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Transportation Services and Manufacturing Output Growth in Nigeria: A Disaggregate Approach (1990-2022)

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Abstract

Investments in transportation infrastructure can influence the productive capacity through its use as a direct input in the production process thereby increasing the economic output through the productive sectors like the manufacturing sector. Therefore, this paper examined the impact of transportation service on manufacturing sector output growth in Nigeria from 1990 to 2022 the paper employed the ex-post facto research design in obtaining, analyzing and interpreting the data and Autoregressive Distributed Lagged (ARDL) was used for the estimation. The result revealed that the road transport service has a positive and significant impact on the manufacturing output growth in Nigeria at a 5 percent significant level. However, rail and pipeline transport service, water transport service and air transport service have a positive and insignificant impact on the manufacturing output in Nigeria at a 5 percent significant level and this implies that a unit change in road transport service will lead to little or no change in the manufacturing output growth in Nigeria. Therefore, the paper recommended that the Federal Ministry of Transportation and other stakeholders should increase the allocation to the road transport sub-sector and strengthen the road transport service policy to increase its impact on the manufacturing output growth in Nigeria. On the other hand, the Federal Ministry of Transportation and other stakeholders should review and revisit the policies and the implementation plans of the rail and pipeline transport service, water transport service and air transport service to increase their significant impacts on manufacturing output growth in Nigeria.

Keywords: *Transportation, Manufacturing Output, Road Transport Service, Rail and Pipeline Transport Services, Water and Air transport services*

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Background to the Study

Good transportation infrastructure is essential for economic development, and it promotes factor mobility and reduces trade costs. In addition, it promotes market integration, thereby providing an avenue for the reduction of price volatility and reallocation of resources in line with comparative advantage. Investments in transportation infrastructure can also influence productive capacity through its use as a direct input in the production process thereby increasing such resources. For example, a newly constructed road allows goods to be transported to market quicker thereby reducing the total cost of production and transportation. On the other hand, transportation infrastructure may affect economic output by changing aggregate demand through the creation and increased demand for intermediate inputs from other sectors.

In Nigeria, the history of transportation dates back to the pre-colonial era; within this period, transportation facilities such as roads, railways, and air transport facilities were non-existent with emphasis on the bush path using foot or animals such as horses, cattle, donkeys and camels as aids to transport. Eventually, the evolution of the modern transport system in Nigeria began during the colonial period; The networks of rail, water and road that were developed then were built for the exportation of cash crops and mass importation of produced consumption goods.

Nigeria also operates public transportation services and Nigeria is diverse and primarily caters to urban and intercity travel. In cities, buses, mini-buses, and tricycles serve as the main modes of public transport. For intercity travel, long-distance buses are commonly used, connecting major cities and towns across the country. Also, in many Nigerian cities and towns, motorcycle taxis, known as "okadas," provide a popular and affordable mode of transport for short distances. However, their use has been subject to regulation in certain areas due to safety concerns. Recently, ride-hailing services such as Uber, Bolt (formerly Taxify), and local operators like OgaTaxi and PickMeUp have gained popularity in urban centres, providing an alternative to traditional taxis and often offering more comfortable and convenient transportation options.

The main benefit of these transportation services and systems is that they have helped in the improvement of the movement of goods and services from one location to another which is one of the major concerns of the manufacturing sector in Nigeria. Therefore, there is a strong link between transportation services and manufacturing output growth and Scholars like Adeyi (2018), Agbede, and Faseesin (2021), Jacob *et al.,* (2019), Karami *et al.,* (2019) agreed that transportation efficiency can help in manufacturing output growth because Nigeria has the great potential of increasing the output of manufacturing based on the resources endowment and statistics have shown that the contribution of the manufacturing sector in recent years that N6.421 trillion in 2018; N6.470 trillion in 2019; N6.292 trillion in 2020; N6.502 trillion in 2021; and N6.661 trillion in 2022, representing 9.20 percent; 9.06 percent; 8.99 percent; 8.98 percent; and 8.92 percent, respectively (Nigeria Bureau Statistics, 2022).

The review also revealed that infrastructural deficiencies have constituted major constraints to the growth of Nigeria's manufacturing sector, chief among which are power supply and transportation service inadequacy in Nigeria. Thus, various governments and administrations engaged different policies across the transportation service sub-sectors, Nigeria's transportation policies were focused on addressing various challenges in the sector and promoting sustainable and efficient transportation systems. The National Transport Policy serves as the framework for the country's transportation sector. It outlines the government's vision and strategic objectives for developing a safe, efficient, and integrated transportation system. The National Transportation Policy (NTP) aims to improve infrastructure, enhance public transportation, and promote private sector involvement in the development of the transport sector. Nigeria has been working to improve its road infrastructure and safety. Policies have been focused on road maintenance, the construction of new roads, and the rehabilitation of existing ones. The government has also implemented measures to improve road safety and reduce traffic congestion. The government has shown a commitment to revitalizing the country's rail network.

Also, the rail transportation policy aims to expand and modernize the railway system to enhance connectivity, facilitate the movement of goods and people, and reduce pressure on roads. Nigeria's aviation policies aim to ensure safety, security, and efficiency in the country's airspace. The government has been investing in airport infrastructure and seeking to attract private sector investment in the aviation sector. also, water transportation is crucial for Nigeria's economy due to its vast coastline and trade activities. Thus, the government has focused on improving port infrastructure, streamlining customs processes, and enhancing water safety and security. However, despite these transportation policies to improve the manufacturing sector's contribution to GDP, the percent contribution of this sector is still below 10 percent given the figures from 2018 to 2022 of 9.20 percent; 9.06 percent; 8.99 percent; 8.98 percent; and 8.92 percent respectively (CBN, 2022). Therefore, this paper examined the impact of transportation services on manufacturing output growth in Nigeria from 1990 to 2022. While specific objectives are to:

i. Examine the impact of road transport services on manufacturing output growth in Nigeria.
ii. Determine the impact of rail and pipeline transport services on manufacturing output growth in Nigeria.
iii. Investigate the impact of water transport services on manufacturing output growth in Nigeria.
iv. Assess the impact of air transport services on manufacturing output growth in Nigeria.

Materials and Methods

Conceptual Review

Manufacturing Output Growth

Manufacturing output growth refers to the rate at which the production output of the manufacturing sector increases over a specific period. It is commonly measured in terms of the percentage change in the value of goods and products produced by manufacturers (Ibrahim &

Saad, 2016). He opined that several factors could contribute to manufacturing output growth which is: economic conditions; technological advancements; innovation and research; infrastructure development; government policies and global demand. On the other hand, manufacturing output growth offers numerous opportunities, but several challenges can hinder its sustained and optimal expansion among them is global competition and this means that manufacturers face intense competition from both domestic and international players. Globalization has led to the emergence of low-cost manufacturing hubs, making it challenging for manufacturers in higher-cost regions to remain competitive. Price pressures and the need to continuously improve efficiency pose challenges to output growth.

Transportation Services

Transportation can be defined as the movement of people and goods from one location to another (Igberi & Ogunniyi, 2013). Transport or transportation which is derived from two Latin words 'trans' meaning 'across' and 'portare' meaning 'carry' is commonly said to refer to the movement of people and goods from one place to another. Thus, Edith and Adebayo (2013) defined transportation as a process or business of taking goods from one place to another or a system for carrying passengers or goods from one place to another. Transportation service is the port of physical distribution activity which is concerned with the actual movement of goods to their various consumers. The field of transportation has several aspects, which can loosely be divided into a triad, infrastructure, vehicles and operations. Infrastructure includes the transportation network (ie roads, railways, airways, canals, pipelines, etc) that are used, as well as the nodes or terminals (such as airports, railway stations, bus stations and seaports). Vehicles, such as automobiles, trains, aero planes etc, generally ride on networks. The operations deal with the control of the system such as traffic, signal and ramp meters, rail-road switches, air traffic control, etc, as well as policies, such as how to finance the system e.g. use of tolls or gasoline taxes in the case of highway transport. Broadly speaking, the design of networks is the domain of civil engineering and urban planning, the design of vehicles, mechanical engineering and special subfields such as nautical engineering and aerospace engineering, and the operations are usually specialized, though might appropriately belong to operations research or systems engineering.

Empirical Review

In a recent study, Yijia and Lu (2023), investigated the relationship between transport infrastructure development and economic growth in the UK from different periods. Principal component analysis (PCA) is used to construct a comprehensive measure of transport infrastructure development. This paper then applies the Vector Error Correction Model (VECM) to investigate both long-run and short-run relationships between transport infrastructure development and economic growth from 1970 to 2017 in the UK. Empirical results suggest that transportation infrastructure has a long-run promotive effect on economic development. However, in the short run, this effect turns out to be significantly negative. The analysis of this paper indicates differentiated roles that the UK's transport infrastructure played in economic growth, which should be considered in future policy design for achieving economic sustainability in the UK.

While Muhammad *et al.,* (2022) assessed the impact of logistics infrastructure, which has received very little attention in the literature, on manufacturing sector performance in Africa. An unbalanced panel data for 35 African countries between 2007 and 2016 were analyzed using the system GMM estimation technique. The result shows that logistics infrastructure has a positive and significant relationship with manufacturing sector performance. An increase in the logistic performance index by 1 point or 20% will result in an increase in the performance of the manufacturing sector by a range of 3.61% and 7.48% depending on the component of logistic infrastructure used. Thus, logistic infrastructure improvement should constitute one of the industrialization strategies of African countries.

In another study, Nnyanzi *et al.,* (2022) examined the effects of infrastructure development, liberalization, and governance on manufacturing production (MVA) in Sub-Saharan Africa. The study employed the Panel-Corrected-Standard-Error estimator on panel data spanning 2003-2018 for 30 SSA countries. The main result of this in-depth analysis shows that infrastructure development, as well as governance, are key to manufacturing production. While infrastructure development affects MVA positively in the long run, an improvement in financial openness facilitates this linkage but only between transport infrastructure on the one hand, and electricity infrastructure on the other, whereas the converse appears the case when trade liberalization is the moderating variable. The study emphasizes that efforts aimed at reversing Africa's pervasive infrastructure deficit, in ways that enhance manufacturing share in GDP, must be carefully nuanced under the avoidance of the incautious liberalization policies.

In another study in Nigeria, Okorie (2020) examined the contribution of transportation to economic development in the Nigerian economy between 1980 and 2018. The study adopted an ex-post research design approach using secondary data collected from various sources and the econometrics method of ordinary least square regression analysis techniques. An estimate of the error correction model shows that both transport sector output and investment in transportation infrastructure have positive and significant impacts on economic development. Based on these findings, the study concludes that transportation is important to economic development and recommends government investment in transportation infrastructure as a strategy for economic development.

Also, Jacob *et al.,* (2019) development and contribution of the transport sector to Nigeria's gross domestic product (GDP) from 1970 – 2018, seems to be the way forward towards sustainable financial stability showing the relationship between the transport sector and economic growth. The research employed regression analysis using the OLS method to verify the relationship that exists between the transport sector and economic growth. The research made use of the Solow growth model which was extended to include transport sector output along with gross fixed capital formation and labour force as the inputs of the function and the gross domestic product as the output. It was recommended by the researcher that the federal government should invest much more resources into the transportation sector and develop other means of transportation like railways and water transport infrastructure which would be more affordable and would ease the road and air transport in the transportation of freight and persons.

While Adebosin *et al.,* (2019) examined the relative impact of transport infrastructure investment on sectoral growth in Nigeria. Ex post facto research design was employed using annual secondary data sourced from CBN, WDI (2016). The investigation of the sectors of the Nigerian economy showed that road transport infrastructure was most significant with industrial sector productivity and agricultural sector productivity not exerting a significant effect on economic growth in Nigeria. It was also evident that health sector productivity and education sector productivity exert a significant negative effect on economic growth in Nigeria at a 5% level of significance. It was thus concluded that road transport infrastructure does not have a significant effect on sectoral growth in Nigeria. Hence it was recommended that the government should embark on development policies that will aim at strengthening the sub-sector of the economy so that it can operate at its full capacity and improve its contribution to economic growth.

While Awujola *et al.,* (2018) investigated the causal relationship between transportation and economic growth and transportation and employment in Nigeria. By applying techniques of co-integration and Hsiao's version of Granger causality, the results infer that economic growth causes total transportation. Economic growth also leads to growth in road transportation, while on the other hand; neither economic growth nor rail transportation affects each other. However, air transportation leads to economic growth. The study implies that transportation development policy regarding road transportation would not lead to any side effects on economic growth in Nigeria. However, transportation policy in the case of rail and air transportation should be adopted in such a way that it stimulates growth in the economy and thus expands employment opportunities.

In another study, Miapkwap and Adeyi (2018) examined the linkage between transportation and economic development. It also examined the supply and demand for transport and then described the foundations of the possible linkage between transport and economic development from historical and contemporary perspectives. The study used both theoretical models as econometrics models as the data were sourced from secondary sources to examine the impact of transportation on economic development. The paper observes that there is a positive relationship between transportation and economic development. The study thereby recommends that there should be positive necessary market conditions as well as complementing and supportive policies well designed and enforced by the transport policymakers and government in addition to the provision of necessary infrastructure facilities.

Also, Sevgi and Tezcan (2017) examined the impact of logistics on economic growth in Organization for Economic Co-operation and Development (OECD) countries using data from 1970-201 4. The study applied the panel data technique. The panel data technique revealed that no significant effect between railroad freight transportation and economic growth, while infrastructure investments have a positive and significant effect on economic growth. The study concluded that transportation, the length of the highway network and the length of the railroad network stimulate economic growth in the Organization for Economic Co-operation and Development (OECD) countries.

And Dimnwobi *et al.,* (2017) investigated the empirical link between transportation infrastructure and the diversification of the Nigerian economy. Descriptive demonstrations are adapted to provide a situational focus to the study, while a generalized method of moment (GMM) model is specified and estimated. Findings reveal that economic diversification is a negative function of the transportation concentration ratio. In the same vein, the result suggests that transportation infrastructure is a significant factor in diversifying the sectoral output share of the country and the export base of the economy from the oil sector to the non-oil sector. To address this, the study put forward policy suggestions to improve the effectiveness and efficiency of transportation infrastructure geared for the rapid diversification of the economy.

In another study, Ogwo and Agu (2016) examined the extent of the influence of transport infrastructure provision on the performance of manufacturing firms in Nigeria and the effect of such performance status on the Gross Domestic Product of the nation. Primary and secondary data were used in the study. The study revealed that the state of road infrastructure in Nigeria has a negative effect on the marketing performance (sales and profitability) of the manufacturing sector. The quality of road infrastructure in Nigeria does not influence manufacturing capacity utilization significantly while it affects the manufacturing production index significantly. It was recommended among others that the government should consolidate the present attention being given to the transport sector given its multiplier effect on the economic growth and development of the nation and that adequate attention should be given to the manufacturing sector, especially in the areas of power, security, finance and regulatory policies.

In another study, Avanenge and Zizi (2016) analyzed issues and challenges in the transportation industry in Nigeria and Egypt. This was achieved by the use of secondary data sources. Major issues analyzed were, lack of coherent air transportation, policy, weak management, obsolete facilities, insecurity, air crashes, bad roads due to lack of maintenance, non-functioning of railway systems, and bad water transportation among others. The study recommended that drastic measures be to employ a total approach to air, road, rail and water transportation planning and management if the desired objective of economic recovery is to be achieved.

Then, Siyan et al., (2015) examined the impact of road transportation on economic growth in Nigeria. Both primary and secondary data were used as sources of data. The probit model was used to analyze the primary data while the multivariate model was used for analyzing the secondary data to determine the long-run relationship between growth and road transportation in Nigeria. The result shows that the transport sector positive impact on the economic growth in Nigeria. Based on the findings, it was suggested that the government should come up with sustainable and implementable road development and maintenance policies that will ensure good access and flow in Nigeria. Also, economic growth in Nigeria depended on the level of good and accessible road transportation and facilitates business activities.

Theoretical Framework

The theoretical framework for the study is based on Alfred Weber's Location Theory. Alfered Weber a German economist was the first economist who gave scientific exposition to the theory of location and thus filled a theoretical gap created by classical economists. He gave his ideas in his Theory of Location of Industries' which was first published in the German language in 1909 and translated into English in 1929. His theory, which is also known as 'Pure Theory' has an analytical approach to the problem. The basis of his theory is the study of general factors which pull an industry towards different geographical regions. It is thus deductive in approach. In his theory, he has taken into consideration factors that decide the actual setting up of an industry in a particular area.

According to Weber transportation costs play a vital role in the location of an industry. Each industry will try to find a location at a place where transportation charges are the barest minimum, both in terms of availability of resources and place of consumption. According to him, transportation costs are determined by the weight to be transported on the one hand and the distance to be covered on the other. The cost will also depend on the type of transportation system available and the extent to which it is in use. The nature of the region i.e. whether rocky, plain, connected or unconnected with roads etc. the kinds of roads in the area where the goods are to be transposed; the nature of facilities required i.e. whether the goods are to be taken with great care, less care or even without any special care. Therefore, the theory establishes the functional relationship between transportation services and manufacturing output growth which is stated as follows:

$$Y = f(X_1, X_2, X_3 \ldots\ldots\ldots + X_n) \quad (1)$$

Where Y is the dependent variable (manufacturing output growth) while $X_1, X_2, X_3 \ldots\ldots\ldots + X_n$ are the independent variable in the model.

Methodology

This study employed the *ex-post facto* research design in obtaining, analyzing and interpreting the data the study adopted the secondary method of data and the data comprise the transportation services indicators (road transport service, rail and pipeline transport services, water transport service and air transport service) and manufacturing output growth indicator (manufacturing contribution to gross domestic product) which were sourced from Central Bank of Nigeria (CBN) Statistical Bulletin December 2022. The paper also employed the Autoregressive Distributed Lagged (ADRL) to estimate and establish the impact of transportation service indicators on the manufacturing output in Nigeria. This procedure was developed by Pesaran and Shin (1999) and was later expanded by Pesaran, Shin, & Smith (2001) and it allows researchers to use variables which are not integrated in the same order.

Model Specification

The paper used the Autoregressive Distributed Lagged Model (ARDL). However, the initial model was adapted from the work of Adeyi (2018) who examined the linkage between transportation and economic development. The functional relationship model is stated as:

$$PL = f(\mathrm{K}, \mathrm{QHC}, \mathrm{TPGS}, \mathrm{TPPS}) \quad (2)$$

Where PL is the Productivity of Labour; K is the Capital Put, QHC is the Quality of Human Capital; TPGS is the Transport Performance in the Good Sector; and TPPS is the Transport Performance in the Passage Sector. The equation (2) was modified and specified to follow the paper's objectives.

$$MAON = f(\mathrm{ROTS}, \mathrm{RPTS}, \mathrm{WATS}, \mathrm{AITS}) \quad (3)$$

The paper established the explicit relationship between transportation services indicators and the manufacturing output growth in Nigeria as stated in equation (3)

$$MAON_t = \alpha + \beta_1 \mathrm{ROTS}_t + \beta_2 \mathrm{RPTS}_t + \beta_3 \mathrm{WATS}_t + \beta_4 \mathrm{AITS}_t + \mu_t \quad (4)$$

From equation (4), MAON is the manufacturing output in Nigeria which is the dependent variable while the following are the independent variables: ROTS is the road transport service in Nigeria, RPTS is the rail and pipeline transport service in Nigeria, WATS is the water transport service in Nigeria and AITS is the air transport service in Nigeria. However, to establish the relationship and the impact of transportation service indicators on the manufacturing output in Nigeria using the Autoregressive Distributed Lagged Model (ARDL), equation (4) is formulated as:

$$MAON_t = \alpha_0 + \alpha_1 \mathrm{ROTS}_t + \alpha_2 \mathrm{RPTS}_t + \alpha_3 \mathrm{WATS}_t + \alpha_4 \mathrm{AITS}_t + \sum_{i=1}^{q} \alpha_5 \Delta MAON_{t-1} + \sum_{i=1}^{p} \alpha_6 \Delta ROTS_{t-1} + \sum_{i=1}^{p} \alpha_7 \Delta RPTS_{t-1} + \sum_{i=1}^{p} \alpha_8 \Delta WATS_{t-1} + \sum_{i=1}^{p} \alpha_9 \Delta AITS_{t-1} + \mu_t \quad (5)$$

Equation 5 presented the Autoregressive Distributed Lagged Model (ARDL) which shows the current and lagged relationship between transportation service indicators on the manufacturing output in Nigeria. The a priori expectation is that $\beta_1 >< 0$ indicates a positive or negative relationship between road transport service and manufacturing output growth in Nigeria, this means, an increase/decrease in road transport service will lead to a decrease/increase in manufacturing output growth in Nigeria.

Presentation and Discussion of Results

Descriptive Statistics

This section shows the descriptive summary of the variables used in this paper which are the manufacturing output growth in Nigeria, road transport service in Nigeria, rail and pipeline transport service in Nigeria, water transport service in Nigeria and air transport service in Nigeria.

Table 1: Descriptive Summary

	MAON	ROTS	RPTS	WATS	AITS
Mean	5641.828	791.3067	0.194545	4.507879	55.01636
Median	2689.080	466.9200	0.110000	3.210000	22.41000
Maximum	27508.52	3876.250	0.570000	11.54000	268.6700
Minimum	87.96000	5.230000	0.020000	0.850000	1.380000
Std. Dev.	7282.637	989.1632	0.169449	3.247177	69.50051
Skewness	1.745743	1.619182	0.830393	0.740280	1.546741
Kurtosis	5.224976	4.825657	2.569904	2.124833	4.560059
Jarque-Bera	23.56886	19.00254	4.046893	4.067214	16.50470
Probability	0.000008	0.000075	0.132199	0.130863	0.000261
Sum	186180.3	26113.12	6.420000	148.7600	1815.540
Sum Sq. Dev.	1.700000	31310202	0.918818	337.4132	154570.3
Observations	33	33	33	33	33

Source: Researcher's Computation Using EViews-12 (2023)

Table 1 revealed that the average value for manufacturing output in Nigeria between 1990 to 2022 is 5641.83 billion Naira, the maximum value is 27508.52 billion Naira and the minimum value is 87.96 billion Naira, the average value for road transport service in Nigeria between 1990 to 2022 is 791.3067 billion Naira, the maximum value is 3876.25 billion Naira and the minimum value is 5.23 billion Naira, the average value for rail and pipeline transport service in Nigeria between 1990 to 2022 is 0.19 billion Naira, the maximum value is 0.57 billion Naira and the minimum value is 0.02 billion Naira, the average value for water transport service in Nigeria between 1990 to 2022 is 4.51 billion Naira, the maximum value is 11.54 billion Naira and the minimum value is 0.85 billion Naira and the average value for air transport service in Nigeria between 1990 to 2022 is 55.01 billion Naira, the maximum value is 268.67 billion Naira and the minimum value is 1.38 billion Naira. This implies that road transport service in Nigeria and followed by air transport service in Nigeria have the highest contributions to the Nigerian economy given their maximum values of 3876.25 billion Naira and 268.67 billion Naira respectively.

Also, the manufacturing output in Nigeria, road transport service in Nigeria, and air transport service in Nigeria are mesokurtic as their kurtosis values are greater than three (3) while rail and pipeline transport service in Nigeria and water transport service in Nigeria are platykurtic given that their kurtosis values are less than three (3). Similarly, the probability of the Jarque-Bera shows that the rail and pipeline transport service in Nigeria and water transport service in Nigeria were normally distributed at the 1%, 5%, and 10% normality test, while manufacturing output in Nigeria, road transport service in Nigeria, and air transport service in Nigeria were not normally distributed as their probability values did not pass the normality test at 1%, 5%, and 10%.

Stationary Tests (Unit Root Tests)

This section shows the unit root of the variables using the Augmented Dickey-Fuller (ADF) Test to check the stationary at a 5 percent level of significance.

Table 2: Unit Root Test Result

Variable	Augmented Dickey-Fuller (ADF) Test		
	@ Level	@ 1st Diff.	Status
MAON	- 4.805277*		1(0)
ROTS	-	- 3.936907*	1(1)
RPTS	-	- 8.170070*	1(1)
WATS	-	- 4.307704*	1(1)
AITS	-	- 7.191663*	1(1)
Asymptotic Critical Values			
1%	-4.296729	-4.284580	
5%	-3.568379	-3.562882	
10%	-3.218382	-3.215267	

**** implies significant at 1% level, **implies significant at 5% level and *** implies significant at 10%***

Source: Researcher's Computation Using EViews-12 (2023)

Table 2 shows the stationary test of the manufacturing output in Nigeria, road transport service in Nigeria, rail and pipeline transport service in Nigeria, water transport service in Nigeria and air transport service in Nigeria. Thus, Table 2 of the ADF test results revealed that manufacturing output in Nigeria was stationary at level, which means that it is integrated of order zero I(0) at a 5% level of significance. On the other hand, the road transport service in Nigeria, rail and pipeline transport service in Nigeria, water transport service in Nigeria and air transport service in Nigeria were not stationary at the level until they were differenced once, and they were said to be integrated of order one 1(1). Given the mix result, as shown by ADF tests as well as the order of integration of the variables, the long-run relationship among the variables will be tested using the ARDL model which can capture the characteristics of a mixture of 1(0) and 1(1) of the variables as postulated by Pesaran, et al. (2001).

Co-integration of ARDL-Bounds Test

This section shows the ARDL co-integration bounds test of the variables used in this paper.

Table 3: ARDL-Bound Testing

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	4.713387	3
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Source: Researcher's Computation Using EViews-12 (2023)

Table 3 shows the ARDL bounds test for co-integration that was carried out based on the unit root outcome and the F-statistic derived from the ARDL bounds test is 4.713387 and when

compared with the critical values obtained from the Pesaran Table at a 5% level of significance, its value exceeded both 2.56 and 3.49 for 1(0) and 1(1) respectively. This implies that the manufacturing output growth in Nigeria as the dependent variable and road transport service in Nigeria, rail and pipeline transport service in Nigeria, water transport service in Nigeria and air transport service in Nigeria as the independent variables are co-integrated at a 5% level of significance.

Presentation and Interpretation of Results

This section presented the long-run and short-run results of the ARDL regression analysis where the manufacturing output growth in Nigeria is the dependent variable while the road transport service in Nigeria, rail and pipeline transport service in Nigeria, water transport service in Nigeria and air transport service in Nigeria are the independent variables.

Table 4: ARDL Regression Results
Dependent Variable: UNMPN

Co-integrating Estimates (ECM Estimates)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(MAON(-1))	0.580815	0.086982	6.677420	0.0000
D(ROTS)	0.120485	0.076010	1.585125	0.1294
D(RPTS)	-0.122088	0.120211	-1.015613	0.3226
D(RPTS(-1))	-0.360887	0.111154	-3.246727	0.0042
D(AITS)	0.001191	0.000563	2.116163	0.0478
D(AITS(-1))	-0.001792	0.000677	-2.646209	0.0159
CointEq(-1)*	-0.402692	0.067375	-5.976831	0.0000
R-squared	0.998810			
Adjusted R-squared	0.998121			
F-statistic	1449.448			
Prob. (F-statistic)	0.000000			
Durbin-Watson stat	1.176389			
Long Run				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ROTS	0.781449	0.089406	8.740424	0.0000
WATS	0.026789	0.052257	0.512646	0.6141
RPTS	0.968843	0.647317	1.496707	0.1509
AITS	0.000796	0.001742	0.456836	0.6530
C	3.090980	0.382107	8.089302	0.0000

Source: Researcher's Computation Using EViews-12 (2023)

From Table 4, the value of F-statistics of 1449.448 and the probability values of 0.0000, indicate that there is a long-run relationship between the manufacturing output growth in Nigeria and transportation service variables in Nigeria. The R-square value of 0.99 revealed that road transport service in Nigeria, rail and pipeline transport service in Nigeria, water transport service in Nigeria and air transport service in Nigeria jointly accounted for about 99

percent of the variation in the manufacturing output in Nigeria during the period under review, while the remaining 1 percent accounted for by other factors outside the model.

The short-run result and the ECT show the 1-period lag Error Correction Term. Its value of -0.40 indicates that it is negative and statistically significant with a probability value of 0.00 at a 5 percent significant level. This means that the average speed of adjustment from the short run to the long run should there be any disequilibrium is 64%. While the short-run coefficient and probability values of each variable revealed that the previous value manufacturing output growth in Nigeria and air transport service in Nigeria have a positive and significant impact on the manufacturing output growth in Nigeria at a 5 percent significant level while, road transport service in Nigeria has a positive and significant impact on manufacturing output growth in Nigeria. On the other hand, the lagged value of rail and pipeline transport service in Nigeria and air transport services in Nigeria has a negative and significant impact on manufacturing output growth in Nigeria while the current value of rail and pipeline transport services in Nigeria has a negative and significant impact on manufacturing output growth in Nigeria. The long-run coefficient and probability values of each variable revealed that road transport service in Nigeria has a positive and significant impact on the manufacturing output growth in Nigeria at a 5 percent significant level. On the other hand, rail and pipeline transport services in Nigeria, water transport services in Nigeria and air transport services in Nigeria have a positive but significant impact on the manufacturing output growth in Nigeria at a 5 percent significant level.

Hypotheses Testing

Table 5: Hypotheses Testing of ARDL Results

Hypotheses	Tc	Tt	Decision Rule	Remark
$H_0: \beta_1 = 0$	8.74	2.05	$Tc >$ Tt Reject H_0	**Rejected**
$H_1: \beta_1 > 0$			$Tc <$ Tt Accept H_0	
$H_0: \beta_2 = 0$	0.51	2.05	$Tc >$ Tt Reject H_0	**Rejected**
$H_1: \beta_2 > 0$			$Tc <$ Tt Accept H_0	
$H_0: \beta_3 = 0$	1.49	2.05	$Tc >$ Tt Reject H_0	**Rejected**
$H_1: \beta_3 > 0$			$Tc <$ Tt Accept H_0	
$H_0: \beta_4 = 0$	0.45	2.05	$Tc >$ Tt Reject H_0	**Rejected**
$H_1: \beta_4 > 0$			$Tc <$ Tt Accept H_0	

Tc is the calculated T-Statistics, Tt is the table T-Statistics (Theoretical T-Statistics) and the decision rule is based on 5% level significance. While the Degree of Freedom is set as (N-K) = 29 (Gujarati & Sangeetha, 2007).

Source: Researcher's Computation Using EViews-12 (2023)

Table 5 shows the hypotheses on the impact of transportation services on the manufacturing output growth in Nigeria. Thus, H_{01}: road transport service has no significant impact on the manufacturing output growth in Nigeria is Rejected at a 5 percent level of significance given that the value of the calculated T-Statistics (Tc) of 8.74 is greater than the value of the table T-Statistics (Tt) of 2.05 and this implies that road transport service has a significant impact on

the manufacturing output growth in Nigeria. While H_{02}: rail and pipeline transport services have no significant impact on the manufacturing output growth in Nigeria is **accepted** at a 5 percent level of significance given that the value of the calculated T-Statistics (Tc) of 0.51 is less than the value of the table T-Statistics (Tt) of 2.05 and this implies that rail and pipeline transport services have no significant impact on the manufacturing output growth in Nigeria.

Similarly, While H_{03}: water transport service has no significant impact on the manufacturing output growth in Nigeria is accepted at a 5 percent level of significance given that the value of the calculated T-Statistics (Tc) of 1.49 is less than the value of the table T-Statistics (Tt) of 2.05 and this implies that water transport service has a significant impact on the manufacturing output growth in Nigeria. While H_{04}: air transport service has no significant impact on the manufacturing output growth in Nigeria is accepted at a 5 percent level of significance given that the value of the calculated T-Statistics (Tc) of 0.45 is greater than the value of the table T-Statistics (Tt) of 2.05 and this implies that air transport service has a significant impact on the manufacturing output growth in Nigeria.

Post-Diagnostic Checks

Table 6: Results of Post-Diagnostic Checks

Test		**Outcomes**	
		Coefficient	**Probability**
Breusch-Godfrey Serial Correlation LM Test	F-stat.	2.303474	0.1302
Heteroskedasticity: Breusch-Pagan-Godfrey	F-stat.	1.203192	0.3483
Normality Test	Jarque-Bera	1.116106	0.5723

Source: Researcher's Computation Using EViews-12 (2023)

Table 6 revealed that the variables are free from the problem of Serial Correlation since the F-statistics is 2.303 and the P-value of 0.130 is greater than the 5% significance level. This outcome suggests the absence of Serial Correlation in the model of the impact of transportation services on the manufacturing output growth in Nigeria. Similarly, the Heteroskedasticity results show that variables are free from the problem of Heteroskedasticity since the F-statistics of 1.203 and P-value of 0.348 are greater than the 5% significance level. This outcome suggests the absence of heteroskedasticity in the model of the impact of transportation services on the manufacturing output in Nigeria. Finally, the Jarque-Bera test of normality shows that the error term in our specified equation is normally distributed. This is evidenced by the respective insignificant Jarque-Bera statistics of 1.116106 and the probability value of 0.5723.

Implication of Findings

The result revealed that the road transport service has a positive and significant impact on the manufacturing output growth in Nigeria at a 5 percent significant level and this implies that a unit change in road transport service will lead to a 0.781-unit increase in the manufacturing output growth in Nigeria. However, rail and pipeline transport service, water transport service and air transport service have a positive and insignificant impact on the manufacturing output

growth in Nigeria at a 5 percent significant level and this implies that a unit change in road transport service will lead to little or no change in the manufacturing output growth in Nigeria. These findings agreed with the study of Awujola *et al.,* (2018) who investigated the causal relationship between transportation and economic growth and concluded that some services in the transportation system especially the road transportation service have a positive and significant impact on manufacturing output growth and economic growth in Nigeria. Also, the study of Muhammad *et al.,* (2022) who assessed the impact of logistics infrastructure on manufacturing sector performance in Africa concluded that logistics infrastructure and services have a positive impact on manufacturing sector performance.

Conclusion and Recommendations

In conclusion, the study revealed that it is only road transport service that has a positive and significant impact on the manufacturing output growth in Nigeria. While other transportation services that is rail and pipeline transport service, water transport service and air transport service though they have positive impact the probability values revealed that their impacts were insignificant in determining changes in the manufacturing output growth in Nigeria. Therefore, the paper recommended that:

i. Federal Ministry of Transportation and other stakeholders should increase the allocation to the road transport sub-sector and strengthen the road transport service policy to increase its impact on the manufacturing output growth in Nigeria.
ii. On the other hand, the Federal Ministry of Transportation and other stakeholders should review and revisit the policies and the implementation plans of the rail and pipeline transport service, water transport service and air transport service to increase their significant impacts on manufacturing output growth in Nigeria and since the services have a positive impact the paper is sure that when strategic and deliberate steps are taken these sub-sectors will have higher contributions to manufacturing output growth in Nigeria.

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