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An Analysis of the Impact of Seaport Efficiency on Nigeria's Economic Growth.

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ABSTRACT: This research is driven by the objective to assess the impact of the seaport efficiency on Nigeria's economic growth. The western ports of Lagos are selected as the Decision-Making Units (DMU) for this study covering the period of 2000 to 2020. Two stage estimation process is employed. Data Envelopment Analysis (DEA) was deployed in the first stage to generate the efficiency index required to test the relationships. In the second stage, the efficiency index so generated is introduced as one of the independent variables in a multiple regression model, using Autoregressive Distributed Lag Model (ARDL). The finding shows that seaport efficiency has a negative but significant relationship with economic growth in both the long run and short run. The study concludes that seaport efficiency has an inverse relationship with Nigeria's economic growth. The result of this study suggests that reforms may not have deepened the level of efficiency in the Nigerian seaport to drive positive economic growth, hence the recommendation for further investment in the terminal operational equipment and technological infrastructure to drive further efficiency in the sector.

KEYWORD: Seaport Efficiency, Economic Growth

1. INTRODUCTION

The comprehensive port reform embarked upon by the Nigerian government in the early year 2000 and concluded in year 2006, was driven by the objective of enhanced port productivity, operational performance, efficiency and effectiveness in terms of increased cargo throughput, reduced berth occupancy rates, and increase in number of vessel traffic (NPA, 2018, Maduechesi, 2023). According to Onikosi-Alliyu (2022), seaports as critical infrastructure that connects producers and consumers across the globe, have long been recognized as important drivers of economic growth, whose development has been a key priority for governments and businesses globally. Seaports' contribution to economic development is largely felt through their mediating roles and facilitation of seaborne transportation which is a major catalyst for international trade worldwide. UNCTAD (2017) estimates that about 80% of the volume and 70% of the value of goods involved in global trade are moved annually through the sea. Hence as a gateway for international trade between countries and their immediate neighbours, seaports open up the foreign markets to both sellers and buyers, providing access to the best products and inputs from around the world (Head, Bert, & Findley, 2018).

Beyond its mediating roles in seaborne trade, Onwuegbuchulam (2020) has observed that the seaport is also a strategic asset for national security and the economy, which had over the years grown in its importance to become a major component of the transport sector in general and the maritime subsector in particular. The maritime subsector encompasses a wide range of services and activities, which include the transportation of goods and passengers, commercial fishing, tourism, cruise shipping, and naval and maritime security. According to Yeo (2010), the seaport as a part of the maritime industry, serves as the node to these maritime services and activities. As a key component of the logistic chain, seaports provide a fast, large-capacity option for companies to move products both internationally and domestically, helping firms provide goods and services at prices considered cheaper and meet fluctuations in demand. Consequently, export competitiveness, final import prices, and other similar economic variables are directly affected by port operations (Dwarakisha & Salima, 2015).

The Nigerian government has anticipated that the port reform will drive economic growth and performance through enhanced export of locally produced goods and services, leading to the diversification of Nigerian economy and other sources of revenue and foreign exchange. The relationship between ports and local economic growth can be either through the economic pull effect, which emphasizes that ports are the accelerators of economic growth, or simply through the physical transfer of freight flows in response to demand (Jung, 2011). This by implication simply means that the port infrastructure contributes to the growth and development of the economy, while economic growth generates demand for port development. Thus fostering a form of mutually benefiting relationship between seaport and the economic growth.

According to the Economic Country Report of the International Monetary Fund (2017), the contribution of maritime sector to the Nigeria Gross Domestic Product was 0.05% compared to South Africa and Kenya which recorded about 1.4% and 3% respectively within the same period. Also, according to Omoke *et al*. (2018), the number of vessels that called at the port in 2016 decline by 2.72% from the previous year value. This suggests a review of the port operation for regional and global competition and by implication, the economy is experiencing high prices of consumables as well as fall in per capita income of port workers and port revenue. While these reports are suggestive of poor performance of the subsector, the question therefore should be what impact does the port reform have on the contributions of the maritime subsector on the Nigerian GDP?

Studies by Okeudo (2013), Onwuegbuchulam (2014) have demonstrated that reform in the Nigeria seaports has led to improvement in the efficiency of the ports. These studies have limited their research on determining the relative efficiency and productivity of the Nigerian ports since the completion of the reform, only few studies in Nigeria such as Ndubisi (2016), have gone ahead to test the impact of the seaport efficiency on Nigeria's economic growth. These few researches have had various outcomes in terms of the causality, direction and significance of port efficiency on Nigeria's economic growth. This study therefore intends to join in the debate by deploying Autoregressive Distributed Lag Model technique to ascertain the relationship between seaport efficiency and Nigerian economic growth. Thus, the objective of this study is to assess the impact of seaport efficiency since the reform on Nigerian economic growth.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. Conceptual Review

2.1.1. Seaport Efficiency

Efficiency according to Cullinane (2012) relates to the difference between the actual level of productivity relative to the ideal level, and also the ratio of output to input or benefits to costs (Begum, 2003). The measurement of efficiency, according to López-Bermdez *et al* (2019), relates to the measurement of productivity. This therefore implies that efficiency and productivity are used interchangeably because the measurement of a company's efficiency is approximated most often using the partial productivity indicators, which are ratios of the products and their factors. Kopp and Diewert (1982) categorized overall efficiency into allocative efficiency (cost minimization of input ratios) and technical efficiency (maximization of production possibility).

In the port sector, efficiency follows the same pattern of input ratio minimsation or production possibility maximization. Hence seaport efficiency is a multi-dimensional concept. It constitutes one of the three components of port performance, the other two being effectiveness and resilience (Notteboom, Pallis & Rodrigue, 2022). In terms of port efficiency, the focus has always been on the terminal operations' efficiency (productivity). Indicators traditionally used to measure terminal operational efficiency include turnaround time, revenue per ton of cargo, berth occupancy, capital equipment expenditure per ton of cargo, and the number of gangs employed to facilitate cargo operations (Brooks & Schellinck, 2015). Port efficiency is considered part of a continuous process that encompasses maritime, terminal, and hinterland operations, and therefore the dimensions are interrelated since inefficiency in one dimension is likely to impact negatively on the other dimensions. Terminal operational delays are going to negatively impact maritime and hinterland operations with further delays (Brooks *et al*, 2020).

The efficiency of maritime access is a component of port performance, which includes average anchorage time. Long waiting times at anchorage could be a result of the inability of berthing slots to accommodate specific ship classes based on issues such as draft and cargo types, as well as terminal productivity issues (Arvis *et al*, 2019). For shipping companies, terminal operation is a crucial factor since it is related to the amount of time ships spend at the port. How cargoes are brought back and forth to the storage yard is also a component of port performance and often related to the number of movements per crane hour (Notteboom *et al*, 2022). The average yard dwell time for inbound, outbound, and transshipment cargo is also a common indicator. The space and equipment required to ease the bottleneck of trucks, as well as the document processing and security inspection at the gate, all contribute to the efficiency and performance of the ports.

The next component and key factor in port performance and efficiency is hinterland operations. This is the capacity of the transport system and local road network in areas adjacent to the port to effectively support port operation. Congestion and bottlenecks at street intersections impair the port's performance in many of the supply chain management strategies of the port's customers. Some ports have near-dock rail yards that must be serviced through the terminals' gates. In many gateway ports, transloading activities that transfer the contents of maritime containers into domestic truckloads, or vice versa, are an element of the performance of hinterland operations. The inability of the port authorities to have oversight, either directly or indirectly, of these hinterland operations has negative impacts on port efficiency.

In conceptualization, seaport efficiency is the optimization of seaport operations and activities through cost minimization and output maximisation. On the other hand, economic growth is the increase of productivity of goods and services (Adofu & Abula, 2010). It is also a steady process of increase in a productive capacity of an economy over time which eventually results to rising levels of national output and income (Todaro & Smith, 2009). In the words of Gobna et al. (2022), economic growth is the increase in an economic output resulting from prudent debt management strategy. That is, a sustained increase, over a significant period, in the quantity of material goods and services produced in an economy as made possible by the public debt management. Agunbiade and Mohammed (2018) believed economic growth is a process that requires harnessing real resources for the production of capital goods not meant for immediate consumption, but rather for increasing the production potential in future. Therefore, this study defines economic growth as the rise in output resulting from the seaport operation and activities.

2.2. Empirical Evidence

Several studies have established a positive relationship between port infrastructure and logistics performance on economic growth. Specifically, Haque-Munim and Schramm (2018) conducted their study adopting the Structural Equation Model, with the aim to highlight the evidence of economic impacts between logistic performance and the quality of port infrastructure. Their findings showed that the quality of port infrastructure contributed to better logistics performance, leading to an increase in seaborne trade and higher economic growth. This position is supported by the result of the study by Yeo (2010). Other studies that focused on the broad impact of seaports on economic growth include Park and Seo (2016), Hargono, Sutomo, and Alisyahbana (2013), Jouili (2016), Chen and Lee-Lam (2018), and Artal-Tura et al. (2016). The summary of their findings suggests a positive relationship between port infrastructure and economic growth, particularly with increased investment in port infrastructure. The growth in the economy is transmitted through enhanced trade activities and the reduction of commodity prices (Dwarakisha and Salima, 2015).

In the study by Edimon *et al* (2015), the specific relationship between seaport efficiency and economic growth was tested using the method of IndoTERM, a CGE-based economic model. Their findings showed a positive relationship between seaport efficiency and economic growth, suggesting that a growth rate of 1.1% will be achieved if there is an improvement in port efficiency of about 50% over five years. The study by Huang and Peng (2014) was similar to the extent that it measured a specific relationship between seaport efficiency and economic growth. The study findings show a non-satisfactory relationship between port efficiency and economic growth.

In Nigeria, Ndalu and Okene (2024), attempted to investigate the impact of port infrastructure and logistics efficiency on economic growth in Nigeria, by adopting the ARDL Bound Test approach in other to estimate the relationship between the variables. The study findings show that both quality of port infrastructure and logistics efficiency have insignificant relationships with economic growth in both the short-run and long-run. On his part, Ndubisi (2016) investigated the relationship between productive efficiency of the ports post privatization and economic growth in Nigeria, with the aim of testing the property rights theory using the concession of the Nigerian port terminals. The findings of the study showed that inefficiency in the port had inverse relationship with economic growth.

2.3. Theoretical Framework

This study is adopting the Solow growth model, an exogenous model of long-run economic growth as the theoretical framework following paths created by Solow (1957). The tenet of the model suggests that in a steady growth state of an economy, higher growth is only possible through (or driven by) technological progress which comes from outside the economy parameters. A number of factors that influence seaport performance, efficiency and productivity are exogenous to the system and not solely determined by the activities within the seaport hence the choice of this model as the theoretical framework for this study. Such factors like levels of security and location within trade routes are some of the factors though exogenous, but contribute to the performance and efficiency of the seaport (Park & Seo, 2016; Maduechesi, Nazifi & Yelwa, 2023).

The Solow's model is depicted by the aggregate production function as seen below.

$$Y(t) = F[K(t), A(t)L(t)] \quad (2.1)$$

Where Y is gross domestic product, K is the stock of capital, L is labour, and 'A' (technology or technological progress) represents the productivity of labour which grows overtime at exogenous rate, while (t) represents time.

The aggregate function is assumed to satisfy a series of technical conditions;

a. It is increasing in both arguments; some conditions;

$$F_K > 0, F_L > 0$$

b. It displays decreasing marginal returns to each factor;

$$F_{KK} < 0, F_{LL} < 0$$

c. It displays constant returns to scale, and

$$AF(\lambda K, \lambda L) = \lambda AF(K, L)$$

d. It satisfies the Inada condition;

$$F_K = F_L = +\infty$$

The remarkable fact about the Solow model in this theoretical framework is the basis of introduction of additional variables in the existing Harrod-Domar model. The addition of labour and technical progress in Solow's view provided a better platform to achieve economic growth. The technological progress represents factor productivity and knowledge in the production process. This will form the basis of introduction of efficiency and cargo throughput as some of the independent variables in the study equations. This makes it easy for the evaluation of the influence of efficiency on the dependent variables adopted as economic performance indicators.

3. METHODOLOGY

This study was conducted under a two-stage estimation process. In the first stage, the efficiency index of the Decision Making Units (Lagos Port and Tin Can Port Complexes Lagos) was determined within the study period. The Malmquist Total Factor Productivity (TFP), one of the techniques of Data Envelopment Analysis (DEA) amenable to panel data in its analysis, was used for the estimation of the efficiency index. The second stage saw the deployment of the efficiency index obtained in the first stage, as one of the independent variables in the multiple regression model to assess the impact of the seaport efficiency on Nigeria's economic growth.

3.1. Model Specification

3.1.1. Data Envelopment Analysis (DEA) Malmquist Total Factor Productivity Index

The DEA is a non-parametric method of determining the efficiency of a decision-making unit with single or multiple inputs output variables (Cullinane & Wang, 2006). The Charnes, Cooper and Rhodes (1978) (CCR) model of DEA was adopted based on the assumption of constant return to scale. Hence to determine the efficiency of the DMU, the study had to solve the mathematical programing model given below;

Maximize h_o *(u, v)* = $\frac{\sum_{r=1}^{s} u_r y_r^0}{\sum_{i=1}^{m} v_i x_i^o}$ (3.1)

Subject to:

$$\frac{\sum_{r=1}^{s} u_r y_j^0}{\sum_{i=1}^{m} v_i x_{ij}^o} \leq i, j = 1,2, \dots\dots, n \quad (3.2)$$

$$U_r \geq 0, r = 1,2, \dots.., s \quad (3.3)$$

$$v_i \geq 0, i = 1,2, \dots., s \quad (3.4)$$

Where:

X_{ij} = represents *the observed input of the* i_{th} *type of the* j_{th} *DMU* (x_{ij} >0, i=1,2, …, *m,j = 1,2,…..,n).*

y_{ij} *= the observed amount of output of the* r_{th} *type of* j_{th} *DMU (*y_{ri} *> 0, r = 1,2,….,S,j = 1,2,….,n)*

U_r *and* V_i *= linear programming determined weights*

The dual for the linear programing problem is as follows;

Min $Z_0 = \vartheta_0$ (3.5)

Subject to:

$$\sum_{j=1}^{n} \lambda_j \chi_{ij} \geq y_r^0, r = 1,2, \dots., s \quad (3.6)$$

$$\theta_0 x_i^0 - \sum_{j=1}^{n} \lambda_j x_{ij} \geq y_r^0, i = 1,2, \dots\dots, m \quad (3.7)$$

$$\lambda \geq 0, j = 1,2, \dots\dots, n \quad (3.8)$$

In solving the mathematical programing problem, the efficiency score for the DMU was derived.

3.1.2. Multiple Regression Model

The study adapted the Cobb-Douglas function-like model of Ndubisi (2016) cited in Maduechesi *et al* (2023) with some modifications to meet the study objective.

$$Y_t = e^{\beta_0} K_t^{\beta_1} L_t^{\beta_2} P_t^{\beta_3} Z_t^{\beta_4} \quad (3.9)$$

Where;

Y = Aggregate output

L = Labor force

K = Capital stock

Z = Vector of other Institutional factors in the aggregate production process

$$P = \frac{C}{(1+i)^{\lambda}} \quad (3.10)$$

And "C" is the cargo throughput of all the DMUs in a year, "*i*" is the measure of port's inefficiency, and "λ" is the weight of the inefficiency in the allocative process. For this study, the variable "Z" represented the vector of other macroeconomic variables that contribute to economic growth. The resulting Cobb-Douglas function therefore became.

$$Y_t = e^{\beta_0} K_t^{\beta_1} L_t^{\beta_2} P_t^{\beta_3} Z_t^{\beta_4} \quad (3.11)$$

Adding natural logarithm on both sides produced a linear equation thus;

$$ln\, Y_t = \beta_0 + \beta_1 lnK_t + \beta_2 lnL_t + \beta_3 lnP_t + \beta_4 lnZ_t \quad (3.12)$$

Substituting the value of P in equation ***3.10*** into equation ***3.12*** gave us

$$\beta_3 ln\, P_t = \beta_3 ln\, \frac{C}{(1+i)^{\lambda}} = ln\, C\, - \varphi ln\, (1-i) \quad (3.13)$$

$$Where\ \varphi = \beta_3 \lambda = \beta_5$$

Substituting equation ***3.13*** into ***3.12*** produced;

$$ln\, Y\ = \beta_0 + \beta_1 ln\, K\ + \beta_2 ln\, L\ + \beta_3 ln\, C - \beta_5 ln\, (1-i)\ + \beta_4 ln\, Z \quad (3.14)$$

Representing the log of the variables with a lower case simplified this to;

$$y = \beta_0 + \beta_1 k + \beta_2 l + \beta_3 c - \beta_5 (1-i) + \beta_4 z \quad (3.15)$$

The importance of the equation (3.15) is that the influence of port on the economic growth is felt through the increase in volumes of cargo throughput represented by β_3, which must have to be greater than zero to ensure the impact is felt. The influence can also be felt through a reduction in inefficiency (1-*i*), which by implication means increase in efficiency, hence the adoption of efficiency index in our study, and for this to be effective, the coefficient β_5, must have to be positive. Where the coefficient β_5 is positive, the implications therefore will be that the port efficiency has a positive contribution to economic growth.

With the introduction of the error term (μ_t) into the equation (3.15) we had:

$$y = \beta_0 + \beta_1 k + \beta_2 l + \beta_3 c - \beta_5 (1-i) + \beta_4 z + \mu_t \quad (3.16)$$

Where the μ_t is a random disturbance term introduced to capture the statistical noise. The disturbance is assumed to be independently distributed with zero mean and constant variance.

$$\mu_t \sim id(0, \sigma_\mu^2).$$

This model for this study therefore is;

$$GDP = \beta_0 + \beta_1 CAP + \beta_2 POP + \beta_3 CARGO - \beta_5 EFF(1-i) + \beta_4 EXCH + \beta_6 INF + \beta_7 INT + \mu_{1t} \quad (3.17)$$

Where;

GDP: Economic Growth Rate

CAP; Capital Stock

POP; Growth Rate of Population

EXCH; Real Exchange Rate

CARGO, Total Volumes of Cargo Throughput

EFF: The Mean Efficiency Change Index

INF: Inflation Rate,

INT: Real Interest Rate

μ_t : Error Term

3.1.3. Nature and Source of Data

Data for this study are sourced from the Nigerian Ports Authority's (NPA) ports statistics, Nigerian Ports Authority year books, annual reports and other publications of the agency. Some of the data for economic variables are obtained from the Central Bank of Nigeria (CBN), National Bureau of Statistics' (NBS) annual abstract statistics, and the World Bank's World Development Indicators (WDI) annual report. The data are sourced for the study period of year 2000 to 2020 and consist of input-output variables from the operations of the seaports including cargo throughput in metric tons, terminal areas in measured in hectares, quay lengths in meters, and cargo handling equipment in their numbers.

3.1.4. The ARDL Estimation Technique

This study made use of the Autoregressive Distributed-Lag Model (ARDL), a procedure first developed by Pesaran and Shin (1999), but later enhanced by Pesaran, Shin and Smith (2001). The ARDL was adopted due the sample size (Year 2000 –Year 2020), and its nonrestrictive properties on a single order of integration on the variables of study (Nkoro & Uko, 2016; Aswata, Nnyanzi & Bbale, 2018; Mohammed, 2021), The linear ARDL model specification is given below.

$$\Delta Log(GDP)_t = \alpha_0 + \alpha_1 T + \beta_1 Log(GDP_{t-1}) + \beta_2 Log(CAP_t) + \beta_3 Log(POP_t) + \beta_4 Log(CARGO_t) + \beta_5 Log(EFF_t) + \beta_6 Log(EXCH_t) + \beta_7 Log(INF_t) + \beta_8 Log(INT_t) + \sum_{i=0}^{k} \lambda_{1i}\, \Delta Log(GDP_{t-1}) + \sum_{i=0}^{k} \lambda_{2i}\, \Delta Log(CAP_{t-1}) + \sum_{i=0}^{k} \lambda_{3i}\, \Delta Log(POP_{t-1}) + \sum_{i=0}^{k} \lambda_{4i}\, \Delta Log(CARGO_{t-1}) + \sum_{i=0}^{k} \lambda_{5i}\, \Delta Log(EFF_{t-1}) + \sum_{i=0}^{k} \lambda_{6i}\, \Delta Log(EXCH_{t-1}) + \sum_{i=0}^{k} \lambda_{7i}\, \Delta Log(INF_{t-1}) + \sum_{i=0}^{k} \lambda_{8i}\, \Delta Log(INT_{t-1}) + \theta ECT_t + \mu_t \quad (3.18)$$

4. DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1. Malmquist TFP Index

Table 4.1: Summary of Annual Means of Malmquist Total Factor Productivity Efficiency Index

Year	EFFCH	TECHCH	PECH	SECH	TFCH
1 (2000)	1.000	1.000	1.000	1.000	1.000
2 (2001)	1.014	1.262	1.000	1.014	1.281
3 (2002)	0.950	1.029	1.000	0.950	0.978
4 (2003)	1.045	1.019	1.000	1.045	1.065
5 (2004)	0.913	1.064	1.000	0.913	0.971
6 (2005)	1.032	1.091	1.000	1.032	1.127
7 (2006)	1.232	0.893	1.000	1.232	1.100
8 (2007)	1.049	1.229	1.000	1.049	1.289
9 (2008)	1.071	1.115	1.000	1.071	1.195
10 (2009)	1.076	0.913	1.000	1.076	0.983
11 (2010)	0.975	1.123	1.000	0.975	1.095
12 (2011)	1.020	1.07	1.000	1.020	1.100
13 (2012)	1.040	1.871	1.000	1.040	0.906
14 (2013)	1.015	1.022	1.000	1.015	1.037
15 (2014)	1.000	1.050	1.000	1.000	1.050
16 (2015)	1.000	0.958	1.000	1.000	0.958
17 (2016)	1.000	0.937	1.000	1.000	0.937
18 (2017	1.000	1.008	1.000	1.000	1.008
19 (2018)	0.997	1.043	1.000	0.997	1.041
20 (2019)	0.999	0.256	1.000	0.999	0.255
21 (2020)	0.998	0.650	1.000	0.998	0.648
Mean	**1.020**	**0.948**	**1.000**	**1.020**	**1.001**

Source: Computation by the Author using DEA Generated Series as found in Maduechesi (2023)

Table 4.1 shows the aggregated annual Malmquist Total Factor Productivity Index for the DMU decomposed into efficiency change (EFFCH), technical efficiency change (TECHCH), pure technical efficiency change, (PECH), scale efficiency change (SECH), and total factor productivity change (TFCH). The efficiency or productivity improvements is recorded when the index score of Malmquist TFP or any of the decompositions is greater than unity and vice versa. However, when the TFP values or any of the decompositions equal to unity, it signifies that the DMUs have experienced no improvement in efficiency or productivity or both. As in Ndubuisi (2016), the efficiency index for our study is the mean annual efficiency change (EFFCH) for the ports of study shown in the second column of the table. The mean efficiency score within the study period is 1.020 which signifies a marginal efficiency improvement in the DMUs within the study period.

4.2. Unit Roots Test

Table 4.2: Unit Root Test

	ADF at LEVELS			*ADF at FIRST DIFFERENCE*			
Variable	*Constant*	*Trend Constant*	*None*	*Constant*	*Trend Constant*	*None*	*I(d)*
GDP	0.239801 (0.9669)	-4.769513*** (0.0064)	-1.286288 (0.1762)	-3.988177 (0.0082)	-4.017980** (0.0292)	-5.321140 (0.0006)	I (0)
CAP	-9.501615 (0.0000)	-9.123093*** (0.0000)	-7.568999 (0.0000)	-5.787757 (0.0002)	-5.555622*** (0.0019)	-6.024607 (0.000)	I (0)
POP	1.245443 (0.9972)	-1.439097 (0.8162)	-3.008186 (0.0046)	-3.423684 (0.0231)	-4.053077** (0.0248)	-2.504713 (0.0154)	I (1)
CARGO	-2.244772 (0.1980)	1.648921 (1.0000)	-0.295975 (0.5656)	-5.969546 (0.0001)	-6.949053*** (0.0001)	-6.150210 (0.0000)	I (1)
EFF	-2.225727 (0.2050)	-2.401442 (0.3658)	0.056736 (0.6881)	-3.198593 (0.0392)	-3.843853** (0.04197)	-3318977 (0.0026)	I (1)

EXCH	-1.749811 (0.3927)	-2.414343 (0.3618)	-0.303222 (0.5636)	-3.778129 (0.0112)	-3.819656** (0.0383)	-3.887937 (0.0006)	I (1)
INF	-3.7297452 (0.0124)	-3.492495* (0.0690)	-0.263048 (0.5763)	-4.888956 (0.0012)	-4.670973*** (0.0091)	-5.054021 (0.0000)	I (1)
INT	-2.025580 (0.2744)	-3.243353 (0.1059)	-0.733816 (0.3858)	-4.830666 (0.0012)	-4.835388*** (0.0056)	-4.897099 (0.0001)	I (1)

Source: Extract from Eviews 11 Output in Maduechesi (2023). NB: *, ** and *** imply significance at 10%, 5% and 1% respectively. ADF is Augmented Dickey Fuller Unit Root Test, PP is Philip Peron Unit Root Test. Values in parenthesis (…) indicate MacKinnon (1996) one-sided p-values.

Stationarity test is conducted to check the time series properties and determine the order of integration of the variables in order to ascertain their credibility and usability. The stationarity test adopted is Augmented Dickey-Fuller (ADF) unit root test with zero order of integration {levels or I(0)}, and first difference, I(1) results obtained for all variables in two categories of equations (intercept with no trend, and intercept with trend). The result shows a mixed order of integration for which variables GDP and CAP are stationary at level, I(0); while variables POP, EXCH, INF, EFF, and INT are stationary at first difference I(1).

4.3. Empirical Results

Table 4.3: Summary of ARDL Model One in Equation 3.18

PANEL A: BOUND COINTEGRATION TEST			
F-statistics	**I(0)**	**I(1)**	**Level of Significance**
45.98767***	1.92	2.89	10%
	2.17	3.21	5%
	2.73	3.9	1%
PANEL B: ARDL			
Long Run			
Variable	**Coefficient**	**t-Statistics**	**Prob**
C	-29.87002**	-3.332127	0.0158
GDP(-1)	-1.288131***	-14.85842	0.0000
CAP	0.118728***	6.833131	0.0005
POP(-1)	31.49634***	16.62835	0.00000
LOG(CARGO(-1))	-2.473284***	-5.650921	0.0013
LOG(EFF(-1))	-41.58304***	-7.041235	0.0004
EXCH	-0.032317**	-3.317451	0.0161
INF(-1)	-0.246034**	-2.627427	0.0392
INT(-1)	-0.174524	-1.527044	0.1776
D(POP)	43.42542***	6.223913	0.0008
DLOG(CARGO)	-1.384611**	-3.259012	0.0173
DLOG(EFF)	-35.14744***	-8.348667	0.0002
D(INF)	-0.391607***	-8.612711	0.0001
D(INT)	0.020232	0.245041	0.8146
Short Run			
CAP	0.092171***	7.906085	0.0002
POP	24.45119***	24.6777	0.00000
LOG (CARGO)	-1.920055***	-5.328229	0.0018
LOG(EFF)	-32.281168***	-8.329398	0.0002
EXCH	-0.025089**	-3.083368	0.0216
INF	-0.191**	-2.880646	0.028
INT	-0.135486	-1.483195	0.1885
C	-23.18864**	-3.581853	0.0116
ECT(-1)	-1.288131***	-31.07638	0.0000

PANEL C: POST ESTIMATION TESTS (ROBUSTNESS CHECK)			
Diagnostics	**F-Statistics**	**Df**	**Prob**
Linearity (RESET)	0.124873	1,5	0.7412
Serial Correlation	0.895859	2,4	0.477
Heteroschedasticity	1.040537	13,6	0.5127
JB-Normality Test	1.096357		0.578002
$Wald_{LR}$ Test			
R^2	0.995171		
Adj. R^2	0.993446		

Source: Extract from EViews 11 Output. NB: *, ** and *** imply significance at 10%, 5% and 1% respectively.

Table 4.3 shows the summary of the ARDL model, compartmentalized into panels A, B and C. Panel A shows the Bound Cointegration Test, and Panel B shows the long and short run results of the ARDL, while Panel C shows the results of post estimation tests. The ARDL lag order of (1, 0, 1, 1, 1, 0, 1, 1) is automatically selected through the Schwarz Criterion (SIC) maximum lag length selection criteria. The coefficients of multiple determinations R^2 and Adjusted R^2 are 0.995 and 0.993. That is, about 99.5 percent and 99.3 percent of the regressors explain the variation in the dependent variable in the model.

Further post estimation tests conducted as shown in Panel C, confirms the reliability of the estimates. For instance, the Breusch and Godfrey (BG) test for serial correlation shows an insignificant F-statistic which confirms the absence of autocorrelation. Similarly, the Breusch Pagan and Godfrey (BPG) test for heteroscedasticity shows insignificant F-statistics hence null hypothesis of Homoscedasticity is not rejected implying that the variances are homoscedastic. The outcome of the RESET test shows that models are correctly specified. The linearity test retains the null hypothesis that the models are devoid of specification error. The Jarque-Bera (JB) statistic for the models are insignificant, hence, suggesting the null hypothesis is not rejected. It evidently demonstrates that the residuals of models are normally distributed.

The Panel A of the Table 4.3 depicts the bound cointegration test for the long-run relationship of the variables in our model one. Since the F-statistics (45.988) lies above the upper bound of I(1), at 1 percent critical value (3.9), we can conclude that there is co-integration among the variables. The ECT shows the speed of adjustment to shocks and dynamics of the dependent variables to disequilibrium caused by the predictor variables. The Error Correction Term in our model in Panel B (-1.288) is significant at 1 percent and is negative as expected. This shows a speed of adjustment of 129 percent. Having ECT value greater than 1 suggests an oscillatory correction mechanism. That is, the speed of adjustment fluctuates forward before converging to equilibrium. This accordingly takes about 9 months (100/129=0.76x12=9.3) for that to happen in the case of our model.

Panel B reports the long run and short-run results of the model. The estimates indicate that gross fixed capital formation (CAP) has positive and significant relationship with economic growth both at long and short run at 1 percent level of significance. This shows that a percentage increase in CAP, will result 11.9 percent and 9.2 percent increase in GDP growth in the long and short run respectively. The result equally shows that populations growth rate (POP) has a positive and significant relationship with economic growth in the long and short run at 1 percent level of significance. A percentage rise in population growth rate, will result in 3,150 and 2,445 percent increase in economic growth in the long and short run respectively. Similarly, the result shows inverse but significant relationship between cargo throughput (CARGO) and GDP growth rate in both long and short run at 1 percent level of significance. Accordingly, a percentage increase in cargo throughput will lead to a decrease in GDP growth by 247.3 percent and 192 percent in both the long and short run respectively.

The result also depicts and inverse but significant relationship between seaport efficiency (EFF) and economic growth in both long run and short run at 1 percent significance level. This is however against the a priori expectation of a positive relationship. The result shows that a percentage increase in seaport efficiency will lead to a decrease in economic growth by 4,158.3 percent and 3,228 percent in the long run and short run respectively. Real exchange rate (EXCH) and Inflation (INF) have both inverse and significant relationship with economic growth in the long run and short run at 5 percent level of significance. However, real interest rate (INT) has negative but insignificant relationship with economic growth in both long run and short run.

4.4. DISCUSSION OF FINDINGS

The outcome of our result implies that seaport efficiency has a negative but significant impact on economic growth in the long run and in the short run. This therefore implies that in the long run and short run, an increase in seaport efficiency will result in the decline of economic growth. This is against a prior expectation of a positive impact of seaport efficiency on economic growth. This result is opposed to the findings of Edimon et al (2015) whose findings suggest a positive relationship between seaport efficiency and economic growth. This result is however similar to findings by Huang and Peng (2014) and Ndalu and Okene (2024), which show that overall influence of seaport efficiency on economic growth is not satisfactory or in the Ndubisi (2016) an inverse relationship between seaport efficiency and Nigerian economic growth.

5. CONCLUSION AND RECOMMENDATION

The result of this study has shown an inverse but significant relationship between seaport efficiency and Nigeria's economic growth at both long run and short run. In other words, the result shows that seaport efficiency is a negative contributor to the Nigerian economic growth. This is not surprising given that cargo throughput equally has an inverse but significant relationship with economic growth.

The result of this study suggests that reforms may not have deepened the level of efficiency in the Nigerian seaport to drive positive economic growth, hence the recommendation for further investment in the terminal operational equipment and technological infrastructure to drive further efficiency in the sector.

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