Knowledge-Based Economy (KBE), Innovations, Road Connectivity and Population Growth in Sub-Saharan Countries: A Conceptual Approach

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Abstract
For doing business in Sub-Saharan Africa, implications to firm are performance, and constraints to mobility of the population to socioeconomic activities. The main aim of this paper is to highlight the importance of research (knowledge-based) backed by public policies in investments and effective institutional management that enhances efficiency of road transport in Sub-Saharan Africa. Facilitating this may require the coordination of a network of systems that will evaluate productivity of physical capital and labour productivity that take into cognizance the importance of knowledge as productive input-output in bringing about innovations in transport infrastructure. This is important in evolving transport policies that serve as a springboard for the growth of trade and movement of people and goods in the region, with high movements resulting from various conditions in the region-draughts, crisis, border trade, and various travel constraints resulting from varying geographical terrains. Reversing the inhibitions in the growth of productive sector as result of low infrastructure investment in transport sector, may require research and innovations in the transpiration system. This study highlights various literature and policies that could bring about changes thereby facilitating growth in Sub Saharan Africa.

Citation:

1. Introduction

Technical progress promotes/generates increase in productivity in accordance with a stochastic process (Papoulis, 1991); it depends on investment in technology and the technological opportunities of the sector. Stochastic process here means directions in which the process may evolve takes various forms – either a specific aspect or trends which tends to introduce innovations in a particular process, road networking for instance or the study of soil and environment types, road links to communities (some of which may have difficult terrain) and other aspects that bring about changes - a random function whose arguments are drawn from a range of continuously changing values. Changing values in road transport carters for changing demographic trends, and growing population in Nigeria that place demand for new connectivity and the growing need for quality of road projects. Demands for new roads sometimes brings about violent demands where communities argued that such projects are ‘dividends of democracy’, that projects is the rights of the communities, they argue. This is a frequent occurrence in different regions in Nigeria – either the oil producing blocs or other mineral producing states in Nigeria and in fact in most of Africa.

Current problems on Nigerian roads are regulating vehicle weights and dimensions to promote safety and infrastructure protection, forms bulk of road-related transport issues
enabling partners, who are experts in
cross-
gion, and the desire for visible
requirements for growth.

Posited that
improvements in technology
is a necessary condition for growth. In developing
countries, must firms
have technical partners, who are experts in
sophisticated installation and usage, are
supposed to teach local workers the ‘how tos’?

Even though there may be teaching sessions,
local staff gains such knowledge through the
spill over (observation) from the technical
expertise from experts. In Nigeria, such
situation (technical partners) exists in Cement
companies and oil installations.

Innovation (resulting from research) is
important in Nigeria and the sub-Saharan
Africa due to changing demographic trends in
the region, and the desire for visible
development of the region brings about rapid
changes. Sub-Saharan Africa is more densely
populated on average than Latin America and
although two-thirds of its population still live in
rural areas, massive migration to the towns
and cities is high (Adésià, 2009). The
phenomenon of population growth; a 2.2 per
cent rate according to United Nations Fund for
Population Activities (UNFPA, 2011) and the
expansion of human settlements expand the
need for transport infrastructure challenges in
sub-Saharan Africa. Briceño-Garmendia
(2010) stated that there are several constraints
to development efforts in Africa, the need to
carter for the expanding population which is
large and living below the poverty line, fiscal
constraints (public expenditure) placed a limit
to investment in infrastructure due to large
debt burden and the fact that most countries in
the sub-Saharan Africa depend on aid to grow.

The growing population of migrants has
created high traffic of people around the sub-
Saharan Africa. Main challenges in transport
infrastructure are effective maintenance of
infrastructures which affects travel time, and
accessibility concerns. These aspects are
important in mobility improvements, and affect
the processes of moving goods and services
across national boundaries. It has also has
implications on regional trade. To date, few
trade facilitation initiatives have successfully
addressed these challenges. Improving border
posts and customs procedures will not only
reduce the cost and delays and both demand-
side and supply-side constraints which is other
side of the coin.
The objectives of this paper is to assess the importance of research in transport infrastructure, which is vital in introducing innovations capable of remedying the need for mobility in the sub-Saharan Africa, meeting the goals of global development strategy - the Millennium development goals (MDGs) and facilitating commerce in the sub-Saharan Africa.

The rest of this paper is structured into section 2 the review of literature, which examines conceptual issues, productivity of capital, role of research (KBE) in transport research, Section 3 is the methodology, which is mainly critical review of literature, section 4 is the conclusion.

2. Literature Review

Large body of literature have argued that infrastructure stock plays a crucial role in promoting socio-economic development, especially in developing countries since the seminal work by Aschauer (1989). Main concerns for efficient transport infrastructure system growth is the introduction of standards and modern techniques propelled by research capable to a steady reduction in transport costs and increase in accessibility, modal travel needs which can be categorised as an agent for increasing firm performance and a growth in mobility overtime.

Better roads provide effective commerce for better markets, the flow of goods and services and social development for majority of African will bring about desired growth rate (IRF, 2008). This is also the agenda of countries of the sub-Saharan countries that struggles with economies burdened with heavy debts, high dependence of aid and low trade regimes. The actualization of this depended to a large extent on increase public spending on infrastructure (which incorporates planning and research) to provide the needed transportation links (based on changing landscapes in road transport logistics) points to the need for sustainability, entrepreneurship growth and a greater economic performance of the economies of Sub-Saharan. Addision and Anand (2012) noted that infrastructure is a paramount importance in Africa because the region is characterised by large and longstanding infrastructure deficiencies. This according most literature inhibits economic growth, regional integration and poverty reduction. Infrastructure in most of Africa still depends on the colonial roads which are not adequate for a wider access, especially in some remote parts of Africa where agricultural activities takes place.

2.1 Conceptual Framework

Innovation strategies according to (Cowan et al, 2000), is a set of policy actions to raise the quantity and efficiency of innovative activities, and innovative activities refers to the creation, adaptation and adoption of new or improved products processes or services. Such innovations are backed by the education. It can be achieved by endogenous technical change or exogenous technical change. The main driving force is growth of the economy. Solo’s work was limited because of assumptions concerning the production that has constant returns to scale-basically of the two arguments, capital and the effective labour, which is knowledge, for instance, the production function is of the form, \( Y(t) = F(K(t), A(t)L(t)) \), where \( Y \) = output, \( K \) = capital and \( L \) = labour and \( t \) = time (but notice that time is not included into the function directly) combined to produce output, thus technological change occurs only if the amount of knowledge increases, \( AL \) is thus the effective labour. This was the endogenous matrix. The exogenous economists however recognised the so called knowledge spillover. According to Carlino (2001), spillovers facilitate the exchange of ideas, promoting creativity and innovation. That knowledge is exogenous, even though it can be endogenously determined, but spillovers are knowledge sharing, even though this may come with cost elements by the inventor to the firm (the user). Technology must confer benefits that are at least partially excludable, because rivalry is a purely technological attribute. This argument can be seen in most African installations that demands technical partner syndrome at a high cost to the developing countries, even though sometimes called aid, it is tied to conditionalities favourable to donors dictate.

Why are innovations important to road infrastructures in the sub-Saharan Africa? It is important because it is relevant for modelling growth (developing gateways for improving import and exports in the Sub-Saharan region); also that technology is an input to firms. If inputs (roads for instance) are not accessible and inefficient, it has effects on cost of doing business. The Region of sub-Saharan Africa has some of the high cost of transport in the world. According to Teravaninthorn and Raballand (2009), transport prices are high compared to the value of the goods transported and that
transport predictability and reliability were low by international standard.

2.2 Productivity of capital
Productivity is the effectiveness with which factors of production are converted into output (Weil, 2009). In terms of the output of public investment in roads for instance, it is the efficiency of roads in connectivity, accessibility, which includes the carrying capacity and other attributes of roads. Output of other factors is important in achieving the desired output level of expenditure in physical capital investment.

Take for instance a typical production (Cobb-Douglas format) below:

\[ Y = AK^{\alpha}h^{1-\alpha} \]

Where:
- \( Y \): Total output (total stock of roads in a location)
- \( A \): the measure of productivity
- \( K \): Quantity of physical capital
- \( h \): Quantity of human capital per worker

Physical capital and human capital \((K, h)\) are the two factors of production that are used in the production. The characteristics of \( K \) and \( h \), depended on amounts invested, and \( h \) factor if influenced by many factors-levels of education, institutional factors (i.e. the reports of Doing Business 2012 document by IMF) which ranked Nigeria as weak or loose in institutional supervision, could have affected \( h \). issues of corruption, difficult to measure, has affected the output of roads in Nigeria. David Aschauer (1989) assess whether public expenditure was productive, and proved that a positive and significant relationship exists for US. There are various stands of literature on government spending impact on the private sector. Some of this (level of expenditure) may hinge also on the traditional discussion on of fiscal policy centred on public sector deficit and importance to decisions of the fiscal authorities. The equilibrium or neoclassical approach to fiscal policy presents a different analysis on the impacts of fiscal decisions on the private sector. Amongst the views tended is that the impact of decisions on government fiscal policies are irrelevant to private sector productivity or its economic agents. This is in relations to tax and debt finance at a particular time sequence of government spending which has been subjected to various empirical tests. The views of the fiscal trends of government on the private sector may look divergent, but other studies like Aschauer (1987) advances the idea that on neoclassical grounds, expansions of public investment spending should have a larger simulative impact on private output than equal-sized increasing in public consumption expenditure. It is argued that public investments induces an increase in the rate of return to private capital and, thereby stimulate private investment expenditure.

Empirically, core infrastructures consisting of street lights, highways, and airports posses greatest explanatory power for productivity. The levels of such impact depended on the environment and institutional structures as contested by O’Fallon (2004), who are argued that the degree of impact in the findings of Aschauer (1989) seem to be higher based on the arguments of Banister and Berechman (2001; 2003). It means empirical results does not show its effects, cannot be seen to measure the causal relationship between government spending and productivity at a particular time. The results may show the extent of such relationship according to the findings the study group.

2.3 Knowledge-Based Economy (KBE) and Developments in Road Transport Research.
The knowledge–based economy creates an environment where policy is focused on the dynamics of the economy based on research and knowledge spill-over which may be exogenous to the traditional Solow’s model. Figure 1 gives an overview of the KBE.

![Figure 1: Knowledge-based Economy Model. (Sources: http://www.alphade.com, 2007)](http://www.alphade.com)
Figure 1 shows factors of production within an economy – with enterprise on the control post. Knowledge relates between factors of production. Knowledge exists as the fifth factor. Human factors use knowledge from different sources to increase the value of other factors. Knowledge brings about innovations which are relevant in the industrial sector and policy making. According to (Silverberg 1994), knowledge is an input in the production of other goods. The basis here may be different but the idea is that knowledge brings about change or an improvement to bring about increase output or in case of transport system, improve speed, accessibility and security. In a typical developing economy like Nigeria, it is the used of substantial body of research which is the basis for a production–led economic growth (Lawrey, 2012). The importance of this is an examination of historical review of road construction and its importance in contemporary (Porter, 2012). Nigeria’s situation of increase in population, opening up of business outlets across the region and the increase attractions in markets in Nigeria - China and other ‘intruders’. Other important implications of this is the view of (Oyelaran-Oyeyinka and Sampath 2010) for a Nigerian case which have set up such knowledge based collaboration with some institutions in Nigeria. According to empirical results based on 2005 survey in mostly agriculture have benefited and improved agricultural output. But there has not been any studies related to improvements in road constructions.

The important aspects of innovations in road transport in Nigeria concerns increase modes to lessen the concepts of Urban sprawl, roads networks, which at the moment can be seen in cities (Brueckner, 2000). But even in cities, the need for high speeds, Asphalt management and research, most importantly is the porous asphalts that results to soil related problems research which cause regular cracks (Pais, 2002). (World Bank 2012) stated that to handle 7 Million vehicles operating on Nigerian roads and the increase traffics on Nigerian roads, seems to be difficult task for the public ‘policing’ of the roads.

Infrastructure, specifically the road transport infrastructure, is the current focused of African economies but factors for a ‘catch up ’in this sector had impacted on the growth of the economy. In Nigeria, road transport accounts for 90 per cent of all movements of goods and service, this has not met the benchmark due to fiscal problems, research in new road building (Karlaftis, Easa, Jha, and Vlahogianni, 2012).

Transport-based policies had impacted on the cost of doing business in Nigeria. Also that according to the general classification of transport cost - costs can be classified into various groups – transport expenditure, accidents, congestions and environmental costs. Some aspects seems to account more on cost – high accidents for instance, contributes to aspects that account for higher components of cost of doing business.

3. Methods and Methodology

Causes of highways failures and other aspects of the road could be traced to various conditions or stages of roads, this may result from myriad factors that impact on the efficiency of such roads. This study is mainly conceptual paper (a review). Knowledge infrastructure includes the complex supporting institutions, practices, and communities - researchers, libraries, societies, standards, databases, books and other aspects that enhance productivity of roads (Brian Kahin, 2002). Professional institutions, researchers and institutional requirements and standards amongst others, determine the complex structure of road transport.

The place of research and innovation lays a structure that starts with public investments which would determine various connections and various determinations of the importance of labour, which the endogenous theory is the effective labour (argument of labour, \( Y_0 = F(K_0, A_0L_0) \)). The main emphasis that knowledge is an input into planning production stems from various theories that gives rise to many researches on various definitions of a simple production function; \( Y = AF(K, L) \) which is defined the quality of labour, and labour determines the knowhow of production, here education or knowledge is an input. From figure 2, it shows several process and structures illustrating that investment in capital and productivity depends on labour (knowledge) which directly can seen as an input with its varying features – of rivalry and excludability of such input (knowledge). It has already been stated that the attribute of technical knowledge is that it has rivalry, introducing elements of excludability, and cost for use of such technique in production or any activity, developed by a company or individual. But for this to be realised, there must be trainings (education to enhance the quality of labour), for efficiency and standardization of the production process especially in the current competitive global market place. For a good road transport planning and in fact other
types, the role of the Private sector is important in several ways – helps in redistribution of risks, expenditures or investments could be redirected to other areas other than roads. There are many types depending on road policies in various countries. In Nigeria concession is used, managed by the infrastructure Concession regulatory Commission (ICRC) which is operational in developed economies and proves worthy.

Infrastructure dynamics must adopt such innovations (based on research, empowered by education and research) to bring about better access and the efficiency of roads in the sub-Saharan region which characterised by changing demographics and low investments in road infrastructure. There are constant problems associated with the structural designs (Thompson, 1996), stabilization of road structures (Mácsik, 2012). One of the critical concerns of roads in the region are issues relating to bearing capacity of roads due to faulty road projects. This is frequently the case in the sub-Saharan Africa. A report by the Economist (2012) of some roads in Cameroon described the roads as ‘roads to hell’; it is a graphical description of the state of roads in the region.

Methodology of such researches traces the role of research institutions, and institutional policies – for instance in Nigeria, road maintenance and security (defined by road reliability and or safety) are done by Federal road maintenance (FERMA) and Federal Road safety Corp (FRSC) respectively. There are some research institutions in Nigeria, but the the Nigerian Building and Road Research Institute (NBRRI) is a parastatal under the aegis of the Federal Ministry of Science and Technology that has made some studies on Nigerian roads. The NBRRI’s reports has seldom not been implemented, this makes the case for many bad segments on the Nigerian roads, Cameroon, Mali and most countries in the sub-region.
3.1 Impacts of Low investments in Roads planning and Research.

Transport infrastructure improvements reduce effective distances between destinations by reducing congestion (the urban sprawl theory), thereby lowering travel times. Improvements in transport results from innovations, planning and public investment, especially in developed economies where there are advanced logistics and firm productivity are effective. Investment by the private sector may also occur in developing countries, but levels of such investment are still low. Examine levels of researchers in a cross-country analysis on figure 3 – shows Africa performance very low both for 2002 an 2007. It shows the description of how decisions concerning transportation programmes and projects have inhabited levels of growth in Africa.

Figure 3: Comparative Number of Researchers per 1m inhabitants

Sources: Anyanwu, 2012

Figure 4: Regions of Sub-Saharan Africa

Developments in the sub-Saharan Africa has affected the region, taking into cognizance the demographic characteristics and terrain of the region. Sub-Saharan Africa faces serious political, economic and social challenges. With an annual rate of growth of 2.2 per cent, the population is expected to rise from 906 million in 2005 to 1.1 billion in 2010 (UNFPA, 2010). This according to many views was (population growth) responsible to favourable conditions in the 20th century to 21st century. This conditions are open to debates since large literature still see the region as still lagging due to high birth and maternal mortality death rates, also due to the fact that diseases like polio and malaria are still a source of high deaths in the region, while some part of the world are nonexistent. This phenomenon in the population characteristics has resulted into high net migration (emigration and immigration) has been the main concerns for countries around the sub-Saharan regions. Due to these trends in the population and new settlements in towns and cities around the region, has introduced a constraints to available transportation and accessibility concerns. The rise also of the population has brought with it a rise in economic activities which demanded mobility due to increasing urbanization in sub-Saharan Africa – leading to is not so much about urban population growth related problems: unemployment and underemployment in urban areas, poverty, crime, overburdening of social services, sanitation, and water and air pollution.

Large portion of the population in Sub-Saharan Africa live in rural Africa, thus rural roads are important due to the occupational needs for agro-allied activities. Sub-Saharan Africa has approximately 700,000 kilometres of rural roads, with half of them in poor conditions. It is also estimated that of 1.8 million Kilometres of roads, only 284,000 Km (16%) is paved in 2007 in Sub-Saharan Africa (COETZER, 2007). Road densities per km2 are generally much lower than those of Asia or Latin America. Low population densities, low levels of income and weak road planning and maintenance capabilities combine to make Sub-Saharan Africa altogether under-equipped and overburdened in terms of rural road infrastructure. Total needs for rehabilitation of existing roads and for expansion of rural road networks are enormous and have generally not been recognized by planners and policymakers (Teravaninthorn & Raballand., 2009). This increases the need for the region’s transport polices in line with the transportation corridor decision making that has the attributes of connectivity and increasing the scope of trade to expand the frontiers of trade in the region.
Conclusion

Production of knowledge is carried out through R&D and innovations especially at the firm-level. To achieve the goals for an effective transport system, it involves planning, research especially in soil, pavements sustainability, institutional enforcement aimed at achieving a sustainable transport policy. In the developing countries and in the sub-Saharan countries in particular, there are lack of efficient roads, weak telecommunication systems, and power outages which are main obstacles to attracting investment and poverty alleviation, Ashauer, (1989).

Sub-Saharan Africa (SSA) is the region that has been experiencing population explosion, apart from other changing demographics – high influx of immigrants in the region (net immigration) partially caused by desertification in Sahel region (Chad, Niger, Namibia, northern part of Nigeria and other parts), conflicts and or Crisis ridden (arm conflicts) regions of Sub-Saharan Arica. These activities have increased the need for efficient forms of transport. This has increased the need for a sustainable transport policy backed by innovations that are supported by public investments in the region, which at the moment has experienced low investment in the sector (Foster, 2008). This position emerges as a major constraint for doing business and is found to depress firm productivity by around 40 % (Escribano et al., 2008). For most countries, the negative impact of deficient infrastructure is at least as large as that associated with crime, red tape, corruption, and financial market constraints.

The study’s central aim is to highlight (bring to the notice) the case of the region for governments and private participation (PPP) in reversing the inhibitions in the growth of productive sector as result of low infrastructure investment. It is important because the growth of SMEs in Africa is a springboard for growth, empowerment for small holders, facilitating border trade that will benefits governments and restore the ancient trans-Saharan trade. Trans Saharan trade has been the bedrock for trade routes in most of Africa up to the 20th century, and for the much needed growth through the development of trade routers and transport corridors (gateways) for connectivity and accessibility in the region.

This study is mainly a review of existing literature on new trends in transport infrastructure systems (even though previous literatures exist as building block for emerging literatures). However, this study points to current trends in transport infrastructure that has inhibited growth in sub-Sahara and the place of modern transport innovations in the global economy. Transport infrastructure research is widely regarded as key components of an efficient, equitable, and sustainable society. This has played a ‘latecomer’ view in Africa, constraint by fiscal and institutional lapses. Future studies on transport economics and the role of research should lay emphasis on specific pilot studies that address individual country-case. However, the limitations of this study addresses regional case which has general implications despite differences in the topography.

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