

ANALYSIS OF INTERMODAL TRANSPORT SYSTEM AND MANUFACTURING ACTIVITIES ON NIGERIA'S ECONOMIC AND REGIONAL IMPACT

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Abstract:

Growth poles are regional hubs that stimulate economic growth through the confluence between firms, centrifugal and centripetal forces, and the resulting multiplier effects, which attract resources and transmit growth to other sectors. This study utilized the survey design to investigate the roles of intermodal transport systems (ITS) in driving economic growth, especially in transporting consumer goods, industrial goods, and the healthcare industry. Data for the study were gathered from 90 companies listed on the Nigerian Exchange Group (NGE) between 2010 and 2019. Of the 90 businesses surveyed, 64 firms (71%) completed the research instrument. Multiple Regression Analysis (MRA) was used to test the derived hypotheses. Findings revealed a causality of the joint predictors of land transport and port clearance procedures (as subset of ITS) on the turnover of consumer products enterprises in a significant way ($p < 0.05$). Similarly, the study revealed significant relationship between ITS and healthcare businesses' ($p < 0.05$) and industrial goods turnovers ($p < 0.05$). This study contributed to knowledge by providing an empirical insight into the interrelationship that exists between the availability of ITS and manufacturing activities, and the impact of the duo as catalysts for economic development. It is concluded that strategic investment by all stakeholders in Nigeria's ITS can incentivize the country's Logistics Performance Index (LPI), spur the growth of key industrial sectors, and lead to its emergence as the leading regional manufacturing hub.

Keywords: Intermodal transport system, economic growth, regional economic hub, growth pole theory, logistic performance index, industry turnover.

1. Introduction

The growth of essential industries like consumer goods, industrial goods, and healthcare products holds significant potential for Nigeria's economic development, contributing immensely to its Gross Domestic Product and creating employment

opportunities (Ajayi, 2021; Oni et al, 2023; Ajayi, 2023¹). In 2012, for example, the retail and wholesale industry, which includes consumer products, contributed 15.5% of Nigeria's GDP (Nigeria Bureau of Statistics, 2017). Findings from Ebere et al, (2021) further established the irrefutable logic of a

positive correlation between these sub-sectors of industrial activities and GDP. The study discovered a high correlation between wholesale and retail trade and GDP, with variations in the former accounting for up to 99.4% of the latter's variance. The aforementioned sub-sectors of the nation's industrial system are critical drivers of the Nigerian commercial ecosystem. Apart from their extensive supply chains, they contribute meaningfully to job creation and the growth of Micro Small and Medium Enterprises (MSMEs) in the country (NBS, 2017; Ajayi, 2020¹; Oni et al, 2023). In Nigeria, available statistics indicated that in 2020, MSME contribution to the employment figures increased 3.5% while its holistic contribution to the GDP expanded to 48% (NBS, 2017; Pricewaterscooper, 2024). Shreds of available evidence indicated that there are striking factors behind the emergence of regional hubs in different climes, one of which is the sectoral agglomeration of business activities resulting in the development of growth poles (Glavič et al, 2021; Frick and Rodríguez-Pose, 2025). Another factor is the indispensability of Supply Chain Integration (SCI) of different stakeholders that act as vital linkages that facilitate the effective movement of goods, information, and materials between

production and consumption points (Hoogenboom et al, 2018; Ajayi, 2023¹).

In Nigeria, available information indicates that the manufacturing sector accounts for 8.4% of the GDP in 2024 (NBS, 2025). This figure is abysmally lower than what is obtainable for the countries in the BRICS economic bloc (Brazil-20%, Russia-12.45%, India-17%, South Africa-12%) [World Bank, 2025]. The Nigerian figure is also about the lowest among the top four economies in Africa (South Africa, Egypt, Algeria, and Nigeria), with the Egyptian manufacturing sector accounting for 16% of its GDP. In contrast, Algeria's manufacturing sector accounts for 9.3% of its GDP for the period under review (World Bank, 2025).

Experiences have shown that manufacturing hubs act as growth poles by agglomerating or concentrating economic activity and driving regional development through various mechanisms (Parr, 2015). These mechanisms include concentration of skilled labor force or pooled labor markets, availability of supply chain integration, offering forward and backward linkages of productive activities, and knowledge spillovers enhanced by co-location of skilled workers, who shared work-related knowledge through face-to-face interactions: thereby promoting innovation,

invention, and productivity (Parr, 2015: Frick, and Rodríguez-Pose, 2025).

Relatable examples of manufacturing hubs that morphed into regional growth poles include the Yangtze and Delta River Deltas, both in China, and the Bavarian region in Germany. Another prominent example is the Research Triangle Park (RTP) in North Carolina, which started as a joint industrial park venture in the 1950s, attracting technology and research companies. It has since become a major center for innovation and economic development in the surrounding region (Wessner and Howell, 2017; Ajayi, 2020²; Ajayi, 2023²; Le Son, 2024: Frick, and Rodríguez-Pose, 2025). Similarly, is the 'Tech Valley', or the nanotechnology cluster based around Albany, New York, that reflected a long-term policy commitment backed by substantial state and industry investments leading to the development of new educational institutions (Wessner & Howell, 2017).

In sub-Saharan Africa (SSA), Ogunleye (2011) alluded to developing regional growth poles as an offshoot of manufacturing activities in Nigeria, South Africa, Angola, and Kenya. However, unlike the situation in the developed countries of the world, where there are concerted efforts of state and private

sector investment in the construction and maintenance of critical infrastructure like Intermodal Transport System (ITS) to drive and sustain this growth, many of the SSA's regional hubs has not been able to weaponized the concept of growth pole to galvanize regional development successfully (Ajayi, 2020²: Ajayi, 2025¹). Failure to build on the initial efforts has either impeded these regional hubs' growth or distorted the lofty plans behind their original designs.

Nigeria's population is projected to reach 401.3 million by 2050. The key drivers of this growth are the youthful population with over 43% under 15, a relatively high fertility of 2.66 per annum, and an unrelenting rate of urbanization at 79.9% (Ajayi, 2020²: Eghosa, 2025). The growth is creating an unprecedented uptake in consumerism, as there is a thriving market for products with industrial sub-sectors like daily needs, industrial, and healthcare/pharmaceuticals items experiencing unprecedented booms in Nigeria (PwC, 2023).

Numerous studies in the Nigerian milieu have highlighted the growing synergy between the availability of intermodal transport systems and the growth of the country's economy (Adenigbo et al, 2023; Oni and Ojekunle, 2024; Oni et al., 2025; Ajayi, 2023²; Ajayi,

2025²). For example, Ajayi (2023³) posited that the resurgence of rail services across some regional divides in Nigeria in the last seven years has increased manufacturing-commercial linkages and expanded the overall capacity of the country's economy. In a similar vein, scholars have identified the inimitable benefits that the availability of intermodal transport infrastructures that link maritime and land transportation networks brings to both local and international trades (Lawal-Fagbo et al, 2023; NBS, 2025).

One of the major blight that has contributed to Nigeria's inability to fully annexed its geographical positioning, human resources and natural endowment as a regional economic powerhouse has been traced to the tepid state of her transportation system, whereas the kilometers of paved/tarred road network in the country is relatively high when compared to other African countries, it is still lower than what is obtainable in some developing countries (Perikesit et al., 2019; Lawal-Fagbo et al, 2023; Adenigbo et al, 2023). Research findings indicated that the failure to provide intermodal linkages between the Lagos port (Nigeria's flagship port) and land transportation subsystems is the primary source of issues like congestion, bureaucratic bottlenecks, inter-agency feuds, corruption, high operating expenses, and supply chain

disruptions (Lawal-Fagbo et al, 2023). The cumbersome port customs clearance procedure is exacerbating the problem of delays at the Lagos port. It has been attributed that Nigeria's business community makes a mind-blowing annual loss of over 2.5 trillion naira due to delays and port inefficiencies (Business Day, 2025).

This paper fills a critical gap in the body of extant knowledge on the dynamics between the efficient ITS and its confluence with manufacturing and their roles in the country's emergence as a regional economic powerhouse. This paper is structured into five sections. The introductory section provides background and highlights the motivation for the study. Section two reviewed existing literature and explored the relationship between maritime transportation and economic growth. Section three highlighted the methodology. Section four discussed the results and findings. Finally, the study is concluded in section five, and practical recommendations were offered.

2. Literature Review

2.1. The Influence of Intermodal Transport System on National Economic Growth

Indubitably, there is a nexus between specific macroeconomic drivers of productivity, like

expansion of business activity, innovations, investments, labor market, competition, domestic and international trade, global mobile activity, regional economic development, population wellbeing, environmental safety, and availability of an efficient intermodal transportation system (Fratila et al., 2021). Maritime transportation is a vital part of the ITS and plays a significant role in global trade (Fagbo-Lawal et al., 2023; Oni et al., 2023). The World Bank (2024) underscored the relevance of well-developed ITS as a precursor to national economic development through the utilization of the Logistics Performance Index (LPI), which is an annual interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their ratings.

The LPI provides empirical and objective optics that determined how well integrated the transportation system of countries are to their overall business ecosystem (Gani, 2017 :World Bank, 2024) The LPI assesses countries' business readiness or logistics performance annually across six key dimensions: customs, infrastructure, ease of arranging shipments, logistics competence, tracking and tracing, and timeliness (Beysenbaev and Dus, 2020: World Bank,

2024). Incidentally, statistics from the BRICS countries and the leading four economies in Africa on the available road network (paved and unpaved) and their LPI ratings (Table 1) indicated a synergistic interaction between the availability of basic transport infrastructure and their readiness to attract new investment opportunities (Beysenbaev and Dus, 2020).

Considering its significance, maritime transportation as a subset of ITS has been attracting considerable investment and attention from scholars in contemporary times (Holzer and Peci, 2009; Akbulaev and Bayramli, 2020). For a very long time stakeholders in the field of international commerce prioritized optimization of the processes of liner transport and port control as the proverbial holy grail in maritime transportation (Lawal-Fagbo et al, 2023:Ajayi et al, 2023), nascent development in the sector showed that substantial investment in port infrastructure and liner transportation without the corresponding growth in the investment portfolio in other transport modes will result in the opacity of the entire global supply chain, providing a higher level of risks to all stakeholders (Holzer and Peci, 2009:Ajayi, 2023²). The importance of integrating development in maritime transportation with other modal types in order to achieve sustainable development in international

trade, national Gross Domestic Product (GDP), and global development patterns can therefore not be downplayed (Akbulaev and Bayramli 2020; Ozer et al, 2021).

Akbulaev and Bayramli (2020), for example through the deployment of a correlation analysis unraveled the import of a deliberate and strategic development in the field of maritime transportation and economic growth dynamics for some Caspian Sea nations, including Russia, Azerbaijan, Turkmenistan, Kazakhstan, and Iran. The analysis identified and measured the strength and direction of the relationships between strategic development in maritime transport and economic development in the study area. Findings from the study indicated that 'internal factors that align with tactical development of allied transport infrastructure that complements existing maritime facilities' are key drivers that differentiated the contributions of maritime transport to sustainable economic growth in these countries (Fratila et al, 2019; Akbulaev and Bayramli, 2020).

Similarly, Ozer et al (2021) in another study that analyzed the effects of maritime and rail container transports on the economic growth in Turkey for a period of 25 years (1991–2016) using the Autoregressive Distributed Lag (ARDL) based bounds testing approach.

Although the analysis results indicated no positive correlation between economic growth and rail container transport, maritime container transport has a positive and statistically significant impact on economic growth both in the short- and long-run. The findings from the research indicated the existence of a positive cointegration between the variables. These findings concluded that implementing an integrated or intermodal transport system propels bigger economic growth in Turkey.

Furthermore, Niavis et al. (2017) utilized an integrated assessment tool for a comparative evaluation of maritime transport against other regional drivers by estimating the significance of maritime transport for the Adriatic-Ionian region's economy, society, and environment using value estimation methodologies. The authors conclude that, after beach tourism, maritime transportation is the second most significant transformative element in the Adriatic-Ionian region.

Literature from SSA is also replete with the vital intersection between strategic, tactical, and operational alignments of the development in maritime transport and the economic development of the countries in the region (Matekenya and Nwadi, 2019; Ajayi, 20231; Adenigbo et al, 2023). Matekenya and

Ncwadi (2019) explored the impact of maritime transport financing on trade in South Africa. Using the Autoregressive Distribution lag model, the study examined the impact of maritime transport financing on total trade in South Africa from 1994 to 2019. The results from the research affirmed the long-held belief of the positive interrelationship between maritime transport financing and growth in total trade output.

In the Nigerian milieu, Adenigbo et al (2023) investigated the effect of shipping trade on economic growth in Nigeria for 50 years (1970 to 2020). The study relied upon the patterns of shipping imports, exports, and real exchange rates on GDP to determine if Nigeria's economic growth is sustainable. The cointegration test established a short- and long-term causality from import, export, and exchange rates to GDP. In the same vein, Lloyd et al (2020) appraised the importance of maritime transportation to Nigeria's economy through GDP output. It should be noted that while the two papers provided both empirical and anecdotal analyses on the confluences between the GDP and maritime transport in Nigeria, and discovered that a positive correlation existed between the two variables, the papers focused solely on the interaction between maritime transport and the GDP.

Recent developments indicate that concerted investment in maritime transport without corresponding investment in intermodal transport infrastructure can considerably reduce the ability of the SC ecosystem to optimize logistics, reduce costs, and enhance sustainability (Kurapati et al, 2015; Karis, 2024). As could be seen there has been quite some research on the intersection between the development of maritime infrastructure and the corresponding impact on the GDP of nations, Nigeria inclusive, on the other hand there has been less focus on the holistic impact that ITS has on the activities of companies that are listed on the Nigerian Stock Exchange (NSE).

Scholars have discovered that the stock market is often a sentiment indicator that can impact gross domestic product (GDP) either negatively or positively (Alfonso and Rimmers, 2022; El-Diftar, 2023; Chikiwira & Mohammed, 2023). Countries' GDPs are primarily driven by spending and investment. By focusing on the stock exchange performances of some listed manufacturing companies, as done in this research, an opportunity is created to focus an investigative lens on the minuscule drivers of the economy rather than the monolithic GDP (Alfonso and Rimmers, 2022; El-Diftar, 2023; Chikiwira and Mohammed, 2023). Such a

diversification filled an important gap in the available literature by interrogating the impact of stock exchange market as an assessment tool for the economic performances of emerging economies like Nigeria (Alfonso and Rimmers, 2022: El-Diftar, 2023: Chikiwira and Mohammed, 2023).

Table 1: Contextual Analysis of Road Infrastructural Development and Logistics Performance Index (LPI) of BRICS and African Leading Economies

S/n	Countries	Total kilometres of road	Total kilometres of paved road	Global ranking of paved road	% of paved road	Logistics Performance Index (LPI)	Global ranking of LPI
1	Nigeria	135,000	60,000	34 th	31	2.7	88 th
2	Brazil	1.7million	213,000	4 th	12.41	3.2	51 st
3	Russia	1.58million	1.1million	5 th	71	3	92 nd
4	India	6.6 million	4.5million	1 st	68	3.7	38 th
5	China	5.5 million	5.3million	3 rd	97	3.7	20 th
6	South Africa	750,000	158,124	12 th	21	3.8	19 th
7	Egypt	325,000	240,000	24 th	74	2.82	57 th
8	Algeria	141,000	117,000	42 th	92	2.5	97 th

Source: Adapted from, World Bank Logistics Performance Index 2024.

Arising from this extensive literature search, the three hypotheses that captured the objectives of this research are derived, these are:

H1: The port clearance procedures, seaport transport, and land transport (as subsets of ITS) do not jointly significantly predict turnover in the consumer products industry.

H2: The port clearance procedures, seaport transport, and land transport (as subsets of

ITS) do not jointly significantly predict turnover in the industrial goods sector.

H3: The port clearance procedures, seaport transport, and land transport (as subsets of ITS) do not jointly significantly predict turnover in the healthcare manufacturing sector.

2.2. The Growth Pole Theory

This research employed the Growth Pole Theory (GPT), a fundamental model in

regional planning and economic geography, as a theoretical underpinning to examine the importance of manufacturing activities on regional development (Komarovskiy and Bondaruk, 2013; Parr, 2015; Frick & Rodríguez-Pose, 2025). Francois Perroux developed GPT in the twentieth century, although the term originated in the 1950s, with his 1955 publication being a key contribution. He postulated that economic growth does not occur uniformly but concentrates in specific "growth poles," such as dynamic firms or core industries, which then catalyzes development in surrounding areas through linkages and innovation, spreading growth unevenly across a region (Komarovskiy and Bondaruk, 2013).

The theory suggests that economic development is not uniform across space, but instead occurs around key areas or 'poles' of economic activity that stimulate growth in surrounding regions. Growth Pole Theory (GPT) posits that key industries drive economic growth through dynamic firms, centrifugal and centripetal forces, and multiplier effects, attracting resources and transmitting growth to other sectors. The growth theory emphasizes identifying and supporting key industries or growth poles to drive economic growth and development,

focusing on interconnected industries and zones of influence (Parr, 2015).

Nigeria's quest to emerge as a regional investment destination in the African region cannot be achieved unless there is a strategic plan targeted at achieving sustainable growth in its manufacturing sector, development of intermodal transport infrastructure, improving the business environment, overcoming the insufficient power supply problem, and stabilizing its exchange rate volatility. Nigeria is West Africa's manufacturing powerhouse and the third biggest manufacturing nation on the continent of Africa (Chilamphuma, 2025).

As West Africa's largest economy, Nigeria's manufacturing advancements act as a catalyst, creating spillover effects on neighbouring economies and boosting regional integration through agreements like the African Continental Free Trade Area (AfCFTA). Key Nigerian manufacturing industries include beverages, cement, food processing, and textiles, with efforts to boost domestic sourcing and exports. Recent statistics revealed the growing impact of manufacturing activities and other non-oil exports on Nigeria's economic output (Okpale, 2025; Aina, 2025). The Nigeria Export Promotion Council (2025) data

revealed that the country grossed \$5.456 billion from non-oil exports in 2024, a 20.77% increase from 2023. Analysts attributed the export growth to the country's emergence as the manufacturing hub for cement, fertilizers, rice, and processed cassava products (NEPC, 2025; Okpale, 2025; Aina, 2025). Available records revealed that Nigeria exported 3.5 million metric tonnes of processed cassava products, generating an estimated \$600 million in revenue (Onyekwelu, 2024; NEPC, 2025; Okpale, 2025).

Similarly, Nigeria's marquee manufacturing entities like Olam International and Dangote Group have invested in value-added processing, particularly rice milling. Nigeria, once a net rice importer, now boasts 3.7 million metric tonnes of local rice production annually, of which 5 per cent is exported to neighboring West African countries, contributing over \$450 million to the economy. Dangote Cement operates in 10 African countries and exports 2 million metric tons annually, with substantial demand in places like Ethiopia, Senegal, and Zambia. In 2023, Nigeria's cement exports contributed over \$800 million to the country's foreign exchange earnings, underscoring the importance of local

manufacturing for export markets (Okpale, 2025; Aina, 2025).

The protagonists of GPT surmised that the agglomeration of these industrial activities has the capability of generating regional centrifugal and centripetal forces, attracting resources and industries towards the growth pole and spreading benefits outward to surrounding areas (Komarovskiy and Bondaruk, 2013; Parr, 2015; Frick and Rodríguez-Pose, 2025). With the waves of the ongoing public and private sector investments in massive transport infrastructural projects (the opening of the Lekki Deep Seaport, and the possible onboarding of the Ibom and Badagry Deep Sea Ports, the Lagos-Calabar Coastal Highway project, the Sokoto-Badagry Super Highway, the Port Harcourt-Aba train service, the Kano-Katsina-Maradi rail services, and the cargo services on the Lagos-Ibadan railway), there is a cautious optimism that Nigeria can perhaps start actualizing some age-long potentials as a growth pole to neighboring African countries.

Although much research has been done on the multiplier effects that the strategic development of an industrial hub has on surrounding region (Komarovskiy and Bondaruk, 2013; Parr, 2015; Frick and

Rodríguez-Pose 2025.), less attention has been paid to how inefficiencies in ITS impact the Nigerian economy by examining turnover of selected quoted firms on the NSE. The deployment of GPT also provided a theoretical prism that bridged the gap in the literature by offering an analytical framework for understanding how concentrated industrial activities in Nigeria are impacting regional development in neighboring West and Central African countries (Onyekwelu, 2024).

3. Methodology

3.1 Population and Sample Size of the Study

The study used a survey research design. Ninety (90) companies listed on the Nigerian Group Exchange (NGE) between 2010 and 2019, that transported their goods by seaport

and land transportation to industrial centers make up the study's population. To be selected for the research, a company must submit at least 20 customs declarations annually, indicating its reliance on imported machinery and raw materials for production, and also evidence of exportation records to neighboring West African countries, especially. The total population (census) sampling technique was used in the study (Darpito, 2022). Sixty-four (64) organizations completed the structured questionnaires and returned them. This is approximately 71% of the entire population (Table 2). These enterprises' logistics or operations managers were the targeted respondents; their responses and the annual customs reports were used to achieve the study objectives.

Table 2. Breakdown of the Selection of the Companies that Participated in the Study

S/n	Number of Listed Companies on NGE That Utilized Intermodal Transport 2010-2019	Number of Listed Companies on NGE That Completed the Questionnaire	%
1	90	64	71

Adapted from the records of the Nigerian Group Exchange (2025).

The structured questionnaire was divided into four sections: demographics (respondents' age, educational background, area of operation, and work experience, among other things); container clearance information (number of steps required to

complete each procedure, number of agencies involved, number of documents, and mode of operation (electronic or manual), etc. Other sections include information on the average duration and delays in container clearance, the total number of containers imported annually, and the overall cost of clearing a container.

3.2 Scale Development

As previously observed, some contemporary studies have investigated the impact of investing in maritime transport without corresponding investment in intermodal transport infrastructure on national development (Kurapati et al., 2015; Karis, 2024). In developing scientific measurements of the variables for the present study, scales developed and utilized in some of these earlier research studies (Akbulaev and Bayramli, 2020; Glavič et al., 2021; Frick and Rodríguez-Pose, 2025) were adapted. Conversely, through the application of these extant variables, fresh operational metrics that measured items like ‘firm turnover for consumer, industrial, and health care goods’ were constructed. Similarly, metrics that evaluated constructs such as ‘port clearance cost’, ‘port clearance time’, ‘land transport cost’, and ‘sea transport use’ are provided. A pre-field exercise helped in

ensuring the validity and reliability of the research instruments. Additionally, the Cronbach alpha test was conducted on each of the constructed multi-item instruments to assess their internal reliability and ability to effectively measure the research variables. A Cronbach’s alpha lower than 0.60 means poor reliability, values between 0.6 and 0.7 are acceptable, and values equal to or higher than 0.70 indicate good scale reliability (Churchill 1979; Simchi-Levi et al. 2003; Ajayi 2010; Ajayi, 2020²). The consumer’s goods subscale which consisted of 10 items have a Cronbach’s alpha of .80 ($\alpha = .80$), industrial goods subscale with 9 items .78 ($\alpha = .78$), healthcare goods with 7 items .74 ($\alpha = .74$), with 8 items for port clearance cost .74 ($\alpha = .74$), 6 items for port clearance time .71 ($\alpha = .71$), 8 items for land transport cost .77 ($\alpha = .77$), and 5 items for sea transport use .69 ($\alpha = .69$).

The study examines the relationship between ITS subsets of land transportation and maritime transport systems and the turnover of consumer goods, industrial goods, and healthcare products industries (as components of the manufacturing sector). The study assessed port and land transportation within the maritime transport system using port clearance costs, port clearance time, land transportation costs, and

distance (Oni et al.,2025). The study measured the economic growth by examining the turnover of the manufacturing firms it sampled (Holzer and Peci, 2009).

3.3 Model Specification

To test the derived hypotheses, regression models are formulated for each of the three hypotheses. The regression models depict and assess the relationship between a dependent variable and one or more independent variables (Churchill, 1979: Akbulaev and Bayramli,2020: Ajayi,, 2020¹: Ajayi, 2023¹). Y represents the dependent variable, which is also known as the outcome or variable you are trying to predict or explain using the other variables in the model. X on the other hand, represents the independent variables (also called predictor or explanatory variables), which are used to explain or predict Y (Churchill, 1979: Akbulaev and Bayramli,2020: Ajayi,, 2020: Ajayi, 2023¹). The general regression model is depicted thus:

$$Y = a+b_0 + b_1X_1 + b_2X_2 + ... + b_pX_p+ e.....$$

For the purpose of this study, the three derived hypotheses are:

$$FTC = a+b_0 + b_1PCC + b_2PCT + b_3 LTC+ b_4ST+e.....(i)$$

$$FTI = a+b_0 + b_1PCC+ b_2PCT + b_3 LTC+ b_4ST+e.....(ii)$$

$$FTH = a+b_0 + b_1PCC + b_2PCT + b_3 LTC+ b_4ST+e.....(iii)$$

Where:

b0 intersection, b1, and b2 = regression coefficients, and e = regression error

FTC Firm Turnover for Consumer Goods (Dependent Variable)

FTI Firm Turnover for Industrial Goods (Dependent Variable)

FTH Firm Turnover for Healthcare Industry (Dependent Variable)

PCC Port Clearance Cost (Independent Variable)

PCT Port Clearance Time (Independent Variable)

LTC Land Transport Cost (Independent Variable)

ST Seaport Transport -use of intermodal services within the port (Independent Variable).

Through the deployment of the Statistical Package for Social Sciences (SPSS) for the analysis, multiple regression analysis was performed by the authors to ascertain the extent to which Firm Turnover (Y) could be

accounted for by variations in Port Clearance Cost (X_1), Port Clearance Time (X_2), Land Transportation Cost (X_3), and Seaport Transport (X_4) for the three categories of manufacturing entities that formed the study group for the study (consumer goods, industrial goods, and healthcare products). Where Y is the firm turnover, X_1 is the cost of port clearance, X_2 is port clearance time, X_3 is the cost of land transportation, X_4 is the distance from the seaport, B_1 , B_2 , B_3 , and B_4 are coefficients, and e is the error term.

The multiple regression model's coefficient can be understood in this way: B_1 : The change in firm turnover, when all other factors are held constant, for a one-unit change in port clearance cost. B_2 : The change in firm turnover, where all other factors are held constant, for every unit change in port clearance time. B_3 : The change in firm turnover, where all other factors are held constant, for every unit change in land transportation costs. B_4 : The change in firm turnover when all other factors are held constant and the distance from the seaport changes by one unit. The multiple regression model's performance was assessed by using the stated metrics. R-square (R^2): For instance, it measures the proportion of variance in firm turnover explained by the independent variables. F-

statistic tests the overall significance of the model, while t-statistic tests the significance of individual coefficients.

4. Results and Discussion.

This section is dedicated to the presentation of the results and discussion of the research findings. The estimation results on the effects of maritime transportation variables on Nigeria's economic growth are shown in this section. The model summary, analysis of variance (ANOVA), regression coefficient estimates, and the outcomes of descriptive statistics are all included in the analysis. These results collectively provide illumination on the relationship between port and land transportation variables and the turnover of the consumer, industrial, and healthcare product industries.

4.1 Effects of port and land transportation variables on consumer goods turnover

Table 3 presents the descriptive analysis of the variables examined in the study. The average annual turnover for consumer goods is approximately 92,778,223,933; the average annual clearance cost is ₦569,250; the average clearance time is 87 hours; the average annual land transport cost is ₦323,630,000; and the average distance to the hinterland location is 73.25 kilometers. These figures give a basic understanding of

the time and resources that consumer goods companies invest in transportation, which may impact their turnover.

Table 3 Descriptive Analysis

Descriptive Statistics^a			
	Mean	Std. Deviation	N
Turnover	92778223933.58	57048461892.646	64
Clear Cost	569.25	486.615	64
Clear Time	87.00	26.833	64
Transport Cost	323.63	219.355	64
Distance	73.2500	13.95064	64

a. Business = Consumer Goods

Cost in Naira; Distance in Km

According to the model summary in Table 4, the joint predictors of port clearance variables and land transportation (as a subset of ITS) have a strong positive correlation ($r=0.571$) with the turnover of consumer goods and explain roughly 32.6% ($r^2=0.326$)

of the overall variation in turnover. Although other factors not included in the model can potentially be responsible for the remaining variation, this indicates that port clearance and land transport variables significantly affect the turnover of consumer products enterprises in Nigeria

Table 4 Model Summary.

Model Summary^a				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1				
1	0.571 ^b	0.326	0.290	4805686462
a. Business = Consumer Goods				
b. Predictors: (Constant), Distance, TransportCost, ClearCost, ClearTime				

Table 5 provides the results of the analysis of variance. Based on the results, the model evaluates the impact of the joint predictors of land transport and port clearance procedures (as subset of ITS) on the turnover of consumer products enterprises in a significant way ($p < 0.05$). In terms of

business turnover, this suggests that the independent variables maritime transport; measured by port clearance and land transport variables collectively have a significant impact on business turnover in the consumer goods production.

Table 5 Analysis of Variance

ANOVA ^{a,b}						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	83897965506664230 000000.000	4	209744913766660 58000000.000	9.082	0.000 ^c
	Residual	17320966783435723 0000000.000	59	230946223779142 9600000.000		
	Total	25710763334102147 0000000.000	63			

a. Business = Consumer Goods

b. Dependent Variable: Turnover

c. Predictors: (Constant), Distance, TransportCost, ClearCost, ClearTime

The regression coefficient Table 6 reveals that the clearance cost variable does not significantly contribute to the overall model ($p = 0.308$, ns). The standardized regression coefficients further indicates that the clearance processes variables (cost and time) both have negative effects

($\beta = -0.106$ & $\beta = -0.463$, respectively) on turnover suggesting that increases in these factors lead to a reduction in performance. Conversely, the land transport variables (cost and distance) both have positive effects ($\beta = 0.499$ & $\beta = 0.495$, respectively) on

turnover, implying that as these variables increase, so does the turnover, which may

reflect either improved distribution reach or inefficiencies in land logistics

Table 6 Regression Coefficients

Coefficients ^{a,b}						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4933136630.712	29836434335.286		-0.165	0.869
	ClearCost	-12408349.939	12095183.537	-0.106	-1.026	0.308
	ClearTime	-984133659.121	247089497.072	-0.463	-3.983	0.000
	TransportCost	129690981.488	28239346.302	0.499	4.593	0.000
	Distance	2026244200.110	455531525.604	0.495	4.448	0.000
	a. Business = Consumer Goods					
b. Dependent Variable: Turnover						

4.2 Effect of Port and Land Transportation variables on Healthcare Business' Turnover

The descriptive analysis of the variables analyzed in the study is shown in Table 7. The average annual turnover for

healthcare businesses is approximately ₦6,840,555,682; clearance costs average ₦662,280; clearance times average 72 hours; and the average cost of transportation in the hinterland is ₦355,000,000, with an average distance

of 51.667 kilometers. These statistics provide a basic idea of the time and expense spent on transportation by

healthcare product companies, which may affect their turnover.

Table 7 Descriptive Analysis

Descriptive Statistics^a			
	Mean	Std. Deviation	N
Turnover	6840555681.81	3672646275.340	64
ClearCost	662.28	422.700	64
ClearTime	72.00	34.131	64
TransportCost	355000,000	149.696	64
Distance	51.6667	8.54598	64
a. Business = Healthcare Business			

The model summary is shown in Table 8
The joint predictors of port clearance procedures and land transport have a very strong positive association ($r=0.805$) with turnover in healthcare businesses, accounting for roughly 64.8% ($r^2=0.648$) of the total variation in turnover. The

remaining variation may be due to other factors not included in the model, but this suggests that land transport and port clearance variables (as subsets of ITS) have a major impact on the turnover of Nigerian healthcare product companies

Table 8 Model Summary

Model Summary^a				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.805 ^b	0.648	0.631	2230195847.319

- a. Business = Healthcare Business
- b. Predictors: (Constant), Distance, TransportCost, ClearTime, ClearCost

Table 9 presents the results of the analysis of variance. The outcome implies that the model evaluates the impact of the joint predictors of port clearance procedures and land transportation on the turnover of healthcare enterprises in a significant way ($p < 0.000$).

This posits that the independent variables—ITS, as determined by port clearance procedures, and land transport variables—collectively have a significant impact on business turnover in the health care manufacturing sector.

Table 9 Analysis of Variance

ANOVA^{a,b}

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	77769068009671950 0000.000	4	1944226700241798 80000.000	39.090	0.000 ^c
	Residual	42277074897885190 0000.000	59	4973773517398257 700.000		
	Total	12004614290755714 00000.000	63			

a. Business = Healthcare Business

b. Dependent Variable: Turnover

c. Predictors: (Constant), Distance, TransportCost, ClearTime, ClearCost

Table 10 displays the regression coefficient report. Regression coefficient summaries demonstrate that every independent variable makes a significant contribution to the overall model. Additionally, the standardized regression coefficients show that only

clearing time has a negative effect on turnover ($\beta = -0.299$), indicating that performance declines as this factor increases. On the other hand, turnover is positively impacted by clearance cost, land transport cost, and land distance ($\beta = 0.381$, $\beta = 0.196$,

and $\beta=0.465$, respectively). This suggests that as these factors rise, turnover also rises, which could be a result of either increased distribution reach or inefficiencies in land logistics.

Table 10 Regression Coefficients

Coefficients^{a,b}		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-	1565187489.2		-3.235	0.002
		5063553063.4	67			
		15				
	ClearCost	3310718.582	735284.185	0.381	4.503	0.000
	ClearTime	-	7083227.701	-0.299	-4.539	0.000
		32151135.508				
	TransportCost	4801280.686	2015274.225	0.196	2.382	0.019
	Distance	199779106.70	29224296.307	0.465	6.836	0.000
		0				
a. Business = Healthcare Business						
b. Dependent Variable: Turnover						

4.3 Effect of Port Clearance Process and Land Transport on Industrial Goods Turnover

Table 11 presents the descriptive analysis of the variables under investigation. The average annual turnover of industrial goods is approximately ₦100,043,674,705, the average annual clearance cost is ₦824,580, the average

clearance time is 84 hours, the average annual hinterland transport cost is ₦532,500,000, and the average hinterland location is 104.167km. These figures give a general indication of how much time and costs industrial goods companies spend on transportation, which could have an impact on their turnover.

Table 11 Descriptive Analysis

Descriptive Statistics^a			
	Mean	Std. Deviation	N
Turnover	100043674704.55	83244236475.483	64
ClearCost	824.58	449.423	64
ClearTime	84.00	27.059	64
TransportC ost	532.50	230.884	64
Distance	104.1667	37.77909	64
a. Business = Industrial Goods			

Table 12 presents the model summary. It reveals that the joint predictors of port clearance procedures and land transportation (as subset of ITS) have a high positive association ($r=0.840$) with the turnover of industrial goods and explain for almost 70.6% ($r^2=0.706$) of the overall variation in industrial goods turnover. Although the

remaining variation can result from other factors not taken into account by the model, this indicates that land transport and port clearance variables significantly affect the turnover of manufacturing entities that specializes in industrial goods companies in Nigeria.

Table 12 Model Summary

Model Summary^a				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.840 ^b	0.706	0.685	46714964319.482
a. Business = Industrial Goods				
b. Predictors: (Constant), Distance, ClearCost, TransportCost, ClearTime				

The findings of the analysis of variance are displayed in Table 13 Based on the results, the model evaluates the impact of the joint predictors of hinterland transport and cargo clearance procedures on the turnover of industrial goods enterprises in a significant way ($p < 0.001$). In terms of business turnover,

this suggests that the independent variables—ITS, measured by port clearance procedure and land transportation variables—collectively have a significant impact on industrial goods manufacturing.

Table 13 Analysis of Variance

ANOVA ^{a,b}						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	28882073745140915	4	72205184362852	33.087	0.000 ^c
		0000000.000		290000000.000		
	Residual	12002583402537531	55	21822878913704		
		0000000.000		60300000.000		
	Total	40884657147678450	59			
		0000000.000				
a. Business = Industrial Goods						
b. Dependent Variable: Turnover						
c. Predictors: (Constant), Distance, ClearCost, TransportCost, ClearTime						

The regression coefficients were shown in Table 14 Only the clearance process variables (cost and time) do not significantly contribute to the overall model, according to a summary of regression coefficients ($p = 0.756$ & $p = 0.452$, ns). The standardized regression coefficients also show that the land transportation variables (cost and distance) have strong positive effects ($\beta = 0.416$ & Table 14 Regression Coefficients

$\beta = 0.714$, respectively) on turnover, while the clearance process variables (cost and time) appear to have positive but little impact ($\beta = 0.027$ & $\beta = 0.416$, respectively). This implies that turnover increases along with these elements, which may be due to either a wider distribution reach or inefficiencies in land logistics.

Coefficients^{a,b}

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1	(Constant)	-		-	0.144
		2029106670		1.483	
		64.647			
	ClearCost	4977072.130	0.027	0.312	0.756
		15929455.98			
		3			
	ClearTime	655861490.6	0.213	0.757	0.452
		34			
	TransportCos	149965783.9	0.416	3.720	0.000
	t	12			
	Distance	1573451384.	0.714	2.526	0.014
		602			
		05			
a. Business = Industrial Goods					
b. Dependent Variable: Turnover					

5. Business Implication and Conclusion

This research undertook an empirical analysis of the role of ITS as a determinant of the Logistics Performance Index (LPI) among selected manufacturing entities in national economic development in Nigeria. Also, the paper examined the impact of the agglomeration of manufacturing activities in Nigeria and its potential on the country's emergence as a regional hub or growth pole for West Africa and the African region's economic development. The study

equally emphasized the importance of supply chain integration (SCI) to stakeholders that acted as vital linkages facilitating the effective movement of goods, information, and materials between production and consumption points.

Findings from this study suggest a positive correlation between the development of ITS and the growth of the manufacturing sector as a catalyst for national economic development. In concrete terms, the functionality of the ITS accounted for 32.6%

of total business turnover in the consumer goods sector. Similarly, the study reveals a strong positive association between the business turnover experienced for the years under review in the healthcare manufacturing sector, which accounted for 64.8% of the total variation for the period studied. Lastly, the availability of ITS significantly contributed to the turnover of industrial goods, accounting for 70.6% of the total variation for the period under review.

Similarly, the results from the regression coefficients for the three models indicated that the clearance process variables, specifically cost and time, do not significantly influence the models. This highlights that the speed of clearing goods at Lagos port has effect on reducing demurrage, terminal fees, and overall shipping costs faced daily by port users.

Salient facts that can be deduced from this study include the indispensability of a functional ITS in Nigeria's quest to achieve sustainable development in its manufacturing sector both for domestic and regional consumption, unlike other studies with similar slants that underscored the relevance of maritime transport alone as a catalyst for economic growth (Ozer et al, 2021: Matekenya and Ncwadi, 2022: Adenigbo et

al 2023), this present study revealed the import of ITS on manufacturing companies performances.

While the possibility of Nigeria's emergence as a leading regional hub for development in the continent of Africa in coming decades appeared to be a low hanging fruit due to some natural endowments (most enormous population size, abundance of natural resources, and rich source of agricultural produce); the fact on the ground is that without concerted efforts by all stakeholders, it could end up as a mirage. A cursory observation of Nigeria's ranking on LPI leaves much to be desired; the country's performance when ranked alongside the BRICS nations (Table 1) also reflects the parlous state of its transport sector.

This research has contributed to knowledge by deploying microscopic lens to examine the intersection between ITS and manufacturing hubs, a good example is the Iranian Intermodal Freight Transportation Network Design Problem (IFTNDP) a policy by the government in conjunction with the business community on the optimization of intermodal hubs and synergistic relationship with ITS service providers to spur production activities (Mohri and Thompson, 2022).

7 Limitation and Areas of Future Research

Some limitations were observed in this study. The first issue concerns the choice of respondents and the source of data for the study; the authors relied on the information provided by logistics/operational managers of the selected manufacturing firms that were sampled. Although the sampling technique was objectively applied, the financial reports and operational information provided by these respondents may warrant further investigation. A new research study that utilizes independently sourced data from government agencies, such as the Federal Inland Revenue Service, will provide a more objective view of the financial reports of these manufacturing entities. The second observed limitation of this research pertains to the study's scope; the present research is limited to the Lagos Port Complex (LPC). However, it is presently the flagship port in the country, and the onboarding of the Lekki Deep Sea Port is expected to be a game-changer in the intermodal transport system in the near future. It is therefore recommended that comparative studies be conducted to investigate the impact of ITS and manufacturing entities on the economy using the two ports.

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