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Discrete Choice Models and Individual Travel Constraints in Nigeria: A literature review

Gambia Suleiman Purokayo[1*], Soon Jan-Jan[2] and Hussin Abdullah[3]

[1-3] School of Economics, Finance and Banking
Universti Utara, Sintok, Kedah 06010,Malaysia.

ABSTRACT

Travel constraints in contemporary Nigeria have affected all sectors of the economy. This trend had impacted on small traders in terms of higher cost of doing business, and individual travel behavior over time. Insecurity and travel time constraints had affected the growth of the entrepreneurial environment in most cities in Nigeria. In some regions trade and commerce have experienced very low performance. In most of the Northern Eastern states and big commercial centers in Kano, markets and commercial activities have remained closed due to high security alerts.

Aims: To highlight various travel constraints affecting mobility as a result of the growing insecurity on Nigerian roads.
Study design: This study examines some literature on discrete choice and travel-based models..
Place and Duration of Study: Contemporary travel constraints in Nigeria from 2000–2012, and the growing ethno-religious crisis in different parts of the country.
Methodology: Review of literature.
Results/observations: The working of these models is effective where the choice set is not constrained, and the independent irrelevant alternatives (IIA) may not include options/alternatives with a “lesser evil” definitions. This is because it is restrictive for behavioural choice, (utility may be ranked). In advanced market economies, infrastructure has been a springboard for creating and enhancing trade hubs that promotes trade and commerce. A high Infrastructure gap exists in less developed countries as a result of fiscal policy problems, high population and the process of prioritizing development programs by the political machineries.
Conclusion: In a typical developing country like Nigeria – a low middle income country, most literature has been concerned with the lack of productivity of roads:
(i) accessibility, the ability to access safe transport in terms of cost and travel time and (ii) connectivity, to be able connect or link up some volatile routes – in terms of security and other adverse road conditions.

Keywords: Discrete choice models, travel behavior, travel constraints, road infrastructure, insecurity.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

1. INTRODUCTION

Modelling travel decisions is an integral part of demand analysis. There are various methods/models of measuring consumer behaviour in different economic and non-economic activities. The modelling process involves desegregation of individual travel behaviour. It is important to measure individuals or household, because the choice or decision is individualistic - all aimed at utility maximization. According to Ben-Akiva [1], models that involve discrete choice are also referred to as disaggregate models, meaning that the decision-maker is assumed to be an individual. The importance of this is to be able discover what set of criteria is used by individuals in choosing from alternatives or from the choice set. Luce [2], also opined that probabilistic choice models have roots in a microeconomic model (consumer behavior) in which the decision maker exhibits rational decision power to reach a desired outcome.

Utility is composed of systematic part and the stochastic component – observed and unobserved (probabilistic). The probability that an individual may choose an alternative j given by explanatory variable x_i, and the characteristics of the individual i are observed. Models with probabilistic decision rules show that in the probability distribution, the assignment of a probability P_x for each outcome $\times$ are equally likely to occur. This supports heterogeneity of human behavior which suggests that the decision rule should include a probabilistic dimension due to the prevalence of uncertainty elements.

Some of the models – the deterministic model for instance, suggest that an individual has perfect knowledge of choices, and Warned [3] opined that a model is deterministic if and only, any two solutions that agree at one time agree at all times. However, due to mutually exclusive nature of events or choices, such events or choices cannot occur at the same time, for instance the choice of a transport mode, a choice between a car or motorbikes (which are preferred means for finding difficult locations in crowded cities in Nigeria) or other choices that explained a socioeconomic phenomenon – employment and unemployment, or for residential mobility which most recently is increasingly becoming a problem in Nigeria due to crisis-prone locations. Take Jos (a town in North-central geopolitical zone in Nigeria), due to the erratic nature of the crisis, the choice for residential mobility is restricted according to ethno-religious lines. Thus all elements in the choice set are important in probability theory, that events *E*1, *E*2, ..., *En* are said to be mutually exclusive if the occurrence of any one of them automatically implies the non-occurrence of the remaining.
Discrete choice models are important tools used in the analysis of choice when the dependent variables take values 0*, 1, 2, ...* e. (Dependent variable takes binary or multiple discrete values The discrete choice model (DCM) had been used as a tool of analysis and prediction of travel decisions and other socioeconomic activities Discrete choice model predicts a decision made by an individual (such as mode or route choice) as a function of many variables [4], that an individual's choice is based on certain probabilistic outcomes. The framework for a discrete choice model can be presented with a set of general assumptions. In a typical discrete choice model, assumptions about the individual making the decision given an array of alternatives or options available is made, the attributes defining benefits and cost is taken into consideration, and actions taken by the decision maker which are referred to as the decision rule.

Utility theories are based on the assumption that individuals maximize their utility. This means that the individual gives each destination a utility value for travel decisions, and that the likelihood of an individual choosing a particular destination depends on the utility of that choice compared to the utility of all choices. In microeconomics, utility maximization is where the marginal utility per Naira (**N**) spent is the same for each of the goods. Shown as:

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

$$\frac{\Delta x}{\Delta y} = -\frac{MU_x}{MU_y} = -\frac{p_x}{p_y} => \frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

Given various transport types (modes), an individual or corporate individuals will maximize their utility where =

$$\frac{MU_{m1}}{p_{n\,1}} = \frac{MU_{m2}}{P_{n\,2}}$$, where m1 = routes throughout trunk A and

m2 = routes through trunk B. The MU = marginal utility and P is the transport price.

m1= transport through trunk A road and m2= trunk B road, and MU is marginal Utility, while P is the transport price. In Nigeria, roads are classified into three, trunk A roads are federal roads, trunk B roads are state roads, while trunk C roads are local government roads. There is 34,340.95 km of roads – these roads are a Federal Highway Network in the Six Geopolitical Zones of Nigeria [5]. Roads are paved and unpaved, and dictate preference of individuals in road transport choice..

Nigeria has significant infrastructure challenges. Challenges range from the growing gap in infrastructure stock, especially road networks for a growing population (between 2 – 2.3% per annum growth rate), the growth of new communities and residential segregation resulting current ethno-religious crisis. Low investment in infrastructure (see figure 2) has been a strong case for Nigeria's inefficient productivity of roads, for both new road projects and the maintenance of existing roads. There are endemic budget deficits and lack of efficient management of large infrastructures of the public sector finances, political priorities in planning and executions of efficient infrastructure projects (in terms of the engineering work). Thus large number literature has strong views that Nigerian roads are not properly built [6] materials [7], engineering [8], institutional policies. The poor state of road infrastructure has had implications on the cost of operating vehicles. According to FERMA[1], car owners spend N219, 500 (about $1,464) for every 10,000 kilometers of road used. The implications of this are the resulting high cost of transactions in Nigeria. The state of the roads has resulted in travel constraints in terms of travel time, cost, travel mode choice, and especially the Northern Nigeria case that depends on transport vital supplies (goods) from major ports in the southern part of Nigeria.

Accessibility in most Nigerian roads, including large rural populace that supply 60 percent of agro-allied goods, suffer most in need of accessibility to reach desired economic activities which affect their socioeconomic life. A measure that is often used is determining accessibility in a transportation analysis zone is:

$$\text{Accessibility}\, y_i = \sum_j Opportunities_j x f(C_{ij})$$

Where :

I=index of origin zones

j=index of destination zones

[1] Federal Road Maintenance Agency, a government body charged with road maintenance.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

$f(C_{ij}) = function$ of generalized travel cost (so that nearer or less expensive places are weighted more than farther or more expensive places).

Accessibility has several definitions in the context of the individual travel decisions in Nigeria. Urban Nigerians seem to be concerned about security on the roads, because availability and cost seem to be fairly overcome. In rural Nigeria, issues of availability and cost must be taken into consideration in the travel function. The choice may be based on "lesser evil". Security is highest in the choice of any decision. Take the contemporary Nigerian situation where some locations in Northern Nigeria cannot be accessed due to current security alarms. Travel is a constraint.

Although accessibility-enhancing strategies expand the range of choice for individuals and increase the possibility of connectivity, they do not ensure that individuals will actually choose some modes or a road network due to several travel needs and costs [9]. Accessibility have many components - connection, movement, cost, time, and comfort. Mobility is sometimes defined to have the same meaning with accessibility. Mobility according to Picket et al [10] is the quality or state of being mobile and "mobile" as "capable of moving or of being moved readily from place to place". This is important because it guides an individual into making a choice given that *U* is utility is:

$$P_{ij} = P_r[U_{ij} > U_{ij'}] \quad \forall_{j'} \neq j$$

The probability *Pij* of individual *i* choosing from product *j or* a set of products, and making comparisons between (U_{ij}, and U_{ij}'). However, the response probability depends not only on the utility differences Uij and Uij', but also on the random utility difference portrayed by other decisions not observed across the population. Take for instance, the product is a transport mode (deciding a type of transport) or types of vehicles available, while the probability of choosing a car is: P {car, bus, and bicycle} (car) = P {car, bus, bicycle} ({car, bus}) P {car, bus} (car) going from various types of vehicles to finally a car. This is the Luce model. The model is important in dealing with uncertainty. Instead of identifying one alternative as the chosen option, it assigns to each option an alternative, a probability to be chosen [11].

The objective of this study is to highlight the many sided travel constraints and its effects on the travel decision of individuals, especially small traders and other groups that daily needs to make travel decisions – how it affects the cost of doing business in Nigeria. The rest of this paper is structured as follows: Section 2 is the survey of literature on some travel-based models, Section 3, selected policies, public programs, and effects on Road transport, Section 4, review of transportation policy and constraints and Section 5, is the conclusion and recommendations.

2. Literature Review

2.1 Random Utility Discrete Choice and Geography of Transport.

Choices are made rationally and depend on a variety of factors and attributes/characteristics. Generally, we cannot measure or predict choices exactly because, a researcher may not be able to observe or measure every characteristic of the individual, product, or the choice situation that affects choice behavior. In a developing country like Nigeria, the choice set for instance may be limited such that the process of estimation may

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

be an uphill task due to an array of 'sub-characteristics' dictated by the characteristics of underdevelopment. For instance transport mode available may be animals (donkey, horse or camels) even in situations that are time bound – transporting a pregnant woman to a hospital 10 kilometers distance. These situations exist especially in Northern Nigeria, especially in the Northeastern and Northwestern geopolitical zones; which are regions that have borders with some countries - Niger, and Chad. However, if we can observe some information about the individual, the product, or the choice situation, we can use available information to help predict choice. In random utility models we presume that the utility u_{ij} provided to individual i by product j is composed of a deterministic component v_{ij}, which can be calculated based on observed characteristics, and a stochastic error component ε_{ij}, which is unobserved, so that:

$$\boldsymbol{U_{ij}} = \boldsymbol{V_{ij}} + \epsilon_{\boldsymbol{ij}}$$

The probability P_{ij} of individual i choosing product j from a choice set is:

$$P_{ij} = Pr\left(U_{ij} > U_{ij'}\right) \; for\ all\ j'is\ not\ equal\ to\ j$$

$$= \Pr\left[U_{ij} + \epsilon_{ij} > \left\{V_{ij'} + \epsilon_{ij'}\right\} for\ all\ j'not\ equal\ to\ j\right.$$

Note that $\mathbf{V_{ij}}$ is the deterministic component and $\epsilon_{\boldsymbol{ij}}$, the unobserved part.

Random utility models take its roots from the rationality of the consumer, a concept used consumer theory in economics - that the decision maker has a perfect discrimination capacity, choosing the best from a set of alternatives. Manski & Lerman [12], identified four different sources of uncertainty: unobserved alternative attributes; unobserved individual characteristics (also known as "unobserved taste variation" in Handbook of transportation science)[2]; measurement errors; and proxy, or instrumental variables. Utility is modelled as a random variable in order to reflect the uncertainty element. In most cases, travel choices are made between a finite number of discrete alternatives that exhibit choices than being probabilistic. Examples of such models are such by Luce [2], and belong to the family of models with probability decision rules.

In probability theory, Luce's choice axiom states that the probability of selecting one item over another from a pool of many items is not affected by the presence or absence of other items in the pool. Selection of this kind is said to have independence from irrelevant alternatives (IIA) - whether A or B is better should not be changed by the availability of X, which is irrelevant to the choice between A and B. In a typical developing country, an individual is constrained to make a choice even if these decisions endangers their health. Consider a choice where the individual has perfect knowledge of a route that could endanger them – the choice of migrants to Europe on the high seas, where most travelers are in danger of death, with few escapes. The decision maker is aware of the dangers. Thus IIA is contentious, it is controversial for two reasons: first, some theorists find it too strict an axiom; second, experiments and others have shown that human behaviour rarely adheres to this axiom , and thus the working of IIA is strict of human rational behaviour [13]. The "elimination

[2] Manski, C. F., & Lerman, S. R. (1977). The estimation of choice probabilities from choice based samples. *Econometrica: Journal of the Econometric Society*, 1977-1988.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

by aspects" approach proposed by Tversky [14], on the other hand, supposes that decision makers follow a particular heuristic (experience-based techniques) during a process of sequential choice. Options are described by their attributes and, at each decision stage, the individuals eliminate all the options not having an expected attribute. The process of 'elimination' continues until only one option remains, which meets the expectations of the decision maker.

Discrete choice models are used in the analysis of choice and takes multiple discrete choice values. In typical binary choice models, decisions are limited to two options, to accept or decline, where *y* – a discrete variable, which equals to 1 if an individual accepts an alternative and 0 if an individual declines. In most developing economies, sometimes decisions are based on the difficult choices, either due to limitation a choice set or the fact that such options are the last resort, but individuals are compelled to make some form of decisions in all circumstances. The disadvantage of the linear probability model (LPM) is that it could, given pr(y = 1| x) that is > 1 or < 0 for some values of x, which does not make much sense, thus LPM is only intended to approximate the true probability for a limited range of x values, and that its constant marginal effects are preferable to those of the binary probit or logit model, which are functions of the values of all elements of x. The LPM will produce predicted probabilities that are too extreme (close to zero or one) even for moderate values of $\times$ $and\ the\ estimated\ \beta$ that stay `in bounds' [15][3]

The multinomial logit (MNL) model is widely used as one of the family of discrete choice models due to its closed-form choice probabilities and its consistency with the random utility maximization (RUM). Multinomial logit models are used to model relationships between a polytomous response variable (>2 discrete outcomes). The model is preferred for this review because we are able to observe an array of options that may exist, especially that there exist many discrete outcomes despite the constraints that exist in Nigeria. Identified constraints are security related, fiscal problems related, which are observed and present in lack of maintenance of roads, and risks associated with some routes around locations in the Northern Nigeria. Some of the vulnerable locations identified are around the Northeast, Plateau, Kaduna, Gombe, Bauchi, Sokoto and some states in Southern Nigeria associated with kidnapping incidences.

Prominent features in different geopolitical zones in Nigeria exhibit varying typologies in the regions. In landlocked areas of Africa have been responsible for much of the preventable occurrences of deaths. Common examples are complications in a pregnancy case, which could have been avoided with access roads. In rural Nigeria, prevalence of deaths as a result of transport accessibility abounds - preventable death [16], mortality [17], access to maternities [18], and, travelled time [19]. Many such studies argue that maternal mortality can be prevented if women access health facilities, but in most cases deaths occur for women and children who live 10 – 15 kilometers from the nearest maternities or health centers. In parts of the Niger-Delta (the oil producing bloc of Nigeria), the South-South zone, travel constraints occur mostly due to numerous creeks and environmental degradation as a result of oil exploration work in various locations. Transport prices are high, thus travels constrained exist apart from the environmental factors. For instance in the past 4-5years, travel restrictions were experienced as a result of Niger-Delta militants 'war' with the

[3] Christopher F Baum, Yingying Dong, Arthur Lewbel, & Yang, T. (2012). A simple alternative to the linear probability model for binary choice models with endogenous regressors. [This presentation is based on the work of Lewbel, Dong & Yang, Comparing features of Convenient Estimators for Binary Choice Models Economics] Working Paper No. 789, *Boston College, Boston College, This presentation is based on the work of Lewbel, Dong & Yang,* 1-82.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

government for increased share of oil wealth, Omofonmwan [20]. In other parts of Northern Nigeria, especially the far North, there are desert conditions and porous border that has impacted on the population of border towns, apart from security threat and growth of underground economies, a thriving forex market exists for various currencies. The CFA (African French currency equivalent) is used as a medium of exchange, and the availability of these currencies in locations has boosted trade in the export of stolen vehicles and many other products. According to Flynn [21], it is like a community of people – various nationalities, security officers, traders all engaged in 'legal' economic activity. Life in the border town has placed a price differential with other part of the country. There are high security threats in Nigerian border towns – with more than 1497 illegal borders [22], mobility is through various terrains. This also hinders free movements. Recently, it has become a battleground for religious insurgents (Boko Haram, al-Quaeda in the magrib etc.), and these crises have spilled from Mali to Nigeria and countries in the subregion.

2.1.1 Building a Multinomial Logit (MNLM): A Hypothetical Case.

We summarize these constraints:

Individual choice may be influenced by risks on some roads,(RI), bad roads may be due to lack of maintenance which may be overcome by use of alternative transports like motorbikes, etc. Travel time may be affected if this is the only link to the location,(TT), landlocked locations (LL), new roads may be gateways to hospitals, capitals of state or local government clinics in case of (epidemics) outbreaks, (Li), bush paths may be used for animal transport and 'short cuts' – bush paths to farms and communities (At).
Due to the size of the choice set, we build a model using the multinomial logit model. The multinomial logit model is applied in modelling relationships between a polytomous response variable and the use of MLE to estimate the product of the probabilities of the chooses alternatives given the conditions of the binary independence (individual preferences, IIA) criterion – l (θ) = (β1.....βj) = $\prod_{i=1}^{n} Pr$ defining the estimators and the vectors of measurements, given that the Pr=probability, with *n* the number of explanatory variables.

The equation of the MNL = $\Pr(y_i = 1|\times_i) = \frac{\exp(\times_i \beta_j)}{1+\sum_{j=1}^{j}\exp(\times_i \beta_j} \quad for\ j > 1$ .....(1)

The logit model is a log ratio of the probability of choosing a mode to the probability of not choosing other options. $y_{i=}$random variable that indicates the choice made, $\times_i$=vector of characteristics to the jth individual, while β_j =vector of coefficient.
To show the case of the conditions for choice available to individuals in a typical Nigerian scenario j 1.2.3.4.5. made up of the choice set – alternatives that the individual can choose given various characteristics or features of each. Some of the options are absolute, meaning that the choice set of individual may just be one alternative, but generally, a typical Nigerian may be faced with choice sets that has these elements (Ri, TT, LL, Li, At) :

i. Ri =Risks on particular roads
ii. TT= Bad roads due to lack of maintenance and affects travel time
iii. LL= land locked locations
iv. Li= new roads that may be gateways provided through public investment.
v. At= Bush paths – 'short cut' to farms and to other communities.

From equation 1, we build a model for the 5 explanatory variables or choice set.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

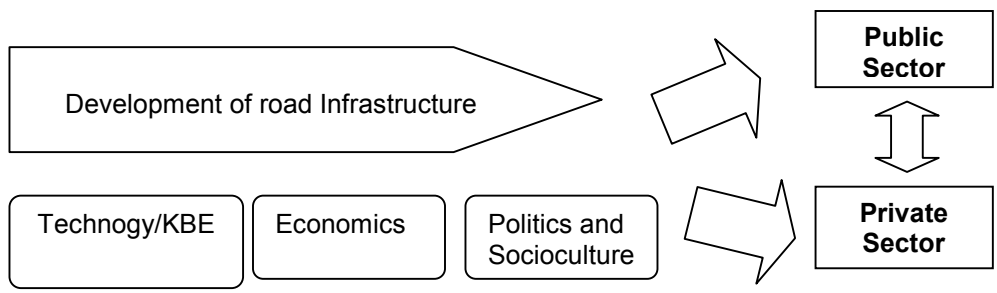
$$P_r(y = j | \times_i) = \frac{\exp\left(\beta'_j \times_i\right)}{\sum_{j=1}^{j} \exp\left(\beta'_j \times_i\right)}$$

$$= \frac{Exp\,(\beta_{,0j} + \beta_{,1j} \times_{j1} + \beta_{,2j} \times_{i2} + \beta_{,3,j} \times_{i3} + \beta_{4,j} \times_{i4} + \beta_{,5j} \times_{i5})}{\sum_{j=1}^{5} \exp\,(\beta_{,0j} + \beta_{,1j} \times_{j1} + \beta_{,2j} \times_{i2} + \beta_{,3,j} \times_{i3} + \beta_{4,j} \times_{i4} + \beta_{,5j} \times_{i5})}$$

The multinomial logit model shows each response probabilities with k=5 (once an individual knows the probabilities for j=1, 2,3,4,5). Note that the choice of an individual is motivated by cost elements and desired to travel (to reach a destination) but the constraints are placed by these factors. These constraints in contemporary Nigeria are the security threats associated with ethno-religious threat in various regions. Marginal effects may result by examining changes in either a restoration of peace in Nigeria and better investment to attain Vision 2020, which affirmed that 90% of movements (people and goods) in Nigeria are by road transport. This statement is applicable and important to attaining the Millennium Development Goals. Efficient infrastructure results in economic growth (infrastructure–led growth theories) and results in a reduction in income inequality (encourages commerce and entrepreneurships) as observed by Nietto-Parra [23].

The development of an efficient infrastructure system must result from: (i) Level of technology - resulting from a knowledge-based economy (KBE), (ii). Level of economic activity – since transport infrastructure is an important input in the production function, and follows the derived demand concept, (iii). Politics and the Socioculture - the driving force of the political machinery in the realization of the development goals of the economy, and the prioritization of development plans, shown in the figure 1.

Figure 1



Public–Private-Partnership (PPP) is an important medium for infrastructure provision in most advanced economies. In Nigeria PPP has not been fully operational even with the establishment of the Infrastructure Concession Regulatory Commission (ICRC) in 2005. Some of the factors limiting its operations are various aspects that inhibit the development of an entrepreneurial environment (multiple tax policies from state and federal government for instance), various government empowerment programs, institutional/bureaucratic bottlenecks, and endemic level of corruption in government establishments.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

3. Selected Policies, Public Programs, and Effects on Road Transport

3.1 Public Investment

Better roads provide the only scope for better access to markets, education, health care and social development for the majority of Africans [24]. This is also the agenda of the National Economic Empowerment and Developments (NEEDs), Vision 2020 etc. The actualization of these programs depended to a large extent on increase public spending on infrastructure. Fiscal policy and public investment in infrastructure is built around a public finance theory that studies government's role in the provision of goods and services. Large volume of literature discusses or examines increasing government spending on varying determinants that affect trends in public expenditures. Even though many such literatures examine the effects of Wagner's law which states that, "as the economy develops over time, the activities and function of the of government increases". The development agenda of government in developing countries still depends to a large extent on public finance, thus it follows Wagner's treatise. However, as examine by researchers, it does not show a causal relationship when GDP growth is examined with public expenditure levels, as in Fernandes [25], meaning that Wagner's laws did not actually measure that growth spurs public spending over time, rather, it merely recognizes a positive statistical association between those two variables. There are evidences that a government budget deficit, which has always been reflected in Nigeria's extra budgetary allocation, gives rise to adverse growth effects as opined by Bose [26], and this has been responsible for the low rate of investment in transport related infrastructure over the years. The stock of roads in Nigeria is a case in point, especially rural roads which provide the bulk of the population in rural Nigeria. Lack of accessible roads has impacted on agricultural productivity and access to markets for agricultural goods according to Fakayode [27].

Public investment in road building or other infrastructures seems not to keep pace with the growth of the economies in the Sub-Saharan region. According to Estache [28], financial crisis created infrastructure gaps. Gaps resulted in high transport cost (for various transport needs), high costs of production, low quality output and other factors that inhibits growth of the economy over time [29]. Most large investments in infrastructure were made to reduce high cost of transportation (accessing landlocked area, or barriers like a bridge). Thus the place of infrastructure is significant for growth according to the World Development Report [30]. Recent concerns have been raised for bulk or large means for moving goods, the Nigerian railways for instance has a sub-optimally function below its actual capacity compared to the early parts of Nigerian independence to 1960s. The modal share between the Nigerian railways and others road transport has dropped in terms of performance Adesanya [31],modal share, Osuji [32].

3.2 Quality of infrastructure

Quality of infrastructure affects various aspects of the transport system. Quality of infrastructure affects the time dimension of travel time, and the travel time affects monetary outlays – the cost dimensions. If delivery time is uncertain, it affects total transaction costs. The more uncertain is delivery time, the more inventories are needed as a buffer stock if demand fluctuations are unrelated to fluctuations in delivery time. Inventories are expensive both because they bind up capital and the value of the stored goods may depreciate over time. In fact inventory valuation process in a typical accounting concepts depends on the time dimension. Measuring quality of infrastructure focuses on the country's ability to enhance the movement of both people and merchandise. Quality of infrastructure can be a proxy of costs because the researcher considers movements of goods either across the borders or within the country to determine its value. According to De [33], the more uncertain

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

is delivery time, the more inventories are needed to guards against inventory levels, which in time is important to prevent 'out of stock' syndrome. To assess the impact of transport infrastructure on trade between countries within sub-Saharan region, an index II, - Infrastructure Index is constructed. The Infrastructure index (II) is designed to measure the cost of travel across a country. The II examines land distance to determine the cost of going through a given infrastructure, say the length in kilometres, transport prices, and measures the relative distances considering a set of observations. Such features may commonly be referred to as geography of the transport, and other barriers like the customs checks and immigration requirements

Initial use of II, an index of a country's infrastructure stocks was used to determined (nine variables), using Principal component Analysis (PCA). The PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possible correlated variables into a set of values of linear uncorrelated variables called principal components.

$$II_{ij} = \Sigma W_{kj} X_{kij}$$ [4]

Where II_{ij} is an infrastructure development index of the i-th country in j-th time, W_{kj} is the weight of the k-th facility in j-th time, and X_{kij} = unit free value of the k-th facility for the i-th country in j-th time point. Large volumes of studies looked at the relationship between trade and infrastructure have found a positive and significant impact of the quality of infrastructure of trade such as Clarke [34], Wilson [35], and Limao [36]. For example, Clark[34] estimated that if a country like Peru or Turkey improved sea port efficiency to the level similar to Iceland or Australia, it would be able to increase trade by roughly 25 percent. However, these studies have focused either on an overall measure of infrastructure quality or on maritime transportation infrastructure. In the current study, the main concern of infrastructure is to facilitate mobility, its productivity using the road access as a determinant. Accessibility defines cost, which sometimes results into inequality for low income group in less developed countries. The implications for low income rural dwellers for instance in Nigeria results into preventable death as stated earlier in this paper.

4. Review of transportation policy and constraints.

The activity-based approach to travel demand analysis view travel as a derived demand; resulting from the need to pursue activities distributed in space (see Jones *et al*., 1990). Derived demand concept establishes an indirect relationship – movements resulting from economic activity as opined by Mokhtarian [37]. Travel constraints refers to problems that result from specific travel activity over time. Most measurements in travel behavior are probabilistic, assigns a probability to each of the possible outcomes of a random experiment. It revolves around the availability (from a choice set) of transport mode or other aspects like accessibility and connectivity. Accessibility defines cost and duration (time), connectivity is used here to mean the ability to link up another access road or a schedule transport time

According to Awoyemi [38], Nigeria has experienced many of public transportation programs; at least last 20 years there has been increased usage of public transport. The growth in public transport was a result: (i). population growth, (ii).state creation that has introduced movements to some cities and evolution of some towns into 'semi urban cities', (iii) rise in public demand for 'democracy dividends' especially in mobility (mass transit buses) around the towns for various needs, (iv). Vision 2020 philosophy of government,

[4] as used by De, P. (2006) in "empirical estimated of trade costs for Asia" (see references)

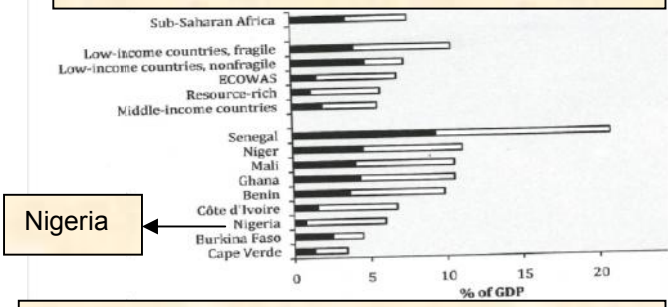
*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

which has evolved from the NEEDs program, emphasizing the need and importance of the transport sector and the need to provide government assisted transportation program. It has also evolved as a tool for empowering the private sector through the provision of funds for acquiring buses. These factors have been responsible for the growth of mass transit programs in Nigeria. However, there was a decline in personal mobility caused by scarcity of foreign exchange and severe import restrictions as with the case of mass transit funding Filani [39]. Lack of sustenance of government program of assistance affected most transport providers – thus an old fleet of transport on Nigeria roads accounts for this phenomenon. The re-structuring program of the Federal government with considerable investment in the bus fleet size had introduced the need for a higher degree of mobility, since the transport policy of government points to the fact that about 90% of the travel needs of the people are met by road public transport [40].

The safety and convenience of Nigerian public transport, coupled with bad roads, due to neglects in maintenance and investment in rural roads especially, have been bottlenecks in the realization of the cardinal points of Nigeria's transport policy. Factors that have dictated travel behavior in Nigeria are:

(1). The level of public investment is low compared to other regions in the Sub Saharan region (see figure 2).

Figure 2 Nigeria's expenditure spending on Infrastructure



Source: Foster & Bricenrio-Germendia, 2009.

[41]

We already explained that public expenditure spending in these countries has the highest prevalence of corruption.

(2). High risks on the roads – arm robbery, road conditions etc.
(3). Maintenance of public transit and general maintenance of fleet on Nigerian roads.
(4). Poverty, especially in the rural sectors of Nigeria, that defines accessibility and,
(5). Armed conflicts/ethno-religious environment in most of Northern Nigeria.

5. Conclusion.

Discrete choice models (DCM) are vital tools for assessing different models of travel behaviour over the years. These models are also referred to as disaggregate and probability models because they examine individual travel choices and the degree of uncertainty.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

These tools have mostly been applied to advanced market economies because of the importance of infrastructure in promoting trade and commerce (infrastructure-led growth). In developing economies, however, most literature has been concerned with the lack of performance, growth and other inhibitions resulting from lack of adequate infrastructure to support industries and the real sector. These conditions have also affected the growth and entrepreneurship.

The study recommends government action in three areas: Government–community based moves to curb growing insecurity in the country generally, specifically some Northern Nigerian roads, secondly the need for partnership (PPP) in road building and maintenance of existing roads, and thirdly, increase public policy actions towards meeting the goals of the millennium development goals (MDGs). Meeting these goals are vital empowerments for individuals small entrepreneurs in Nigeria.

This study is a springboard or a pointer to the fact that "good public transport system must be easy and convenient to use, fast, safe, clean and affordable" Kyle [42]. Safe and good roads are important empowerments for Nigerians, especially the quality of our democracy where equality, eradication of extreme poverty, improve maternal and child health, and universal primary education amongst others, will bring about the needed entrepreneurial growth and the attainment of the goals of Vision 2020.

References

1. Ben-Akiva, M., & Bierlaire, M. (1999). Discrete choice methods and their applications to short term travel decisions *Handbook of transportation science Springer,* (pp. 5-33).
2. Luce, R. D. (1959). Luce's choice axiom. *Scholarpedia, 3*(12), 8077.
3. Werndl, C. (2011). On choosing between deterministic and indeterministic models: under determination and indirect evidence. *Synthese*, 1-23.
4. Pavlyuk, D., & Gromule, V. (2010). Discrete Choice for a Preferred Transportation Mode Reliability and statistics in transportation and Communication, 22
5. Alaba Adetola, J. G., Champika Lyannage. (2011). A Critical Appraisal of Road Transport infrastructure :Management in Nigeria. *DOCTORAL RESEARCH WORKSHOP, Wednesday, 12th October 2011 University of Central Lancashire, United Kingdom*, 77-94.
6. Campbell, A. (2009). Federal road management for sub-Saharan African nations: A Nigerian case study.
7. Campbell, D. (2012). Arrested development: growth theory has come a long way. How much further can it go? *Region Focus*(Fall), 36-40.
8. Okojie, G. (2012). Nigerian roads have challenges of poor design, materials, and supervision, *Leadership, 30/02/2012,* pp. 5-8.
9. Hashim, Y., & Meagher, K. (1999). *Cross-Border Trade and the Parallel Currency Market-Trade and Finance in the Context of Structural Adjustment: A Case Study from Kano, Nigeria, Research Report 113* (Vol. 113): Nordic Africa Inst.
10. Pickett, Joseph P., and others, eds. The American Heritage Dictionary of the English Language: Fourth Edition. Boston: 399 Houghton Mifflin, 2000
11. Bierlaire, M. (1997). Intelligent Transportation System Program. *Massachusetts Institute of Technology*, 1-30.
12. Manski, C. F., & Lerman, S. R. (1977). The estimation of choice probabilities from choice based samples. *Econometrica: Journal of the Econometric Society*, 1977-1988.

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

13. Kahneman, D., & Tversky, A. (1996). On the reality of cognitive illusions. *Psychological review, 103*(3), 582-591
14. Tversky, A. & Kahneman, D. (1973). Availability: A heuristic model for judging frequency and probability. Cognitive psychology, 5(2), 207-232.On the reality of cognitive illusions. *Psychological review, 103*(3), 582-591
15. Christopher F Baum, Yingying Dong, Arthur Lewbel, & Yang, T. (2012). A simple alternative to the linear probability model for binary choice models with endogenous regressors. [This presentation is based on the work of Lewbel, Dong & Yang]Comparing features of Convenient Estimators for Binary Choice Models Economics Working Paper No. 789, *Boston College, Boston College, This presentation is based on the work of Lewbel, Dong & Yang,* 1-82.
16. Iliyasu, Z., Abubakar, I. S., Galadanci, H. S., & Aliyu, M. H. (2010). Birth preparedness, complication readiness and fathers' participation in maternity care in a northern Nigerian community. *African Journal of Reproductive Health, 14*(1).
17. Kawuwa, M., Mairiga, A., & Usman, H. (2007). Community perspective of maternal mortality: Experience from Konduga local government area, Borno state, Nigeria. *Annals of African medicine, 6*(3), 109.
18. Ouro-Bang'na, M., Kabore, R. A. F., Zoumenou, E. E. N., Gnassingbe, K., & Chobli, M. (2008). Anesthesia for children in Sub-Saharan Africa–a description of settings, common presenting conditions, techniques and outcomes. *Pediatric Anesthesia, 19*(1), 5-11.
19. Tukur, B. M., Bawa, U., Odogwu, K., Adaji, S., Passano, P., & Suleiman, I. (2010). Praying for Divine, African journal for reproductive health, 1(14), 113-119
20. Omofonmwan, S. I., & Odia, L. O. (2009). Oil exploitation and conflict in the Niger-Delta region of Nigeria. *J Hum Ecol, 26*(1), 25-30.
21. Flynn, D. K. (1997). "We are the border": identity, exchange, and the state along the Bénin-Nigeria border. *American Ethnologist, 24*(2), 311-330.
22. Reporters, S. (2013, May 24, 2013). 1,497 Illegal Routes Into Nigeria news page, *Sahara Journal,* pp. 1-10. Retrieved from http://saharareporters.com
23. Nieta-Parra, S., Olivera,M., & Tibocha, A. (2011). The politics of transport infrastructure policies in Colombia: OECD Publishing, 1-58
24. IRF(International Road Federation). (2008). Building the better road. *Special Bulletin for Africa, November,* (International Road Federation), 1-20.
25. Fernandes, A. C. (2009). Explaining Government Spending: a Cointegration Approach: Universidade do Porto, 366 Faculdade de Economia do Porto.
26. Bose, N., Haque, M. E., & Osborn, D. R. (2007). Public Expenditure and Economic growth: A disaggregated analysis for developing countries*. *The Manchester School, 75*(5), 533-556.
27. Fakayode, B. S., Omotesho, O., Tsoho, A. B., & Ajayi, P. D. (2008). An Economic Survey of Rural Infrastructures and Agricultural Productivity Profiles in Nigeria. *European Journal of Social Sciences,* 364 *7*(2).
28. Estache, A., Speciale, B., & Veredas, D. (2005). How much does infrastructure matter to growth in Sub-Saharan Africa? *unpublished, World Bank (June 2005)*.
29. Sunil Sinha, I. F. (2011). Literature on the constraints to investment in Developing Countries. *Department for International Development., Final Report 2011*, 1-34.
30. Bank, W. (1994). World Development Report 1994: Infrastructure for Development. *World Bank: Washington,DC, USA*.
31. Adesanya, A. (2010). Bringing the Nigerian Railways back on track: Challenges and options., 1-21.
32. Osuji, O. (2013, March 21, 2013). Once upon a Nigerian Railway Corporation, *National Mirror,* pp. 1-10. Retrieved from http://nationalmirroronline.net

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.

33. De, P. (2006). Empirical Estimated of Trade Costs for Asia. *ADB institute and Inter-American Development, Third LAEBA Annual Meeting Seoul, South Korea* (LAEBA 16/11/2006), 1-15.
34. Clarke, D., et al., 2004, "In-depth study of motorcycle accidents", D.f. Transport, Editor.London
35. Wilson J.S., Mann, C.L. and Otsuki, T. (2003), "Trade Facilitation and Capacity Building: Global Perspective" 410 unpublished manuscript, World Bank: Washington DC.
36. Limao, N., & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *The World Bank Economic Review, 15*(3), 451-479.
37. Mokhtarian, P. L., & Salomon, I. (2001). How derived is the demand for travel? Some conceptual and measurement considerations. *Transportation Research Part A: Policy and Practice, 35*(8), 695-719.
38. Awoyemi, J. R. (2011). A Study of the factors militating against Public transport operation in Nigeria. *Department of Management Science, Ladoke Akintola University of Technology, Ogbomoso*(Web Directory), 1-5.
39. Filani, M. O. and Abumere, S. I. (1993). *Operational Efficiency in the Provision of Mass Transit Services by State-owned Transit Companies in Nigeria. Urban Passenger Transportation in Nigeria*, Edited by S. G. Ikya, Ibadan. Heinemann Educational Books (Nig.) Plc
40. F.G.N. (2010). Draft National Transport Policy. *Federal Government Press, Abuja, Nigeria*.
41. Foster, V., & Briceño-Garmendia, C. (2009). Africa infrastructure country diagnostics. *Overhauling the Engine of Growth: Infrastructure in Africa. September. Washington, DC: World Bank*.
42. Kyle, R. (2011). How important are good public transport systems to urban and social development? [Sustainable Development Department]. *World Bank Online*(Global: International Briefing), 1-5

*Corresponding author:
Tel.: +60102412396. E-mail address: suleimangambiyo@gmail.com.