat	1.998981
Prob(F-statistic)	0.000702		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.026577	10%	2.68	3.53
k	4	5%	3.05	3.97
		2.5%	3.4	4.36
		1%	3.81	4.92

ARDL Error Correction Regression
Dependent Variable: D(LPOR)
Selected Model: ARDL(2, 0, 0, 1, 3, 0)
Case 1: No Constant and No Trend
Date: 08/18/25 Time: 09:43
Sample: 1990 2024
Included observations: 32

ECM Regression
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LPOR(-1))	-0.567377	0.118504	-4.787846	0.0001
D(LLAB)	5.939768	1.352102	4.392989	0.0003
D(LGR)	-0.742997	0.314499	-2.362481	0.0279
CointEq(-1)*	-0.427951	0.049127	-8.711180	0.0000

R-squared	0.756485	Mean dependent var	0.214193
Adjusted R-squared	0.709655	S.D. dependent var	0.435627
S.E. of regression	0.234732	Akaike info criterion	0.106615
Sum squared resid	1.432576	Schwarz criterion	0.381441
Log likelihood	4.294155	Hannan-Quinn criter.	0.197712
Durbin-Watson stat	2.327797		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	10.21524	10%	1.81	2.93
k	5	5%	2.14	3.34
		2.5%	2.44	3.71
		1%	2.82	4.21

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LPOR)
Selected Model: ARDL(2, 0, 0, 1, 3, 0)
Case 1: No Constant and No Trend
Date: 08/18/25 Time: 09:44
Sample: 1990 2024
Included observations: 32

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPOR(-1)*	-0.427951	0.089761	-4.767656	0.0001
LFSH**	-0.190775	0.564696	-0.337837	0.7388
IFR**	0.007106	0.005892	1.205922	0.2413
LLAB(-1)	0.347249	0.607618	0.571492	0.5737
TRF**	-0.058355	0.058854	-0.991518	0.3327
D(LPOR(-1))	-0.567377	0.159229	-3.563285	0.0018
D(LLAB)	5.939768	2.813029	2.111520	0.0469

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFSH	-0.445787	1.327489	-0.335812	0.7403
IFR	0.016604	0.015458	1.074133	0.2950
LLAB	0.811421	1.432209	0.566552	0.5770
TRF	-0.136358	0.141849	-0.961288	0.3473

EC = LPOR - (-0.4458*LFSH + 0.0166*IFR + 0.8114*LLAB + 2.5840*LGR
-0.1364*TRF)

ARDL Error Correction Regression
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 1, 1, 1, 1, 1)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 09:51
Sample: 1990 2024
Included observations: 34

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LAQT)	0.028668	0.051302	0.558821	0.5819
D(IFR)	-0.001357	0.001386	-0.978581	0.3384
D(LLAB)	-0.818319	0.523761	-1.562390	0.1325
D(TRF)	0.055609	0.024682	2.253016	0.0346
CointEq(-1)*	-0.517771	0.081687	-6.338441	0.0000

R-squared	0.570883	Mean dependent var	0.054283
Adjusted R-squared	0.494255	S.D. dependent var	0.119378
S.E. of regression	0.084897	Akaike info criterion	-1.935982
Sum squared resid	0.201808	Schwarz criterion	-1.666624
Log likelihood	38.91170	Hannan-Quinn criter.	-1.844123
Durbin-Watson stat	1.751037		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.509533	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

ARDL Error Correction Regression
Dependent Variable: D(LSHPC)
Selected Model: ARDL(1, 3, 3, 3, 3, 0)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 08/18/25 Time: 09:54
Sample: 1990 2024
Included observations: 32

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	372.4412	64.80956	5.746702	0.0001
@TREND	1.003712	0.172783	5.809108	0.0001
D(LAQT)	-0.406603	0.154575	-2.630455	0.0220
D(LAQT(-1))	0.705401	0.158030	4.463716	0.0008
D(LAQT(-2))	0.343347	0.093264	3.681444	0.0031
D(IFR)	0.000734	0.001761	0.416730	0.6842
D(IFR(-1))	-0.004316	0.001720	-2.509115	0.0275
D(IFR(-2))	-0.005579	0.001778	-3.138010	0.0086
D(LLAB)	8.057765	2.023853	3.981398	0.0018
D(LLAB(-1))	-19.48242	13.19743	-1.476228	0.1656
D(LLAB(-2))	76.20461	14.30096	5.328636	0.0002
CointEq(-1)*	-0.498660	0.086677	-5.753079	0.0001

R-squared	0.806505	Mean dependent var	0.009201
Adjusted R-squared	0.647156	S.D. dependent var	0.144487
S.E. of regression	0.085826	Akaike info criterion	-1.768010
Sum squared resid	0.125224	Schwarz criterion	-1.080946
Log likelihood	43.28816	Hannan-Quinn criter.	-1.540268
F-statistic	5.061247	Durbin-Watson stat	2.648949
Prob(F-statistic)	0.001085		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.893873	10%	2.75	3.79
k	5	5%	3.12	4.25
		2.5%	3.49	4.67
		1%	3.93	5.23

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LSHPC)
Selected Model: ARDL(1, 3, 3, 3, 3, 0)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 08/18/25 Time: 09:55
Sample: 1990 2024
Included observations: 32

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	372.4412	172.0393	2.164861	0.0513
@TREND	1.003712	0.449640	2.232256	0.0454
LSHPC(-1)*	-0.498660	0.158878	-3.138641	0.0086
LAQT(-1)	-0.810178	0.346251	-2.339857	0.0374
IFR(-1)	0.003889	0.004362	0.891716	0.3901
LLAB(-1)	-33.55715	15.86408	-2.115292	0.0560
LGR(-1)	-0.297435	0.261942	-1.135501	0.2783
TRF**	-0.004238	0.055908	-0.075805	0.9408
D(LAQT)	-0.406603	0.351366	-1.157208	0.2697
D(LAQT(-1))	0.705401	0.243148	2.901122	0.0133
D(LAQT(-2))	0.343347	0.127233	2.698581	0.0194
D(IFR)	0.000734	0.003028	0.242377	0.8126
D(IFR(-1))	-0.004316	0.002307	-1.870753	0.0860
D(IFR(-2))	-0.005579	0.002451	-2.276212	0.0420
D(LLAB)	8.057764	3.774293	2.134907	0.0541
D(LLAB(-1))	-19.48242	18.89632	-1.031017	0.3229
D(LLAB(-2))	76.20461	22.14414	3.441300	0.0049
D(LGR)	-0.376452	0.179047	-2.102533	0.0573

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAQT	-1.624709	0.875214	-1.856355	0.0881
IFR	0.007800	0.009099	0.857250	0.4081
LLAB	-67.29464	39.55236	-1.701407	0.1146
TRF	-0.008499	0.110343	-0.077023	0.9399

EC = LSHPC - (-1.6247*LAQT + 0.0078*IFR -67.2946*LLAB -0.5965*LGR
-0.0085*TRF)

ARDL Error Correction Regression
Dependent Variable: D(LPOR)
Selected Model: ARDL(1, 3, 2, 3, 3, 3)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 08/18/25 Time: 10:25
Sample: 1990 2024
Included observations: 32

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1321.466	116.8593	-11.30818	0.0000
@TREND	-3.378472	0.298801	-11.30678	0.0000
D(LAQT)	-0.319403	0.241215	-1.324142	0.2149
D(LAQT(-1))	-1.468863	0.358420	-4.098159	0.0022
D(LAQT(-2))	-0.353348	0.150932	-2.341106	0.0413
D(IFR)	0.003039	0.003233	0.939781	0.3695
D(IFR(-1))	-0.012391	0.003114	-3.979715	0.0026
D(LLAB)	3.873333	3.428651	1.129696	0.2850
D(LLAB(-1))	-113.2760	24.20994	-4.678906	0.0009
D(LLAB(-2))	-116.8959	26.53649	-4.405099	0.0013
D(TRF)	-0.049920	0.058604	-0.851808	0.4143
D(TRF(-1))	0.260873	0.059359	4.394815	0.0013
D(TRF(-2))	0.247559	0.074720	3.313150	0.0078
CointEq(-1)*	-1.416620	0.125441	-11.29311	0.0000

R-squared	0.948297	Mean dependent var	0.214193
Adjusted R-squared	0.893147	S.D. dependent var	0.435627
S.E. of regression	0.142399	Akaike info criterion	-0.755548
Sum squared resid	0.304164	Schwarz criterion	0.023124
Log likelihood	29.08877	Hannan-Quinn criter.	-0.497441
F-statistic	17.19490	Durbin-Watson stat	2.487565
Prob(F-statistic)	0.000001		

* p-value incompatible with t-Bounds distribution.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 3, 3, 3, 3, 1)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 08/18/25 Time: 10:27
Sample: 1990 2024
Included observations: 32

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.73497	30.15666	0.886536	0.3943
@TREND	0.085206	0.076888	1.108186	0.2914
LCTP(-1)*	-0.485544	0.163536	-2.969032	0.0128
LDLNT(-1)	-3.213320	0.839274	-3.828688	0.0028
IFR(-1)	-0.015697	0.004784	-3.281412	0.0073
LLAB(-1)	1.843785	2.606906	0.707269	0.4941
TRF(-1)	0.193615	0.049550	3.907471	0.0024
D(LDLNT)	-0.834638	0.353276	-2.362567	0.0376
D(LDLNT(-1))	1.715465	0.526393	3.258907	0.0076
D(LDLNT(-2))	1.411544	0.408668	3.454008	0.0054
D(IFR)	-0.006023	0.003074	-1.959410	0.0759
D(IFR(-1))	0.011705	0.003433	3.409505	0.0058
D(IFR(-2))	0.007426	0.002509	2.959349	0.0130
D(LLAB)	-7.094345	2.170023	-3.269249	0.0075
D(LLAB(-1))	19.72265	11.79828	1.671655	0.1228
D(LLAB(-2))	24.24519	14.48815	1.673449	0.1224
D(LGR)	-0.255348	0.138229	-1.847282	0.0918
D(TRF)	0.125569	0.037056	3.388683	0.0060

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LDLNT	-6.617985	3.024428	-2.188178	0.0511
IFR	-0.032328	0.016826	-1.921344	0.0810
LLAB	3.797362	5.602791	0.677763	0.5119
TRF	0.398760	0.111908	3.563297	0.0044

EC = LCTP - (-6.6180*LDLNT -0.0323*IFR + 3.7974*LLAB -0.9093*LGR + 0.3988*TRF)

ARDL Error Correction Regression
Dependent Variable: D(LCTP)
Selected Model: ARDL(1, 3, 3, 3, 3, 1)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 08/18/25 Time: 10:29
Sample: 1990 2024
Included observations: 32

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.73497	3.619465	7.386442	0.0000
@TREND	0.085206	0.011806	7.216934	0.0000
D(LDLNT)	-0.834638	0.226507	-3.684823	0.0036
D(LDLNT(-1))	1.715465	0.243329	7.049990	0.0000
D(LDLNT(-2))	1.411544	0.215260	6.557382	0.0000
D(IFR)	-0.006023	0.001813	-3.322524	0.0068
D(IFR(-1))	0.011705	0.001943	6.024822	0.0001
D(IFR(-2))	0.007426	0.001350	5.499205	0.0002
D(LLAB)	-7.094345	1.238362	-5.728816	0.0001
D(LLAB(-1))	19.72265	7.356719	2.680903	0.0214
D(LLAB(-2))	24.24519	8.461426	2.865378	0.0154
D(TRF)	0.125569	0.023001	5.459244	0.0002
CointEq(-1)*	-0.485544	0.065386	-7.425781	0.0000

R-squared	0.865221	Mean dependent var	0.043010
Adjusted R-squared	0.738866	S.D. dependent var	0.110929
S.E. of regression	0.056686	Akaike info criterion	-2.595726
Sum squared resid	0.051413	Schwarz criterion	-1.862858
Log likelihood	57.53161	Hannan-Quinn criter.	-2.352801
F-statistic	6.847547	Durbin-Watson stat	2.825072
Prob(F-statistic)	0.000212		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.318380	10%	2.75	3.79
k	5	5%	3.12	4.25
		2.5%	3.49	4.67
		1%	3.93	5.23

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LPOR)
Selected Model: ARDL(2, 3, 4, 4, 3, 4)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 10:39
Sample: 1990 2024
Included observations: 31

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-50.83534	22.50474	-2.258872	0.0735
LPOR(-1)*	-1.627055	0.388512	-4.187913	0.0086
LDLNT(-1)	-3.434250	2.398843	-1.431628	0.2117
IFR(-1)	-0.025934	0.017219	-1.506081	0.1924
LLAB(-1)	9.884993	4.162395	2.374833	0.0636
TRF(-1)	0.955940	0.332054	2.878866	0.0346
D(LPOR(-1))	-0.369413	0.156674	-2.357843	0.0649
D(LDLNT)	3.484801	1.158290	3.008572	0.0298
D(LDLNT(-1))	3.514216	1.802197	1.949962	0.1087
D(LDLNT(-2))	4.032599	1.918656	2.101784	0.0896
D(IFR)	-0.000774	0.011438	-0.067685	0.9487
D(IFR(-3))	-0.009886	0.007743	-1.276739	0.2578
D(LLAB)	14.13689	6.935363	2.038378	0.0971
D(LLAB(-1))	49.59806	31.32412	1.583382	0.1742
D(LLAB(-2))	24.95756	53.12824	0.469761	0.6583
D(LLAB(-3))	138.7644	46.22436	3.001976	0.0300
D(TRF)	0.037118	0.126013	0.294561	0.7802
D(TRF(-1))	-1.057240	0.368916	-2.865799	0.0352
D(TRF(-2))	-0.804689	0.285534	-2.818187	0.0372
D(TRF(-3))	-0.582882	0.190381	-3.061657	0.0280

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LDLNT	-2.110716	1.494127	-1.412675	0.2169
IFR	-0.015939	0.010695	-1.490361	0.1963
LLAB	6.075391	1.955159	3.107364	0.0266
TRF	0.587528	0.176424	3.330201	0.0208
C	-31.24378	7.904413	-3.952701	0.0108

EC = LPOR - (-2.1107*LDLNT -0.0159*IFR + 6.0754*LLAB -1.1874*LGR + 0.5875*TRF -31.2438)

ARDL Error Correction Regression
Dependent Variable: D(LPOR)
Selected Model: ARDL(2, 3, 4, 4, 3, 4)
Case 2: Restricted Constant and No Trend
Date: 08/18/25 Time: 10:39
Sample: 1990 2024
Included observations: 31

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LPOR(-1))	-0.369413	0.066385	-5.564716	0.0026
D(LDLNT)	3.484801	0.467069	7.461001	0.0007
D(LDLNT(-1))	3.514216	0.463586	7.580501	0.0006
D(LDLNT(-2))	4.032599	0.528524	7.629930	0.0006
D(IFR)	-0.000774	0.003740	-0.206977	0.8442
D(IFR(-1))	0.012737	0.003435	3.707648	0.0139
D(IFR(-2))	0.005542	0.003104	1.785324	0.1343
D(IFR(-3))	-0.009886	0.002577	-3.836030	0.0122
D(LLAB)	14.13689	2.658635	5.317350	0.0031
D(LLAB(-1))	49.59806	15.14730	3.274383	0.0221
D(LLAB(-2))	24.95757	26.21549	0.952016	0.3848
D(LLAB(-3))	138.7644	17.21477	8.060775	0.0005
D(LGR)	-2.579886	0.296077	-8.713568	0.0003
D(TRF)	0.037118	0.044743	0.829601	0.4446
D(TRF(-1))	-1.057240	0.111050	-9.520365	0.0002
D(TRF(-2))	-0.804689	0.080826	-9.955809	0.0002
D(TRF(-3))	-0.582882	0.057835	-10.07843	0.0002
CointEq(-1)*	-1.627055	0.119900	-13.57015	0.0000

R-squared	0.973028	Mean dependent var	0.183720
Adjusted R-squared	0.926440	S.D. dependent var	0.406684
S.E. of regression	0.110300	Akaike info criterion	-1.316992
Sum squared resid	0.133827	Schwarz criterion	-0.391839
Log likelihood	40.41338	Hannan-Quinn criter.	-1.015415
Durbin-Watson stat	2.947937		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	11.95772	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

Null Hypothesis: CTP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.649388	0.4471
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CTP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.791706	0.0005
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

Null Hypothesis: SHPC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.020309	0.9541
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

Null Hypothesis: D(SHPC) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.429365	0.0170
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: SHPC is stationary
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.205179
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

Null Hypothesis: D(SHPC) is stationary
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.653725
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Null Hypothesis: CTP is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.656691
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

Null Hypothesis: D(CTP) is stationary
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.291735
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Variance Inflation Factors
Date: 08/20/25 Time: 01:02
Sample: 1990 2024
Included observations: 34

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
AQT	0.019170	12.46890	5.364844
LAB	2.94E+10	161.3633	8.078982
LGR	2.00E+09	461.6353	7.191377
TRF	97867227	48.59945	4.114277
IFR	442850.4	5.298373	2.151743
C	3.15E+12	61867.27	NA