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INTER-SECTORIAL CONNECTEDNESS- THE ANALYSIS OF THE TRANSPORTATION SECTORS IN NIGERIA

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ABSTRACT: *This study examined the relative importance of the transportation sectors in the Nigerian economy by exploring the extent of the inter-sectorial connectedness of transportation sectors with other sectors of the economy. Using input-output table for 2011, the backward and forward linkages for road transport, rail transport & pipelines, water transport, air transport and transport services in Nigeria were computed. Road transport was found to be forward and backward oriented, while rail transport & pipelines, water transport, air transport and transport services were found to be backward-oriented. The role of government and private sector in revamping the sector was emphasised.*

KEYWORDS: Connectedness, Inter-sectorial, Transportation

INTRODUCTION

Transportation is an essential part of human activity, and in many ways form the basis of all socio-economic interactions. Indeed, no two locations will interact effectively without a viable means of movement (National Bureau of Statistics, 2012). It is expected that a good transport system will spur economic growth and development. Keeling and Mooney (2011) argued that transport system adds directly to economic growth and development as well as employment generation through bus, rail, road, air and maritime services, while it has a large indirect impact through all the other sectors and activities in the economy that depend on and use these various modes of transport to move people and goods around, nationally and internationally, in an efficient and safe manner.

Transport system in Nigeria over the years has witnessed a plethora of problems that restrained the economy to maximise the benefits that the sector has to offer. This includes irregular, inadequate and overcrowded trains and airplanes and congested ports, inadequate fleets of buses or trucks and bad road networks and inadequate incentives for the operators of the sector. Thus, an exercise on understanding the extent of the interconnectedness of the transport system with other sectors of the economy is not out of place.

Study on interdependency and inter-sectorial connectedness of sectors within any economy cannot be overemphasised. A model that has been widely adopted in analysing such complexity is the Leontief input-output model. In the economic context, one interesting dimension of complexity is the level of interdependence between the component parts of an economy. The Leontief input-output model is, by its very nature, one of the best theoretical and empirical methodologies for studying this.

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Information on linkages among the sectors of an economy provides better understanding of the economy's structure and dynamics that are important in formulating policy in the economy (see Cai, Leung, Pan and Pooley; 2005; Chenery and Watanabe, 1958; Hirschman, 1958). Some authors also argued that the indices of inter-sectorial linkages also help in identifying the key sectors of an economy as key sectors usually have both strong forward and backward linkages with other sectors in the economy (see Beyers, 1976; Hewings, 1982; Hewings et al., 1989; Sonis et al., 1995, 2000; Cai and Leung, 2004).

This study examines the relative importance of the transportation sectors in the Nigerian economy by exploring the extent of the inter-sectorial connectedness of transportation sectors with the other sectors of the economy. Section two discusses the background issues regarding transport system in Nigeria. Literature on role of transportation in economic growth and development as well as issues on interdependency within an economy is the focus of the third section. Section four gives a brief description of the methodology employs in this study, while section five discusses the findings. The last section, section six, concludes and proffers policy options.

Stylised Fact on Transport System in Nigeria

Transport statistics in Nigeria are grouped into five basic categories, namely, road transport, rail transport and pipelines, water transport, air transport and other transport services (CBN, Various statistical Bulletins). Of the entire transportation modes in Nigeria, road transport is the most commonly used. Presently in Nigeria, road transport accounts for more than 90 per cent of the sub-sector's contribution to the Gross Domestic Product (GDP). It involves the conveyance of passengers, farm produce, merchandise and animals from one location to another, and the execution of mobile services (clinics, libraries and banks). The use of motor cars for pleasure also contributes tremendously to the importance of road transport in Nigeria. This is more predominant in Nigeria than in most other African countries because of the poor state of alternative means of transportation by which journeys could have been made and also due to the psychological satisfaction offered by the possession of car(s) (NBS, 2012).

Although most suitable transportation of bulky materials, rail transport and pipelines are not as effect as road transport in Nigeria due to the deplorable state of the infrastructure that supposed to facilitate the use of this mode of transportation. It accounted for less than 0.5 per cent of the total GDP of the country. According to NBS (2012), Nigeria's single-narrow-gauge railway line constructed in the colonial period was for many years the only mode of freight movement between the northern and southern parts of the country.

Water transport scores a distant second to road transport, with an average share of about 1.6 per cent of Nigeria's gross domestic product (NBS, 2012). The importance of water transport relates with the geography of the country concerned. In Nigeria, land-locked communities has less concerned with water transport than inland or peninsular settlements. Water transport has the following three components: ocean transport, coastal water transport and inland water transport. Air transport has a unique advantage over all other modes of transport regarding speed, time and distance. Air transport is of high value in relation to weight. It is also preferred where accessibility by other modes is a problem (especially in riverine or mountainous regions). Air transportation is a system with many inter-related parts (NBS,

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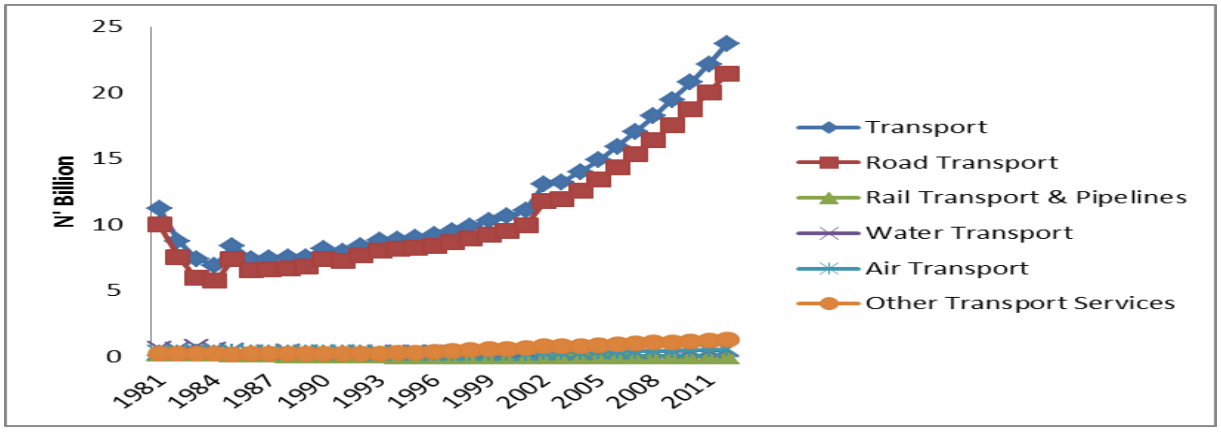
2012). In Nigeria, air transport contribution to GDP is still small relative to other mode of transportation.

Over the year road transport sector in Nigeria has been responsible for most of the output of transportation sector in Nigeria. As illustrated in Figure 1, road transport sector was responsible for more than 90 per cent of the output of the sector between 1981 and 2012. Other sector, rail transport and pipelines, water transport, air transport and other transport services, were responsible for less than 10 per cent of the transport output in Nigeria between 1981 and 2012.

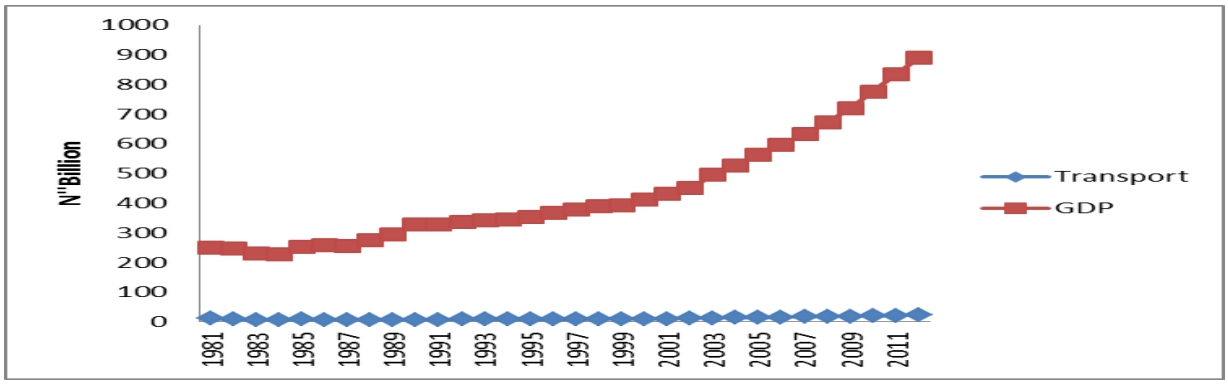
Figure 1: Components of Transportation Output in Nigeria



Source: Graphed with data from CBN, Statistical Bulletin 2012

Figure 2 compares the output of transportation sector with the total output of Nigeria from 1981 to 2011. Two striking features ensued from the figure. First, total output in Nigeria has been on increase over the years while the rate of growth of the output of transportation sector is low compare to that of the total output. Second, transportation sector output constitutes a small proportion of the total output in Nigeria as illustrated in Figure 2.

Figure 2: Trends of Gross Domestic Product and Transportation Output in Nigeria



Source: Graphed with data from CBN, Statistical Bulletin 2012

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REVIEW OF SOME RELATED STUDIES

In this section, some empirical studies on the role of transportation in economic development are considered. The outcomes of the review gave support for the purpose of the study and reiterated the need to further understand the dynamics of transportation sector. In what follows, some studies on transportation sector are highlighted.Amba and Danladi (2013) examined the Nigerian transportation sector with emphasis on the railway and aviation subsectors. The authors observed low and continuous fall in the activity of railway and aviation transport sectors in Nigeria. They identified high operation cost and inadequate funding as major challenges facing the sub-sectors and they highlighted increased private sector participation and improved funding as major policy options.

Boopen (2006) analysed the contribution of transport capital to growth for sub-Saharan African countries and for a developing states using both cross sectional and panel data analysis. Using an extended Cobb-Douglas production function, the author developed a model that expressed total output as a function of total factor productivity, total physical capital, transportation capital and labour in the study. The author found that transport capital has been a contributor to the economic progress of the examined countries. The study also revealed that in the sub-Saharan African, the productivity of transport capital stock is superior as compared to that of overall capital, while that of developing states transport capital is seen to have the average productivity level of overall capital stock.

Nourzad and Vrieze (1995) investigated a panel data for 7 OECD countries over the period 1963-88 on the effect public investment on output. The study adopted a Cobb-Douglas function controlling for energy input price and taking into account random effects. The authors found a relatively low but significant output elasticity with respect to public investment. Similarly, Canning (1999) estimated an aggregate production function for a panel set of 77 countries. He used annual cross country data for the period 1960-1990 and his production function incorporated labour, physical capital, human capital and infrastructure variables. Canning used panel data co-integration methods that took account of non-stationary nature of data and also robust to reverse causation. Canning found that the elasticity of output to physical capital is positive, while he found no significant impact of elasticity generating capacity, or transportation structure on growth.

Thus, the interface between transportation investment and economic development has broad ramifications that go beyond transportation's basic purpose of moving goods and people from one place to another. Transportation also has a broader role in shaping development and the environment. Although, transportation is essential in the operation of a market economy, much still needs to be understood about ways in which an efficient transportation system can improve the productivity of the economy as well as the extent of its interconnectedness with other sectors. To make prudent decisions, policy makers must be equipped with the best information and analysis possible about the interactions among these various factors.

METHODOLOGY

This study explored the interdependencies within the transportation sectors and other sectors of the economy. In a specific term, Leontief matrix, formulated in 1951 by Wassily Leontief,

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from an input out table (Nigeria input-output table for 2011) was computed and the measures of forward and backward linkages for the transportation sectors and other sectors were computed from it.

Backward linkage refers to the extent to which a sector depends on the other sector for input use in its production. A sector backward linkage can be influenced by the quantum of its value added, for instance, the lower the value added of a sector as a share of its output, the higher the proportion of the intermediate inputs used in its production process. This implied that the higher the proportion of the intermediate inputs sourced domestically, the higher the degree of backward integration for the sector. It represent the extent to which a unit increase in net final demand for a sector's output affects the production activities of sectors that supply inputs to the sector that increases its output to meet up with the increase in net final demand. Backward linkage is often called the output multiplier.

Forward linkage of a sector refers to the extent that other sectors of the economy depend on the sector for their intermediate input. In a layman parlance, it represents the extent to which other sectors depend on a sector for the supply of the intermediate inputs that will be required in their production. When a sector increases its output, which is used as input in other sectors, the impact it has on the other sectors' output is described as the sector's forward linkage. Forward linkage is also referred to as input multiplier as it gives the impact of a unit change/increase in the input supplied by a sector on the economy.

An input-output table is a symmetric table that shows the flows of income between consumer and producers. It also presents the distribution of output of every sector across all other sectors in the economy and the sector itself as well across various economic agents (government, households, investors and rest of the world).

The hinge of input-output table is the inter-industry transactions table that mirror the sort of production relationships that subsists in the economy. The input-output model that uses the data contained in the table is characterised as an equilibrium cohort of model and therefore, the data are expressed in terms of identities, behavioural assumptions and equilibrium conditions (see Schaffer, 1999). The sets of identities that can be derived from an input-output table are stated in equation (1) and equation (2) given as:

$$B_i = \sum_j b_{ij} + Z_i \quad \text{..... (1)}$$

$$T_j = \sum_i b_{ji} + n_j + m_j \quad \text{..... (2)}$$

Where B_i stands for total supply by sector *I*, which has as its components supplies (b_{ij}) to sectors *js* and supplies (Z_i) to final demanders (government, households, investors and rest of the world). T_j is demand for inputs by sector *j* and it is made up of purchases of output of other sectors (*is)*, value-added inputs (n_j) (comprising labour, capital and others) and non-competitive intermediate imports (m_j). The equilibrium is anchored on the assumption that over a long period it is neither rational nor economical/profitable to supply more than is used/needed and inconceivable to consume more units produced. Therefore, in every sector, the following equilibrium condition is expected to hold:

$$B_i = T_j \quad \text{.....3}$$

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Equation (3) implies that the each column's total equals the corresponding row total.

The behavioural assumption is captured in equation (4) given as:

$$a_{ij} = \frac{b_{ij}}{T_j} \quad \text{.....4}$$

a_{ij} in equation (4) are the technical coefficient that represents every input (which is another sector's output *i*) used as a proportion of the value of each sector's output or entire inputs (outputs of other sectors, factors of production and non-competitive imports). Equation (1) to equation (4) described the central characteristics of input-output data that form the core of input-output modelling. To compute for the sectorial linkages, there is need to substitute for b_{ij} in equation (1) and arrive at the expression given in equation (5) below:

$$B_i = \sum_j a_{ij} B_j + Z_i \quad \text{.....(5)}$$

If **A** stands for the matrix of a_{ij} and z represents the column vector z_i equation (5) can be expressed in matrix form as:

$$B = (I - A)^{-1} z \quad \text{.....(6)}$$

The expression $(I-A)^{-1}$ in equation (6) is referred to as the Leontief inverse matrix, which is central to the input-output model. The matrix can be used to determine the backward and forward linkages.

The computation of backward linkage is quite straight forward as it is the sum of the elements in the sector's column in the core matrix of the input-output model. The sum of the elements in the row of a sector in the core matrix gives the forward linkage of the sector. The backward linkage is also described as output effect of a unit change in the net final demand for a sector's output. The interpretation of either the backward or forward linkage is made in relation to unity following the normalisation rule proposed by Rasmussen (1956). When a sector's backward linkage is higher than unity, it means the sector has an above average dependency on other sectors (domestic) for its input requirements and such a sector is deemed to be backward-oriented and a key sector of the economy. In case a sector's forward linkage is higher than unity, it implies that domestic sectors have an above average dependency on the sector concerned and is therefore considered to be forward-oriented and a key sector In fact, Hirschman (1958) observes that backward linkages lead to a new set of investment in input-supplying entities while forward linkages spur investment in output-using firms/sectors.

The data used for the analysis is derived from Nigeria's input-output (I-O) tables for the year 2011. The key focus of the study is to evaluate the backward and forward linkages of the transportation sectors in Nigeria. The I-O table of 2011 has 33 sectors, but for the purpose of this study, the I-O table is regrouped into 13 sectors, namely Agriculture (Crop Production,

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Livestock, Forestry and Fishing), Industry (Crude Petroleum and Natural Gas, Coal Mining, Metal Ores, Quarrying and Mining, Cement, Other Manufacturing), Premium Motor Spirit, Dual Purpose Kerosene, Automotive Gas Oil, Utilities (Electricity and Water), Road Transport, Rail Transport & Pipelines, Water Transport, Air Transport, Transport Services, Communication (Telecommunication and Post) and Other Services (Hotel and Restaurant, Financial Institutions, Insurance, Real Estate, Business Services, Public Administration, Education, Health, Private non-Profit Organizations, Other Services and Broadcasting). Out of the 13 sectors, 5 are for transportation and the forward and backward linkages of them as well as of the other 8 sectors are computed and reported in this study. Data preparation and computation of indices is carried out using excel spread sheet and General Algebraic Modelling System (GAMS).

ANALYSIS AND DISCUSSION OF THE RESULTS

Presented in this section are the results of the estimation of the backward and forward linkage indices for the transportation sectors, namely, road transport sector, rail transport and pipelines sector, water transport and other transport services. Also the backward and forward linkages indices for other sectors of the economy are also presented. The transportation forward linkage measures the relative importance of the transport sector as supplier to the other (non-transport) sectors in the economy and the backward linkage measures its relative importance as demander from other sectors.

The results of the forward and backward linkages in Nigeria are presented in Table 1. Out of the five transportation sectors considered in this study, road transport sector has the highest forward linkage (1.638). This implies that road transport sector is forward-oriented and it is very important in Nigeria as its index is above one. Other transportation sectors cannot be said be forward-oriented has their coefficient indices are very low, they are below one. For instance, the index of air transport sector is 0.0422, while that of water transport was 0.0242. Those of transport services and rail transport and pipelines are 0.0166 and 0.0039, respectively. The results clearly showed that out of the transportation sectors in Nigeria, only road transport sector stand out with respect to the supply of domestically produced output to the domestic sectors. This can be attributed to the extent of the governmental involvement in constructing and repairing the road networks aside the role the sector place in facilitating the other economic activities.

On the whole, the industry sector has the highest forward linkage index (4.0774) in Nigeria, while other services sector is in the second position (3.2231). Road transportation is in the third position. Although, the agriculture and the premium motor spirit sector have low forward-orientation, 0.2383 and 0.2379, respectively, their importance in the Nigerian economy cannot be under stressed. On likely explanation for the low forward linkages observed in some sectors in 2011 could be due to the fact that there may be some unexploited market opportunities in Nigeria, which the sectors are yet to tap into due to unfavourable trade conditions in terms of low competitiveness, lack of demand, and perhaps unfavourable investment policy environment.

The degree of backward linkages in the transportation sectors in Nigeria ranged between 0.9805 and 0.9986. Road transport sector backward linkage is 0.9931, rail transport and

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pipelines is 0.9805, water transport is 0.9969 and transport services is 0.9986. This means that each of the transportation sectors has approximately average dependency on other domestic sectors for their input requirements and each of them can be deemed to be backward- oriented and key to the Nigerian economy.

Table 1: Indices of Forward and Backward Linkages in Nigeria: 2011

Sectors	Forward Linkage	Backward Linkage
Agriculture	0.2383	0.9945
Industry	4.0774	0.9918
Premium Motor Spirit	0.2379	0.9686
Dual Purpose Kerosene	0.0354	0.9580
Automotive Gas Oil	0.0438	0.9778
Utilities	0.0196	0.9937
Road Transport	**1.6380**	**0.9931**
Rail Transport & Pipelines	**0.0039**	**0.9805**
Water Transport	**0.0242**	**0.9969**
Air transport	**0.0422**	**0.9828**
Transport Services	**0.0166**	**0.9986**
Communication	0.0526	0.9676
Other Services	3.2231	0.9894

Source: Calculated from Nigeria 2011 input-output table

Similarly, other sectors considered in this analysis have approximately average dependency on the other domestic sector for their input requirements. The indices ranged between 0.9580 and 0.9945, both for dual purpose kerosene and agriculture sectors, respectively. For instance, the index of backward linkage for agriculture sector is 0.9945, while that of industry is 0.9918. The indices of communication and other services are 0.9676 and 0.9894, while that of automotive gas oil and utilities are 0.9778 and 0.9937, respectively.

CONCLUSION

This study examined the role of transport system in economic growth and development in Nigeria. Specifically, the study considered the extent of backward and forward integration of transportation sectors in Nigeria. Road transport was found to be forward and backward oriented, while rail transport & pipelines, water transport, air transport and transport services were found to be backward-oriented. There is therefore need for government to resuscitate the sector through investment in transportation infrastructure, especially in the transportation sector that do not have high forward orientation like rail transport & pipelines, water transport, air transport and transport services.

One of the problems that restrain the foreign investment in the transportation sector in Nigeria is decaying infrastructure. To revamp the transportation sector in Nigeria, there is need to involvement the private sector in the development of the sector. Although government has tried concessions, leasing, privatisations as well as partnerships between operators and government to speed up the needed growth in the transportation sectors, more efforts on government side are required. According to the Central Bank of Nigeria estimates,

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the repair and develop of the transportation sector infrastructure will take up to $510-billion over 15 years. Aside the direct investment that government need to make in the sectors, government should intensify her effort to re-awaken the interest of the private sector in the transportation sector, especially, air transport, rail transport and pipeline, water transport and transport services, by creating enabling economic and political environment that will facilitate the involvement of the private sector in salvaging the transportation sectors, especially, those with low forward linkages.

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