IMPACT OF LOGISTICS INFRASTRUCTURE ON MANUFACTURING SECTOR PERFORMANCE IN AFRICA: Lessons for Nigeria

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ABSTRACT

In spite of its role in achieving sustainable growth, the manufacturing sector continues to perform abysmally in African countries, including Nigeria. This situation has resulted in a continued search for policy initiatives to address the problem of 'manufacturing deficit' in the region. This study assessed the impact of logistics infrastructure, which has received very little attention in literature, on manufacturing sector performance in Africa. An unbalanced panel data for 32 African countries between 2007 and 2016 were analysed using system GMM estimation technique. The result showed that logistics infrastructure has positive and significant impact on manufacturing sector performance. An increase in logistics performance index (LPI) by 1 point or 20% would result in an increase in the performance of manufacturing sector by a range of 3.61- 7.48%, depending on the component of logistics infrastructure used. Thus, logistics infrastructure improvement should constitute one of the industrialization strategies of African countries.

JEL classification: L90; O14

1. Introduction

THE role of logistics infrastructure in enhancing economic outcomes and performance of the manufacturing sector of an economy cannot be overemphasized. Logistics infrastructure has the potential to positively influence the performance of firms in terms of cost reduction, timely delivery, reduced lead time, demand realization, increased market share, quality products and customer service satisfaction (BTE, 2001; Hayaloglu, 2015; Mwangangi, 2016). Logistics infrastructure affects the firm's ability to efficiently and effectively attract the flow of input and the flow (distribution) of its output to the market. Thus, the entire logistics architecture in an economy affects not only the manufacturing firms' supply chain but also the ability to effectively distribute its products.

Industrialization continues to receive attention in African countries' development debates. In fact, the idea that countries in the continent should industrialize is obviously not new, as most of its leaders view industrialization as a strategy towards transforming African societies and reducing their dependence on primary products (Page, 2016). African governments like Nigeria, Ghana, Rwanda and Tanzania have the vision of increasing their share of manufacturing GDP (African Development Bank, 2014; Enu and Attah-Obeng, 2013; Page, 2016). The need for industrialization is also recognized in the recently adopted Sustainable Development Goals (SDGs). Goal 19 of SDGs emphasizes resilient infrastructure and sustainable industrialization.

Studies have considered industrialization as a solution to the problems of slow growth, low income and unemployment that characterize the regions given its key role in achieving sustainable economic development and generating higher incomes (Zhang, 2002). Rodrik (2015) noted that industrialization impacted on sustainable growth via two channels which include reallocation of workers from low productive activities to higher productive ones; and the relatively strong manufacturing growth experienced by manufacturing over the longer term. Diversifying into manufacturing sector will make an economy to be less exposed to exogenous shocks such as climatic conditions. Fox, Thomas and Haines (2017) noted that manufacturing sector development is beneficial to the economy of any nation because of its strong potential for increasing value-added, potentially important technological spill-over effects, access to foreign know-how, stimuli to greater innovation, and a general knock-on effect on other sectors of the economy through created demand for goods and services.

In spite of the roles play by manufacturing sectors, it continues to perform abysmally as the continent suffers from 'manufacturing deficit'. The share of manufacturing in the GDP of African countries is generally low. Bhorat, Rooney and Steenkamp (2016) reported that the share of manufacturing sector in GDP in Africa, on average between 1980 and 2013 dropped by 0.8 percentage point from an average of 11.3% in 1980s to 10.6% 2000 and 2013. Recent statistics indicates that the share of manufacturing in GDP of sub-Saharan Africa is the lowest when compared with other regions of the world. The abysmal performance of the manufacturing sector in Africa has necessitated a continued search for the factors capable of enhancing the success. Available statistics reveal that logistics architecture of African countries is nothing to write home about. In terms of logistics performance, no African country is among the top ten ranked countries in the world, while five African countries are in the least 10 ranked countries. Zimbabwe, Lesotho, Sierra Leone, Equatorial Guinea and Mauritania are ranked 151, 154, 155, 156 and 157 respectively out of the 160 assessed countries. Only three countries below their ranks are war-ravaged countries, namely Somalia (158), Syrian (160) and Haiti (159) (WDI, 2016).

Even though, several studies have been carried out on the performance of manufacturing sector in Africa and beyond, little or no study exists on the role of logistics infrastructure on manufacturing sector performance especially in a panel of Africa countries. Therefore, the study assessed the role of logistics infrastructure in enhancing manufacturing sector performance in Africa. Accordingly, objective of this study are to examine: The state of logistics infrastructure in African region; and the impact of logistics infrastructure on manufacturing sector performance in the region. To that extent, the research questions of the study are: What is the state of logistics infrastructure in Africa? Does logistics infrastructure impact on manufacturing sector performance in Africa?

The rest of the paper is arranged as follows: section two presents overviews of concepts, while section three deals with theoretical and empirical reviews; section four deals with theoretical framework. Empirical model and data are presented in section five, while results and discussion are presented in section sixth. The seventh section is the conclusion and recommendation.

2. Conceptualization of Infrastructure and Logistics

In order to properly conceptualize the study, it is pertinent to understand what the infrastructure and logistics mean. The term infrastructure is used to broadly cover economic infrastructure and social infrastructure. Infrastructure could be broadly defined as physical facilities, institutions and organizational structure which serve as the social, financial and economic base for the operation of a society (UNCTAD, 2008; Snieska and Simkunaite, 2009).While economic infrastructure promotes economic activities, social infrastructure promotes well-being in the society such as health and education (Snieska and Simkunaite, 2009). Portugal-Perez and Wilson (2009) classified infrastructure into hard and soft infrastructure. Hard infrastructure includes highways, rail roads and ports, while soft infrastructure includes transparency, customs efficiency and institutional reforms among others (Portugal-Perez and Wilson, 2009). This implies that the classification above is not limited to physical facilities, but also includes institutions and organization structure in an economy.

The term logistics has been defined in various ways in academic literature. Logistics include, in addition to information flow, a range of extensive activity that facilitates the transformation and distribution of goods from raw materials source to end market in which the goods are consumed (Rodrigue, 2012). Logistics investment encompasses enterprises on some components such as various transportation networks, storage systems, information and communication devices, packing services etc (Hayaloglu, 2015). Logistics infrastructure improvement, according to Rodrigue (2012), encompasses improvement in freight distribution via: physical infrastructures, such as terminals, real estate, and telecommunication; operations, including transport modes and equipment; and human resources such as labour, management, and governance, as well as research and development. In this study, logistics infrastructure encompasses a broad range of economic infrastructure, which could be both soft and hard, that facilitates flow of materials, information as well as distribution of the final product.

3.0 Theoretical and Empirical Review

Among the theories that relate logistics system with manufacturing sector performance are location theory and the theory of firm which are discussed below:

3.1 Location theory

This is a classical theory which focuses on the territorial allocation of resources within a country and the supply (cost factors) and demand (market factors) variables which affect the distribution process of firms. According to this theory, the location of a firm in an economy depends highly on supply and demand factors. It emphasized the role of cost as the determinants of the location of firm (Weber, 1928; Fujita and Thiese, 2002). Since logistics infrastructure influences the supply via its impact on the production input cost and demand variables via the distributional impact, the theory clearly shows that the state/nature of logistics infrastructure will no doubt influence the performance of manufacturing firm in an economy. By implication, logistics infrastructure affects location of industry indirectly through its impact on the cost of production. Zhang (2002) confirmed via empirical study that logistics development brings about birth of new industries. This impact may be explained in terms of two channels as follows.

Firstly, in deciding whether to locate a firm in an economy, the cost of production is often considered and as such, a firm may be motivated to operate in an economy characterized by low input cost resulting from better logistics architecture. Secondly, firms consider the distribution channels of their products in deciding the location of the business. An economy with inefficient logistics infrastructure will have an insufficient distribution system and such will put manufacturing firms that operate in such an economy at a competitive disadvantage when compared to manufacturing firms in an economy with better logistics infrastructure.

3.2Theory of Firm

The theory of firm was developed by the classical economists and was meant originally to identify why firms exist. There are several sub theories emanating from this theory. However, the relevant one to this study is the transaction cost theory. According to the theory, firms that perform well are those with the most efficiently completed transaction costs and minimum production costs (Meutzer et al., 2004). While transaction costs are associated with exchange, production costs are associated with various production activities coordination. Since logistics architecture affects both the exchange (Erkan, 2014) and production costs (Erkan, 2014; Mwangangi, 2016), a firm that operates in an environment with efficient logistics system tends to be in a situation where both transaction costs and production costs are at possible minimal level (Fugate et al., 2010). Thus, the transaction cost theory shows that logistics infrastructure could influence firms' performance indirectly through its impact on production cost.

3.3 Empirical review

Though several empirical works exist on manufacturing sector performance and logistics infrastructure, very few studies investigate their direct relationship. Such studies are reviewed in this subsection. A study by Zhang (2002) found evidence of circular relationship between logistics infrastructure and economic development. Base on this study, better logistics cause higher development and yet better logistics and other additional positive impacts. The study concluded that 'modern logistics development also changed the regional economic growth ways and promotes the formation of new industries and optimizes the regional industrial structure.'

Green et al. (2008) investigated the impact of logistics performance on organizational performance using data gathered from 1,461 selected firms from data base of US manufacturers with 800 or more employees. The study used descriptive statistics, confirmatory factor analysis and non-normed-fit index and found that positive relationship exists between logistics performance and organizational performance within the manufacturing sector. In a similar study, using a self-reported survey completed by one representative individual from each of the sampled firm, Keebler and Plank (2009) reported that logistics infrastructure has a positive impact on the United States of America manufacturing firms' performance.

Vilmo et al. (2011) conducted a study to investigate the impact of logistics infrastructure on economic development of Finland. The study measured logistics infrastructure with logistics performance index and qualitative method of analysis was adopted. They found that connection exists between economic development and logistics infrastructure. Coto-millan et al. (2013) used aggregate global production function, expanded with the logistics performance index, to examine the impact of logistics performance on economic growth using data of the world countries between 2007 and 2012. The study found that logistics has positive, significant and important impact on economic growth of the world's countries. An increase of logistics performance by 1% results to economic growth ranging between 0.011% and 0.034%.

In a study to investigate the existence of long-term relationship between logistics development and economic growth in Turkey, Kuzu and Onder (2014) found that – using Granger causality, unit root and cointegration test— long-run relationship exists between logistics development and output growth in the Turkish economy. The study proxied logistics infrastructure with index of transport and storage. According to the study, a one unit increase in the measure of logistics infrastructure (index of transportation and storage), results in 30 percent increase in the GDP and vice-versa. Seinchez, Tomassian and Perroti (2014) investigated the performance of logistics on economic development. The focus of the study was to show if the probability of an economy being developed is due to difference in logistics performance (logistics gap). Using probabilistic approach, the study found that the probability of an economy being developed increases with improvement in the logistics performance of the economy. The logistics performance index sourced from World Bank and other variables were used in the study.

Hayaloglu (2015) used annual data for 32 OECD countries between 1994 and 2011 to investigate the impact of development in logistics sector on economic growth. He found evidence of some impact of logistics sector development on economic growth. The study used different variables as indicators of development in the logistics sector and revealed that the relationship between development in the logistics sector and economic growth differs depending on the indicator used. Mwangangi (2016) examines the influence of logistics on the performance of the manufacturing firms in Kenya. Using both descriptive and exploratory research designs, the study found that three aspects of logistics (transport management, inventory management and order process/information flow management) influence the performance of manufacturing firms in Kenya. He concluded that firms with efficient logistics system will have a competitive edge and that logistics architecture in a firm has the potential to positively influence firm's performance via reduction in costs, timely delivery, and reduction in lead time, increase market share, quality products and customer service satisfaction.

Thus, empirical evidence shows that logistics infrastructure is very important in any economy. Some of the reviewed literature found positive and significant relationships between logistics infrastructure and countries and regional economic development. Others equally confirm the existence of positive and significant relationship between logistics infrastructure and manufacturing sector performance. It is however pertinent to know that (i) majority of the studies either focused on economic development and logistics infrastructure or economic growth and logistics infrastructure, while very few studies investigated the impact of logistics infrastructure on either manufacturing sector performance or industrial growth. (ii)Virtually, all the few studies that investigated the relationships between logistics infrastructure and manufacturing sector performance only focused on one country using either time series or cross sectional approach and no study is known to the author of this study to have investigated the impact of logistics infrastructure on Manufacturing sector Performance using a panel data of Africa countries. This study therefore contributes to empirical literature on manufacturing sector enhancement as well as importance of logistics infrastructure by investigating the impact of logistics infrastructure on manufacturing sector performance in Africa using Arrelano-Bover (1995) and Blundell-Bond (1998) system GMM estimation technique.

4. Theoretical Framework

The study adopts the framework of Clarida and Findlay (1992) and Stephen and Golub (2007) on infrastructure and productivity with slight modification. Accordingly, the theoretical framework for this study is based on the following major assumptions: (i) the economy is a small open economy with sector j that produces product j. The implication of this assumption is that the economy will take the j vector of world price p as given. (ii) The sector uses constant return to scale technologies to produce product j. (iii) Both products and factor market are perfectly competitive and the economy maximizes the value of final output of sector *j*. The common formulation of the maximization problem is given as (following Dixit and Norman, 1980):

$$r(P, Ƶ) = Max\ \{P.\lambda\ /(\lambda, Ƶ)\ feasible\} = P.\lambda(P, Ƶ) \qquad 1$$

Where *r(P,Ƶ)* is the revenue function of the economy , *λ(P,Ƶ)* is the vector of net output produces, which maximizes the national income value.

The vector of output produce in an economy can then be expressed as:

$$\lambda(P, Ƶ) = \frac{\partial\ \lambda(P, Ƶ)}{\partial P_j}, j = 1, - - - - J \qquad 2$$

Suppose that sector *j* production technology can be written as:

$$\lambda_j = \varphi_j f_j(ƶ_j) = \varphi_j \lambda_j^* , j = 1, - - - J \qquad 3$$

Where φ_j is productivity shift parameter, $ƶ_j$ is an M-vector of factor input by sector j while increase in φ_j represents Hicks' neutral productivity increase (see Stephen and Golub, 2007 for details).

According to Dixit and Norman (1980), equation (3.1) has a form *r(ΘP, Ƶ)*, where $\Theta = diag\ (\varphi_1, - - - \varphi_J)$, such that changes in productivity of sector j's (φ_j) affects output in the same way as changes in P_j . The formulation above provides justification for productivity differences across countries and this difference, according to Stephen and Golub (2007), results from (i) inherent technological differences and (ii) stocks of infrastructure. Since it is assumed that increase in φ_j represents Hicks' neutral productivity increase, then productivity shifter in sector j can be written as:

$$\varphi_j = \delta_j\ h_j(\mathrm{I}), \qquad 4$$

Where δ_j is a technological parameter inherent to sector j, I is the stock of infrastructure available in the economy, and $h_j(\bullet)$ is an increasing function that maps the availability of infrastructure into productivity.

Following Heckser-Ohlin model that technologies are identical across countries or differ by an equal proportion across countries, it is assumed that $h_j(\bullet)$ is specific to sector j but the same across countries. The implication here is that infrastructure is a source of comparative advantage, as its sector-specific productivity effect interacts with international differences in factor endowments. Assuming that government provides infrastructure using Leontief technology with a fixed unit input requirement Ω. The net vector of factor endowment that is available for producing infrastructure could be specified, according to Clarida and Findlay (1992), as:

$$NV = V - \Omega.I \quad 5$$

Then the sector revenue function could be written as:

$$r(\delta_j \ h_j(I).P, V - \Omega.I) \quad 6$$

The derivative of equation 6 with respect to *P* yields the sector's net output in an economy, i.e:

$$\lambda_j(\delta_j \ h_j(\mathrm{I}).\mathrm{P}, \mathrm{V} - \Omega.\mathrm{I}) = \frac{\partial \ r(\delta_j \ h_j(\mathrm{I}).\mathrm{P}, \mathrm{V} - \Omega.\mathrm{I})}{\partial P_j} \quad 7$$

An industrialization minded government will thus choose the level of *I* that maximizes equation 6. It is expected that increase in I will increase productivity of sector *j*. It should be noted that equation 7 shows that the size of increase in output of sector *j* associated with an increase in *I* also depends on other characteristics of the country in which the sector operates namely; its factor endowment (*V*) and its technology size (*δ*). Thus, the output of sector *j* at time *t* depends on the stock of infrastructure in country *i* at time $t(I_t^i)$, the country *i*'s factor endowment at time t (V_t^i), unobserved technological ability of country *i* at time $t(\delta_t^i)$ and a stochastic error component (ε_{jt}^i) such that:

$$ln\varphi_{jt}^i = \beta_j I_t^i + lnV_t^i + ln\delta_t^i + \varepsilon_{jt}^i \quad 8$$

5. Empirical Model Specification and Data

Manufacturing value added (MVA) is the most widely used proxy of manufacturing sector performance in literature. There is however no universal way of specifying the model with MVA as the dependent variable in literature as various authors gave variant specification (Muhammad et al., 2013; Timothy and Chigozie, 2015). This study thus, in addition to the theoretical framework presented in the preceding subsection, relies on previous empirical studies by

(Zhang, 2002; Muhammed et al., 2013) to specify the model. Accordingly, the model is specified as:

$$lnMVA_{it} = F(\, LI_{it}, X_{it}) \qquad 9$$

Where: MVA is manufacturing value added which here proxy the performance of the manufacturing sector. *LI* is the logistics infrastructure while *X* is the vector of other explanatory (control) variables namely: gross fixed capital formation (GFCF) with which capital is proxied with (Muhammed et al., 2013 also proxied capital by GFCF) and industrial employee as a percentage of total employees (LAB). Equation 9 becomes:

$$\mathrm{lnMVA}_{it} = \mathrm{f}\,(LI_{it}, GFCF_{it}, LAB_{it}) \qquad 10$$

Equation 10 can then be expressed in form of unbalanced panel model as:

$$\mathrm{lnMVA}_{it} = \lambda + \theta LI_{it} + \delta GFCF_{it} + \varphi LAB_{it} + U_{it}, i = 1 - - - N; t1 - - - T \qquad 11$$

Where λ is the intercept term and $U_{it}$is the error term of country *i* at time *t*.

In panel regression, one major issue is the possibility of presence of time-invariant unobservable countries characteristics (Cameroon and Travedi, 2009) which may correlates with the explanatory variables$LI_{it}, and\ X_{it}$. Such unobservable time-invariant error would be stored in the error term U_{it} and caused it to be biased. This is expressed as:

$$U_{it} = \omega_i + \varepsilon_{it} \qquad 12$$

Where ε_{it} is white noise and ω_{it} is the unobservable time – invariant component

In the presence of equation 3, OLS method cannot be used since one of its assumptions has been violated. To overcome the problem, literature suggests the use of fixed effect estimation technique (Cameroon and Travedi, 2009). Such involves the use of within transformation fixed effect to eliminate the unobservable time invariant ω_{it} in equation 11. This would be achieved by demeaning the variables using within transformation as follows:

$$\mathrm{lnMVA}_{it} - \overline{\mathrm{lnMVA}_{it}} = \lambda + \theta(LI_{it} - \overline{LI_{it}}) + \delta(GFCF_{it} - \overline{GFCF}_{it}) + \varphi(LAB_{it} - \overline{LAB}_{it}) + (\omega_i - \overline{\omega}_i) + (\varepsilon_{it} - \bar{\varepsilon}_{it}) \qquad 13$$

Since ω_i is constant – because it is time invariant- then $\omega_i = \overline{\omega}_i$, which makes the expression $(\omega_i - \overline{\omega}_i)$ equals zero and equation 5 becomes:

$$lnMVA_{it}^{*} = \lambda + \theta LI_{it}^{*} + \delta GFCF_{it}^{*} + \varphi LAB_{it}^{*} + \varepsilon_{it}^{*} \qquad 14$$

Equation 14 is the demean equation which has now eliminated the fixed effect in the relation. Thus, OLS can then be used on equation 14 to obtain the fixed effect estimator. It may however be possible that the manufacturing value added in this year may be related with its previous value, which will makes it imperative to incorporate dynamics into the model. Thus, the model becomes:

$$\ln MVA_{it} = \lambda + \alpha \ln MVA_{it-1} + \theta LI_{it} + \delta GFCF_{it} + \varphi LAB_{it} + U_{it}, i = 1 - - - N; t = 1 - - - T \qquad 15$$

The introduction of first lag of MVA as an independent variable results to what is called endogeneity problem in econometric literature since it is an endogenous variable. Thus, the major task then becomes how to account for endogeneity problem in the face of countries level/specific effect. The country level effect in equation 15 can be eliminated by differencing the equation as:

$$\ln\Delta MVA_{it} = \lambda + \alpha \ln\Delta MVA_{it-1} + \theta\Delta LI_{it} + \delta\Delta lnGFCF_{it} + \varphi\Delta LAB_{it} + \Delta U_{it} \qquad 16$$

Given equation 10, equation 15 becomes:

$$\ln\Delta MVA_{it} = \lambda + \alpha \ln\Delta MVA_{it-1} + \theta\Delta LI_{it} + \delta\Delta lnGFCF_{it} + \varphi\Delta LAB_{it} + \Delta\varepsilon_{it} \qquad 17$$

Equation 17 has resolved the problem of country level effect but the potential problem of autocorrelation and endogeneity remain given that the term $\ln MVA_{it-1}$ is still in the equation. In order to overcome the problem, Arrellano-Bover (1995) and Blundell-Bond (1998) built on the work of Arrelano and Bond (1991) to develop a GMM instrumental variable estimation method, where the first difference lagged dependent variable is instrumented with further lagged levels. This estimation technique has been reported to be capable of accommodating a dynamic specification and at the same time account for the time-invariant specific characteristics (Cameroon and Travedi, 2009).

5.1 Variables description

A brief description of the variables used in the model is presented in this section. *MVA*: the manufacturing value added represents the basic indicator of country's level of industrialization. It is measured in terms of value rather than volume and it is deflated by population to adjust for the country's size. It is obtained by subtracting the values of inputs from the value of output (see WDI, 2015). This variable is sourced from the World Development Indicators data base.

GFCF: Gross fixed capital formation measures gross net investment (acquisition) less disposals in fixed capital assets by enterprises, government and households within an economy in an accounting period. By implications, GFCF shows how much of the new value added in the economy is invested rather than consumed (see UN, 2008). 'If GFCF increases, capital is available to enhance the manufacturing sector' (Muhammad et al., 2013). The data is sourced from WDI.

LAB- This measures employment in the industrial sector as a percentage of total employed employment. The unavailability of separate data on manufacturing sector necessitated the use of this proxy.

LI- Logistics infrastructure is proxy in this study by logistics performance index (LPI). LPI which is available in the World Bank Development Indicators (WDI) has received wide acceptance and is a composite index based on proxy measures for transport and information infrastructure, supply chain management, and trade facilitation capabilities, which are obtained based on a world survey of global freight forwarders and express carriers. The survey scores customs, infrastructure, international shipment, tracking and tracing, and Timelines. The goal of LPI is to assess countries rank in terms of LPI ranges from lowest score of 1 and highest score of 5 (World Bank, 2010) and it shows that 'building the capacity to connect firms, suppliers, and consumers is key in a world where predictability and reliability are becoming more important than costs in supply chain management' (Rodrigue, 2012). Each of the components is explained below.

Customs reflect the perception on the efficiency of the clearance process (such as speed, simplicity and predictability of formalities) by border control agencies, including customs. *Infrastructure* captures the perception of freight forwarders on the quality of trade and transport related infrastructure (e g ports, railway, information technology etc), while *shipment* reflects the ease with which competitively priced shipments are arranged.

Furthermore, *logistics competence* reflects the perception on the competence and quality of logistics services (such as transport operators, customs brokers etc), while *tracking and tracing* deal with the perception on the ability to track and trace consignments; and *timeliness* reflects the perception on timeliness of shipments in reaching destination within thin stipulated or expected time. The study is based on logistics performance index (LPI) data from 2007 to 2016 as well as annual data on other covariates within the same period. The data were collected from world development indicators (WDIs) and International Labour Organization.

6. Results and Discussion

The descriptive analysis and the analysis of estimated result obtained using Arrellano-Bover /Blundell-Bond dynamic panel system GMM are presented in this section. The state of logistics infrastructure in Africa compared to other regions and world average is depicted in figure 1. The figure shows that African countries have the least performance in terms of logistics infrastructure. According to the 2016 edition of LPI, which measures logistics infrastructure across 160 countries, no African country is among the top ten performers. Instead, 5 African countries (Zimbabwe (151th), Lesotho (154th), Sierra Leone (155th), Equatorial Guinea (156th), Mauritania (157th)) are among the least ten performers. The best performer in Africa is South Africa which is ranked 20th in the world, while Nigeria's rank (90th) made it 13th in Africa (WDI, 2016). This clearly shows that African countries are still far behind in terms of logistics infrastructure.

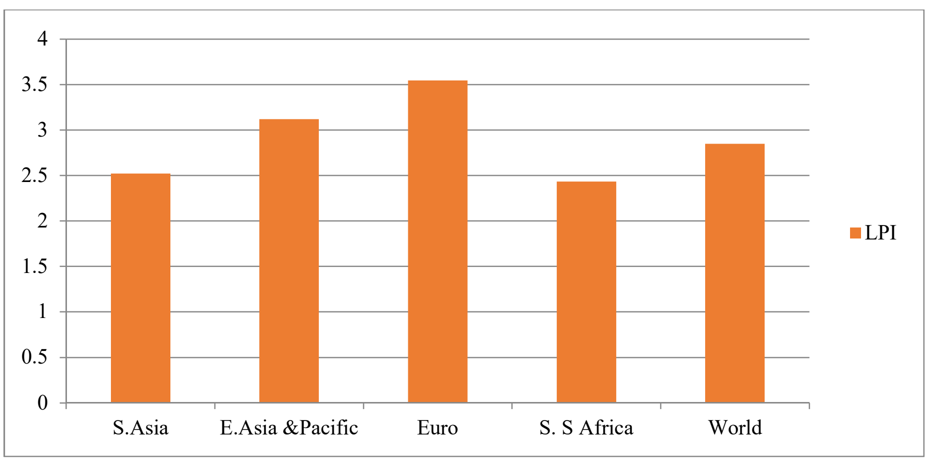

Figure 1: Average regional logistics performance between 2007 and 2016
Source: Author's computation (2017)

Figure 1 shows that Africa has the least share of manufacturing sector in GDP, compared to other regions. Its performance is even below world average. The performance of manufacturing sector in Africa stagnated at just around 10% in the last decade. The performance of African manufacturing sector contrasts the success story of Asian region with which Africa shared economic structures in the 1970s. In fact, the structural transformation of Asia has earned it the enviable accolade 'the world factory' (Bhorat, Rooney and Steenkamp, 2016).

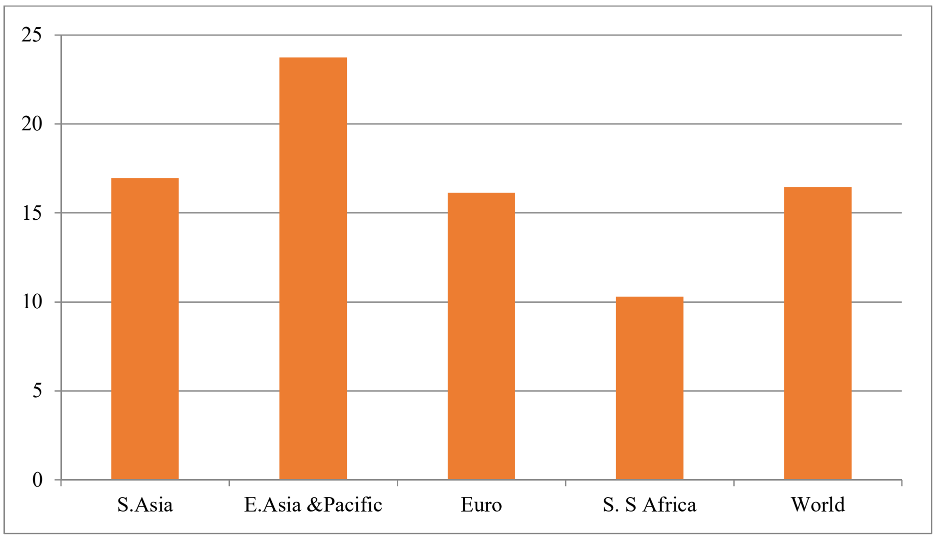

Figure 2: Average share of manufacturing sector in GDP between 2007 and 2016
Source: Author's computation (2017)

Analysis of dynamic panel system GMM result

The analysis, which was based on Arrelano-Bover/Blundel-Bond system GMM, shows that in model one, the performance of the manufacturing sector measured by MVA was positively related to its previous value (its lag). Models two to seven also show similar results that previous development in the manufacturing sector impacts positively on the contemporary performance of the sector. Similarly, models one to seven indicate that gross fixed capital formation of a country impacts positively and significantly on the MVA and, by extension, the manufacturing sector performance as well as industrialization. Model one indicates that an increase (decrease) in the GFCF by 1% would result in an increase (decrease) in the MVA by 7%.

Models two to seven also indicate that the elasticities of MVA with respect to GFCF fell in between 0.058 and 0.0777. The variation in the elasticity is due to different control variables used in each of the models. According to the result, model five has the highest elasticity of 0.0777. This result aligns with the finding of Muhammad et al. (2013) who found a positive relationship between manufacturing sector and GFCF in Pakistan. In addition, Ibadin, Moni and Eikhomun (2014) lent support to the fact that GFCF has positive and significant relationship with real sector development.

The result also shows that labour units have positive impact on the MVA in each of the seven models. The associated p-values however indicate that labour unit has no significant influence on MVA. This is against the classical economists' proposition in the theory of production that labour is an important determinant of output. This result for labour may be attributed to the fact that labour cost in African countries is cheap and the labour is characterized by low skilled manpower. The implication of the result is that it is capital that matters most in the industrial development struggle of African countries, when compared to labour. Moreover, African countries are blessed with high level of manpower, albeit majority are not skilled.

The first model test the impact of logistics infrastructure using the overall index, while the remaining models use each of the components of the logistics performance index so as to see which component has the highest influence on MVA. In model one, overall logistics performance index has a positive and significant influence on the MVA. Ceteris paribus, an increase in logistics performance by one unit or 20% (since it is measured on a 5-point scale) increases the manufacturing value added (MVA) by 6.7%. In the same vein, while track and tracing, shipment, customs, and timeliness performance have positive and significant influence on MVA, both trade and transport-related infrastructure and logistics competence have no significant impact on MVA, though the relationship is positive. The change in MVA varies depending on the LPI component used. Ceteris paribus, an increase by one unit or 20% of track and tracing, shipment, customs, and timeliness performance will result in an increase in MVA by 3.6, 3.9, 7.5 and 3.8% respectively. The implication of the outcome is that customs have the highest impact on MVA.

Post-estimation tests were conducted to ensure that the result does not suffer from the problem of autocorrelation and that the instruments used are valid. The correlation test shows that though there is correlation of the first order, there was no second order auto correlation as shown by the *ar*(1) and *ar*(2). Thus, the model does not suffer from autocorrelation problem. The Sargan test results fails to reject the null hypothesis of the validity of over identifying restriction in any of the models as none of the p-values of the Sargan test is below 10%. The implication of such result is that the instruments used for the estimation of the models are valid.

Conclusion and Recommendations

Owing to its potential to promote sustainable growth through reduction in the level of unemployment, income inequalities and low level of living standard, industrialization has, over more than three decades, occupied a central position in the development agenda of African countries, including Nigeria. The manufacturing sector which is recognized in literature as a major driver of industrialization continues to perform abysmally in the region. Thus, policy initiatives are needed to address the menace.

This study thus assessed the role of logistics infrastructure in enhancing the performance of manufacturing sector in Africa using panel data of 32 African countries between 2007 and 2016. Logistics infrastructure was measured via logistics performance index (LPI) published by the World Bank and available in the world development indicators (WDIs). The results obtained using Arrelano-Bover/Blundell-Bond system GMM estimation technique revealed that logistics infrastructure has a positive impact on the manufacturing value added which served as a proxy for manufacturing sector performance in this study and as an indicator of the level of industrialization in a country. The result, however, revealed that the significant and extent of the impact vary, depending on the component of the logistics performance index used. The implication of this is that, if the industrialization target of countries in the continent is to be realized, significant commitment must be made to improve the logistics architecture of the region. Such policy initiatives should include improvement in the efficiency of the clearance process by the border control agencies, ability to track and trace consignment, timeliness of shipment in reaching destination within the scheduled or appointed time and the way international shipments are arranged. The result shows that quality of transport and trade infrastructure and logistics competence are not significant. This implies that quality of transport and trade infrastructure is generally low in the region.

In addition, policy initiative capable of enhancing the gross fixed capital formation must be promoted by countries in the region, including Nigeria. The result shows that labour units have no significant impact on the manufacturing sector development in the region even though the sign of the coefficient signalled a positive relationship. In order to make labour play a significant role in the industrialization process, the skill level of labour in the region must be enhanced. This could be achieved through investment in primary and secondary education as well as research and development (R&D) activities.

Conclusively, for Nigeria to improve its manufacturing sector performance as a means towards achieving its long-term industrialization objective, it must, in addition to other policy initiatives in literature, improve the logistics architecture in the country. The recent move by the federal government of Nigeria to decongest the airports in the country and the recent renovation of Abuja International airport runway are right steps in the right direction which must be sustained. Other areas of logistics infrastructure in the country should also be improved. Finally, to raise the productivity of manufacturing firms in African countries, there must be holistic policy interventions by different stakeholders - such as government, maritime shipping lines, port authorities/ terminal operators, logistics real estate developers among others- aimed at mitigating critical bottlenecks imposed by inadequate logistics infrastructure.

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