



MODAL CHOICE DECISIONS AND WORKERS COMMUTING COSTS IN METROPOLITAN LAGOS

OLUWOLE Matthew Sunday, SALIU Babantunde Akintayo and OJEKUNLE Joel Ademola.

¹Department of Transport Management Technology, School of Entrepreneurship and Management Technology, Federal University of Technology, Minna, Niger State.

²Department of Transport Management Technology, School of Management Technology, Federal University of Technology, Akure, Ondo State.

Abstract

The task of estimating the choices which commuters makes with the relevant money cost and travel time in order to establish the trade –off, they are making between time and money is fast becoming a component of modal choice decision in transportation planning. This studies attempt to evaluate the relationship between mode patronage and mode characteristics among commuters in Lagos metropolis. The study uses multinomial logit model to explain discrete choices i.e. choices commuters have to make among the mutually exclusive modes of transport. The result shows that majority of Lagos metropolis residents do not commute by train and quite larger proportion do not even commute by ferry services despite the huge potential that these modes of transportation offers in the study area, therefore making the road transport mode the dominant mode of transport for commuting with its attendant negative consequences. It is hereby recommended that transport Policy makers in Lagos metropolis should intensify its efforts at having an accessible network of metro line railway system for mass transportation of workers at affordable fare. This recommendation is anchored on the fact that access to affordable transportation options is a key factor in the economic mobility of the working poor. Consequently, there is need to adequately invest in all modes of public transportation (rail, inland waterways and road) as this will not only ensure that there is a balanced transportation system in Lagos metropolis but mass movement of workers at most affordable cost and quality environmental sustainability will be guaranteed.

Key Words: Commuting Cost, Polycentricity, Metropolis, Spatial and Household

1.0 INTRODUCTION

Mode choice is the process whereby the means of travelling to work by the commuters is determined; the means of travel is referred to as travel mode (Clark, 1987). Modal choice studies attempt to establish the relationship between mode patronage and mode characteristics, an interesting by-product of modal choice models is that by comparing choices which people actually made with the relevant money cost and travel time, it is possible to establish the trade – off, they are making between time and money. This enable estimate to be made of values of time for various trip purposes and this choice are frequently used in estimating the time related

benefits of particular transport schemes. Lagos metropolis has all the mode of travel to choose from, it ranges from private vehicle/Car, taxi, commercial motor cycle, Bus Rapid Transit (BRT)/LAGBUS Services, other commercial buses, train services, Ferry service and walking. In making a choice between the modes, the traveler will have regard to their relevant characteristics like: Money cost (the fare for public transport services and operation cost for private vehicle/car), Travel time (from real origin to real destination), Safety/Security, Comfort, Convenience among others. Understanding the intricacies between modal choice and its implication on commuting particularly in the developing countries is becoming a great concern to transport planners and therefore deserve detailed study at the highest level. Therefore, this study unraveled the characteristics of each mode of travel in terms of affordability, availability, acceptability, availability and acceptability. These characteristics affected the choice of travel mode and the monetary and time cost of commuting and even the external costs of commuting.

1.1 Literature Review

Neighborhood Theory and commuter mode Choice

Literature on the impact of urban form on travel behavior has increasingly recognized that residential location choice and travel mode choice may be interconnected, (Schwanen and Mokhtarian (2004). In the USA and Europe land use based solutions to transportation problem, have rapidly gain popularity over the past decade. The principle of new urbanism (in the USA) the compact city (Europe) has found a solid plan in urban planner thinking. This thinking have connection with the results of numerous empirical studies demonstrating that living in higher density, mixed landuse neighborhoods is associated with less car use compared to living in low density, suburban environments (Frank and Pivo, 1994).

Wikipedia (2015) defines neighborhood as a geographically localized community within a large city, town, suburban or rural area, Schwanen and Mokhtarian (2004) observed that it is not completely clear, for instances, how important land use characteristics are in the explanation of commuter behavior. Oyesiku (2010) observed that over the past four decades, there has been a perceptible trend in the urbanization process all over the world, whereby urbanites consciously or unconsciously move outside to live. This process is called suburbanization. While urban form diversion, at the neighborhood level affect commuter mode choice or commute length (Cervero 2002).

A number of authors have claimed that residence location choice is not exogenous to the association between land use variable and travel behavior (Boarener and Crane (2001); Cervero and Duncan (2002); Handy (1996), Sermons and Seredich (2001), Srinvas and Ferrira (2002, Van Wee et al (2003)). They argued that a household with a predisposition toward a certain type of travel “self-selects” a residential location enabling the pursuit of that preferred type of travel. This phenomenon is referred to as residential self-selection. For example households whose members prefer to travel by public transit choose to reside for that reason in a location providing easy access to public transit infrastructure. The commonly observed correlation, between land use configuration and travel behavior do not so much reflect direct causality but complex relationship of these factor with others, such as attitudes toward travel.

Shwanan and Mokhtarian (2004) works centered on exploring the role of attitudes toward travel and land use in residential location choice. While attention to the attitude travel behavior relationship faded during the 1980s, interest in the impact of attitude on mode choice regained momentum with the shift in transportation policies from supply measures to Travel Demand Management (TDM) and the underlying concern about air quality and global warming (Fujii and Kitamura (2003); Golob and Hensher, (1998); Hagman, (2003). Insight into the role of attitude

factors are needed to formulate auto-use reducing policies that are more realistic in their objective and perhaps more effective in terms of outcomes.

The basic hypothesis underlying the studies of Schwanen and Mokhtarian (2004) is that two sets of factors physical neighborhood structure and preference regarding physical neighborhood attributes simultaneously affect commute mode choice. Distinguishing commuters currently residing in urban and suburban neighborhoods from commuters with urban and suburban land use preferences, the researchers compared the mode choice behavior of four population segments. Urban residents with urban preferences (true urbanites); urban dwellers with suburban preferences (mismatched or dissonant urban dwellers); Suburban residents with urban preferences (mismatched or discount suburban dwellers) and suburban dwellers with suburban preferences (true suburbanites). Resident in each of these segment are hypothesized to fall on a continuous scale in terms of their average probability of commuting by private vehicle or any alternative mode of transportation as in the Figure 1.

Y

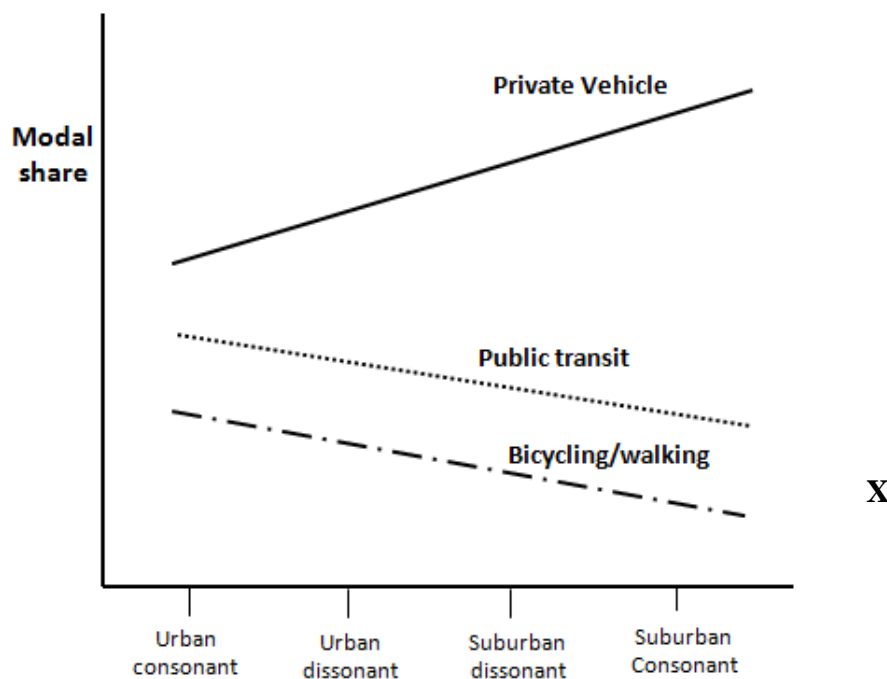


Figure 1: Hypothesized Continuum of Actual And Preferred Residential Neighborhood Type and Commute Mode Choice (Schwaram And Mokhtarian, 2004).

The underlying principle behind the concept is to answer question of to what extent commute mode choice differs by residential neighborhood and by neighborhood type dissonance, the mismatch between a commuter current neighborhood type and her preferences regarding physical attributes of the residential neighborhood. Using data from the San Francisco Bay Area, they discovered that that neighborhood type dissonance is significantly associated with commute mode choice: dissonant urban residents are more likely to commute by private vehicle than consonant urbanities but not quite as likely as true sub urbanities.

1.2 Methodology

Multinomial logit model was used because of its usefulness in explaining discrete choices i.e. choices commuters have to make among the mutually exclusive modes of transport. In this study, three alternative transport modes used by the commuters were considered; private vehicle/cars, public transport (comprising of BRT/LAGBUS and other commercial vehicles) and taxi. The model estimate is a multinomial logit with a linear-in-parameters systematic utility based on the theory of stochastic utility, whereby a choice is made by decision makers in order to maximize a utility function.

Multinomial logit is a generalization of logic regression, allowing more than two discrete outcomes, for this study we have three (3) discrete outcomes which include car/private vehicles, BRT/LAGBUS and commercial vehicles. It is a model that is used to predict the probabilities of the different possible outcomes of a categorically distributed dependent variable, given a set of independent variables (which may be real-valued, binary-valued and categorical-valued). The use of the term “multinomial” in the name arises from the common relationship between the categorical and multinomial distributions. Logit is derived on the assumption that the error terms are extreme value distributed with constant mean and a scale parameter, i.e. their distribution is identical and independent among alternatives. The distribution is also called Gumball and type 1 extreme value. Multinomial logit models are used to model relationship between a polychromatic responses variables and a set of regression variable. The generalized logit model focuses on the individual as the unit of analysis and uses individual characteristics as independent variables. The independent variables, being characteristics of an individual, considers an individual choosing among alternatives in a choice set i.e. using private cars, public transport or taxi for commuting).

Let π_{jk} denote the probability that individual j , chooses alternative K ,

Let X_j represent the characteristics of individual j and

let Z_{jk} be the characteristics of the K^{th} alternative for individual j . For example in the case of the study X_j may be an income and each Z_{jk} the mode choice of the head of a household.

The probability that individual j chooses alternative K

$$\pi_{jk} = \frac{\exp(B_i - X_i)}{\sum_{i=1}^m \exp(B_i X_i)} = \frac{1}{\sum_{i=1}^m \exp[(B_i X_i) X^i_j]} \dots \dots \dots 1$$

B_1, \dots, B_m are M vectors of unknown regression parameters (each of which is different, even though X_j is constant across alternatives). Since $\sum_i^m TT_{jk} = 1$, the sets of parameters are not unique by setting the last set of coefficients to null (that is, $B_m = 0$), the coefficient B_k represent the effects of the X variables on the probability of choosing the K^{th} alternative over the last alternative. In fitting such a model, you estimate: $M-1$ sets of regression coefficients. In conditional logic model, the explanation variables Z assume different values for each alternative and the impact of a unit of Z is assumed to be constant across alternatives.

The probability that the individual j chooses alternative K is \emptyset is a single vector of regression coefficients. The impact of a variable on the choice probabilities derives from the different of its value across the alternative.

$$\pi_{jk} = \frac{\exp(\emptyset^l Z_{jk})}{\sum_i \exp(\emptyset^l Z_{ji})} = \frac{1}{\sum_i \exp(\emptyset^l Z_{ji})} \dots \dots \dots 2$$

The equation thus give the probability or likelihood for an independent variable say ‘income’ to increase or decrease the use of our dependent variable say commercial vehicles.

To show the effect of socio economic characteristics of commuters on their modal choice decision the following independent variables are given in the table 1 below.

Table 1: Variable Label

	Variable	Variable label code	Description of Variables
1	Age	AGE	Continuous
2	Sex	SEX	Dichotomous 0 = Male 1 = Female
3	Marital Status	MRT	Dichotomous 0 = Single 1 = Otherwise
4	Household member below 18 years	B18	Continuous
5	Number of Household Member	NHM	Continuous
6	Monthly Income Level	INC	Continuous
7	Commuters Job Status	JST	Dichotomous 0 = Employed 1 = Not Employed
8	Accommodation Status	AST	Dichotomous 0 = Home owned 1 = Rented Tenure
9	Mode of Transport to Work	MTW	Dichotomous 0 = Private Car 1 = Commercial vehicle

Source: Authors' Compilation (2017)

1.3 Results and Discussion

1.3.1 Frequency of Use of Commuting Mode

Table 2 shows the frequency of use of each commute mode. The most commonly used transport mode for commuting in Lagos metropolis is other commercial buses while train and ferry are not often used by commuters because of their limited coverage. It is also worthy of note that BRT/LAGBUS is most often used by 252 respondents, far lower than other commercial buses with 1114 who indicated that they most often used this mode. Given the economy of scale inherent in use of mass transport mode such as LAGBUS/BRT buses there is a scope to increase the availability of BRT/LAGBUS to catch up or even overtake other commercial transport operation in Lagos metropolis.

Table 2: Frequency of Use of Commuting Mode

Frequency of Use					
MODE		Most Often Used (4)	Sometimes Used (3)	Rarely Used (2)	Never Used (1)
	Car/Private Vehicle	307	293	271	357
	BRT/LAGBUS	252	404	309	247
	Other Commercial Bus	1114	391	58	35
	Taxi	15	272	358	430
	Walking	182	387	416	218
	Commercial Motorcycle	451	400	334	190
	Train	0	0	167	1044

	Ferry	2	0	108	1105
--	-------	---	---	-----	------

Source: Authors' Field Survey (2017)

1.3.2 Weekly Transport Modes Used and Commuting Time for all Households Members

Table 3 present buses (BRT/ LAGBUS and other commercial buses) as the mostly used mode of transport as 65.3% of the residents in Lagos metropolitan used this mode for commuting. This mode of transport is followed by car/private vehicle with 13.20% of Lagos metropolitan resident using this mode of transport. The other mode which experienced significant use is walking (10.30% of resident) and commercial motorcycles (8.9% of resident). The average commuting time in the metropolis is 68.5 minutes.

Table 3: Weekly Transport Modes Used and Commuting Time for all Households

LGA	Popula tion	Popula tion Densit y	Comm uting Time (min)	Percentage of Resident Using the Mode					
				Car/pr ivate vehicle	BRT/ LAG BUS	Other Comme rcial Bus	Taxi	Walk ing	Comme rcial M/Cycl e
Agege	459939	41071	89	7.7%	26.0 %	56.7%	0.0 %	9.6 %	10.2%
Ajeromi/If elodun	684105	55474	60	21.4%	8.6%	52.1%	15. 0%	2.9 %	5.2%
Alimosho	127771 4	6899	89	13.5%	7.3%	66.8%	5.8 %	6.6 %	10.2%
Amuwo Idofin	318166	2364	87	15.3%	20.8 %	51.4%	0.0 %	12.5 %	12.1%
Apapa	217362	8153	46	15.8%	7.9%	60.5%	0.0 %	15.8 %	9.6%
Eti Osa	287785	1496	47	16.3%	12.2 %	61.2%	0.0 %	10.2 %	4.4%
Ifako Ijaye	427878	16078	53	26.7%	0.0%	64.0%	0.0 %	9.3 %	3.2%
Ikeja	313196	6785	52	13.6%	13.6 %	69.7%	0.0 %	3.0 %	5.0%
SKosofe	665393	8174	39	10.6%	2.1%	64.1%	0.0 %	23.2 %	4.1%
Lagos Island	209437	24182	39	13.9%	13.9 %	63.9%	2.8 %	5.6 %	11.5%
Mainland	317720	16322	53	12.5%	12.5 %	64.1%	0.0 %	10.9 %	10.2%
Mushin	63009	36213	70	5.0%	27.7 %	51.1%	0.0 %	16.3 %	11.2%
Ojo	598071	3781	148	15.4%	4.4%	64.7%	0.0 %	15.4 %	9.7%
Osodi-	621509	13886	84	10.6%	17.0	68.8%	0.0	3.5	15.2%

Isolo					%		%	%	
Somolu	402673	34862	59	8.1%	14.0%	58.1%	0.0%	19.8%	6.7%
Surulere	503975	21912	81	12.4%	18.1%	66.7%	0.0%	2.9%	8.3%
Total	793793		68.5	13.20	12.50		2.30	10.30	
	2			%	%	52.80%	%	%	8.90%

Source: Authors' Field Survey (2017)

1.3.3 Transport Mode Used for Commuting by Income Groups

It is useful for policy making purposes to consider what effect income has on the choice of travel modes, Table 4 shows the modes used for travel to work for three income groups.

Table 4: Mode Used for Commuting by Income Groups

Monthly Income Group (₦)	Car/Private Vehicle	BRT/LAGBUS	Other Commercial Bus	Taxi	Walking
100,000 and below	11.6%	20.4%	59.6%	2.2%	6.3%
100,000 - 300, 000	25.6%	6.0%	57.9%	0.0%	10.5%
300, 001 - 500, 000	56.0%	0.0%	0.0%	44.0%	0.0%
Total	16.0%	17.2%	56.1%	4.1%	6.6%

Source: Authors' Field Survey (2017)

From the table it can be seen that most people (80%) with low income used commercial Buses (Other commercial buses and BRT/LAGBUS) to work. On the other hand highest income earners (₦300,000 – ₦500,000) travel by car/private car and taxi to work. This buttressed the fact that even though car ownership in Lagos is lower than in advanced countries cities, the car usage is higher in Nigeria since once an individual owns a car in Nigeria he/she rarely travel by public transport.

1.3.4 Workers Mode of Transport to Work

The modal share for work/school trip is depicted in table 5 below. The mode used vary from one local government to local government area to another, on the whole about 73% of all commuters travelled by one form of public transport or the other while only 14.3% travelled by car/private vehicle a negligible 3.3 percent travel by taxi.

Table 5: Modal Share for Work/School Trip

Modes	Frequency	Percentage
Car/Private Vehicle	420	14.3
BRT/LAGBUS	408	13.9
Other Commercial Bus	1731	59.1
Taxi	98	3.3
Walking	272	9.3
Total	2929	100.0

Source: Authors' Field Survey (2017)

1.3.5 Transport Accessibility

Accessibility describes the ease with which all categories of passengers can access public, transport. It could also be used to describe ease of accessing the bus stop or station. If a walk to the bus stop is intimidating or dangerous, a bus stop at 200 meters may be perceived as inaccessible to 14 year old boy because of the risk of mugging, furthermore accessibilities also includes ease of finding out about travel possibilities.

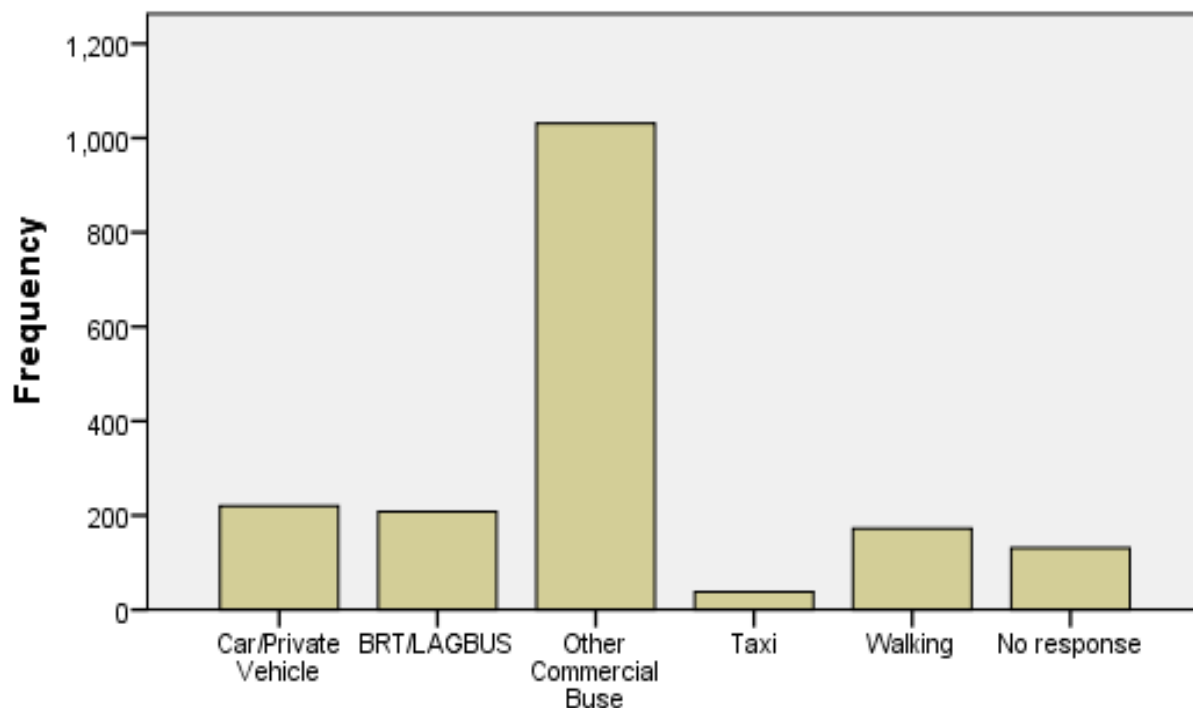


Figure 2: Mode of Transport Accessible to Respondents for Long Journey to Work

Source: Authors' Field Survey (2016)

Figure 2 above show the mode of transport accessible to respondents for long journey to work. Most respondents indicated that they travel to work by other commercial buses since this is the most accessible mode of transport to them. Figure 3 shows second mode of transport used in conjunction with the main mode for respondent to commute to work. Commercial motorcycle is the mostly used second mode of transport. This is because for most household in Lagos motorcycle is the mode used to access the terminals of other public transport (Bus stops, BRT Stops, Railway Station, Ferry Terminal etc). 9.2% of respondent used no other mode apart from the main mode to travel to work. These are car owners and those whose home is within walking distance to public transport terminal.

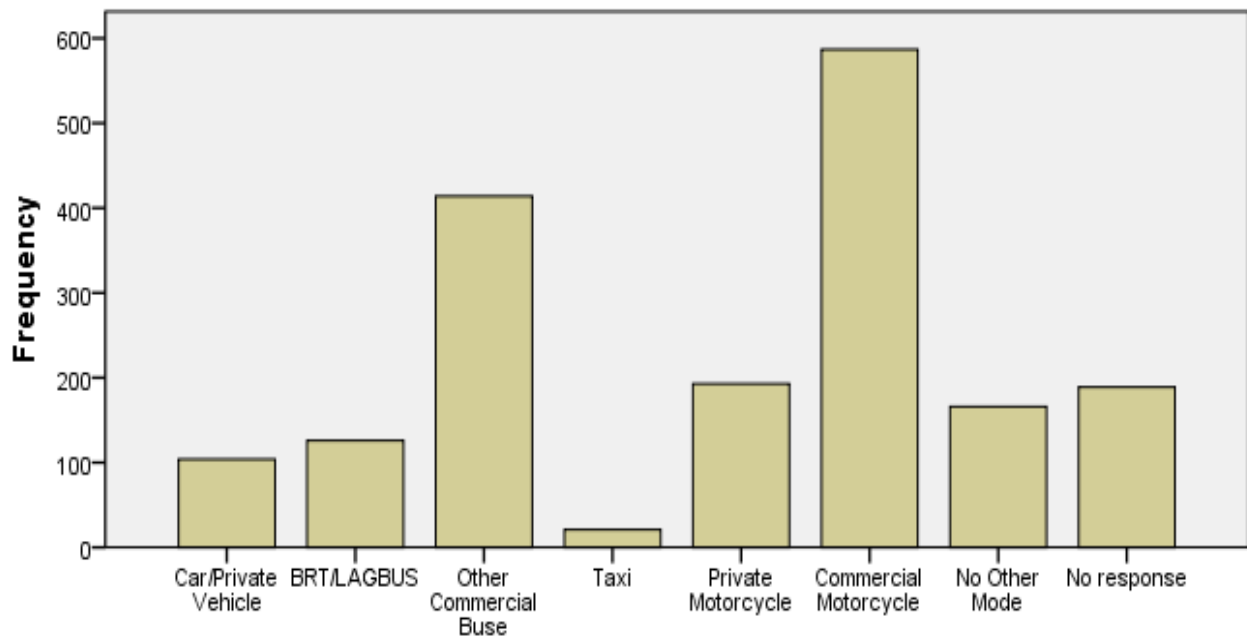


Figure 3: Second Mode of Transport to Work/School by Respondents Using More Than One Mode

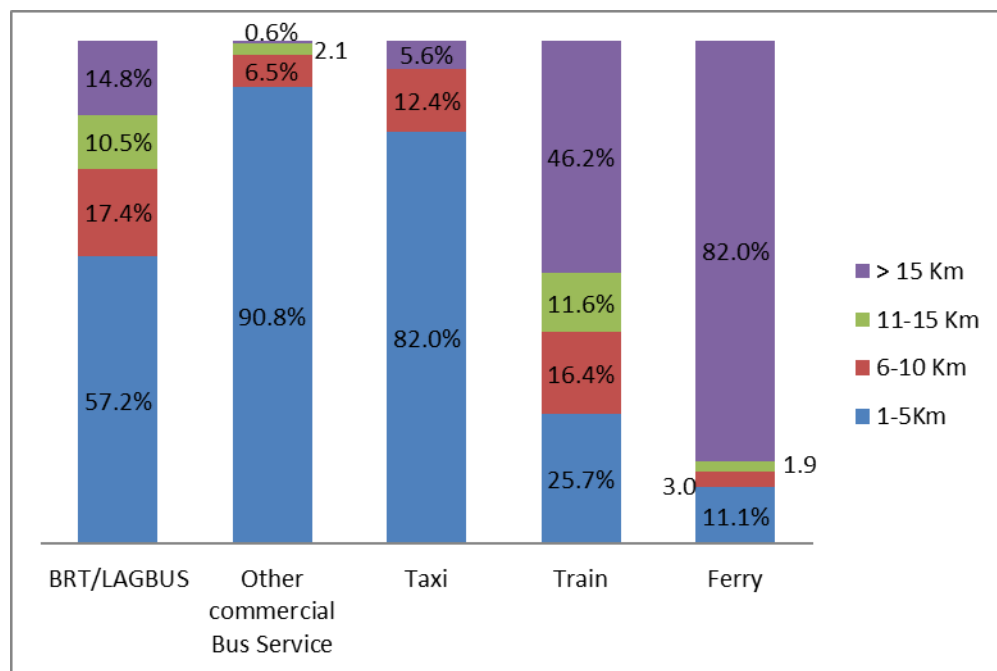


Figure 4: Household Accesses to Public Transportation Bus Stop

Figure 4 show the respondents' access to public transportation bus stop. The vast majority of the households (82%) reported that they did not have access to ferry service since they have to travel over 15 kilometers to reach a ferry station. This can be explained by the natural limitation of navigable waterways for water transportation. Furthermore, 46.2% of the respondent resides over 15km from train station and only 25.7% of the respondent are within the walking distance (5km) from the train station. The most accessible public transportation mode to commuters in Lagos

metropolis is commercial bus services with 90.8% of respondents living within 1-5km distance to the nearest bus stop. This is followed by taxi services which are available to 82% of the respondent who have access to taxi within 5km distance. 57.2% of the respondent resides within 1-5km distances to the nearest BRT/LAGBUS route. This is commendable given the fact that BRT/LAGBUS is the most recent mode of public transportation available to Lagos metropolis residents and with this growth it is expected to catch up with other public transport mode of commuting (other commercial buses) in the nearest future.

1.3.6 Car availability per household

Table 6 shows the average number of cars per household. Eti-Osa local government area has the highest average number of cars per household (1.39 cars per household). This can be explained on the ground that Eti-Osa is the home of the largest business centre including the upscale communities of Victoria Island and Ikoyi. Eti-Osa local area is followed by Mushin Local Government Area in terms of average number of cars per household with 0.85 cars per household. For Lagos Metropolitan areas as a whole the average number of cars per household is 0.61.

Table 6: Car Availability per Household

Local Government Area	% of Household With Access to Car	No. of Cars per Household
Agege	39.4	0.65
Lagos Island	40.0	0.54
Mainland	45.5	0.78
Mushin	50.0	0.85
Ojo	38.8	0.53
Oshodi	46.2	0.63
Somolu	26.8	0.48
Surulere	8.3	0.08
Ajeromi Ifelodun	38.4	0.64
Alimosho	40.4	0.53
Amuwo Idofin	44.4	0.67
Apapa	30.6	0.42
Eti Osa	14.0	1.37
Ifako Ijaye	29.8	0.57
Ikeja	29.7	0.43
Kosofe	43.0	0.68
Lagos Metropolitan Average	35.3	0.61

Source: Author's Field Survey (2017)

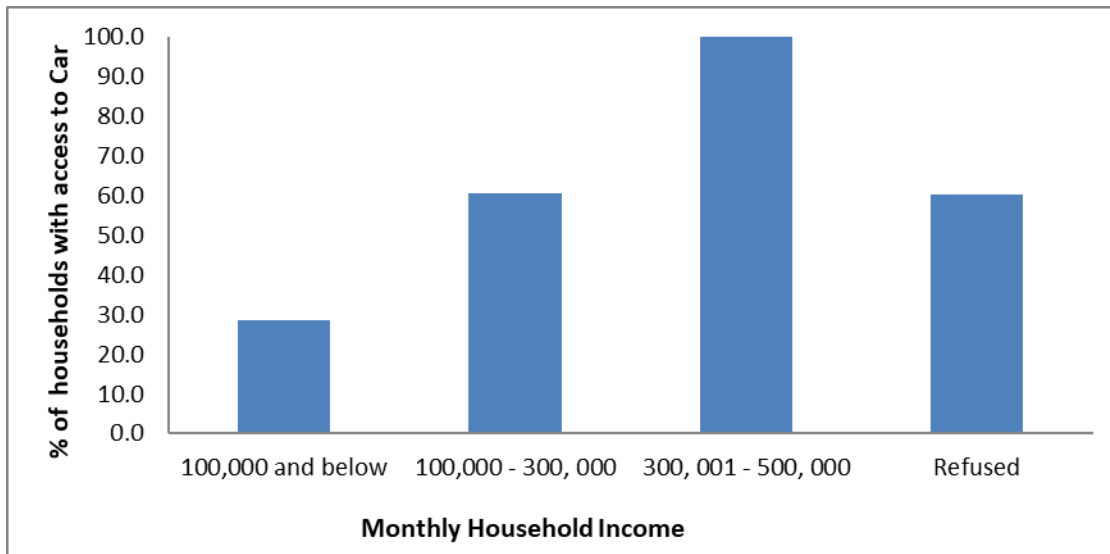


Figure 5: Household Access to Car by Income Group

Figure 5 shows household access to cars by income group. As expected access to cars is highly positively correlated with household monthly income with household in income bracket ₦300,001 – ₦500,000 having 100% access to cars.

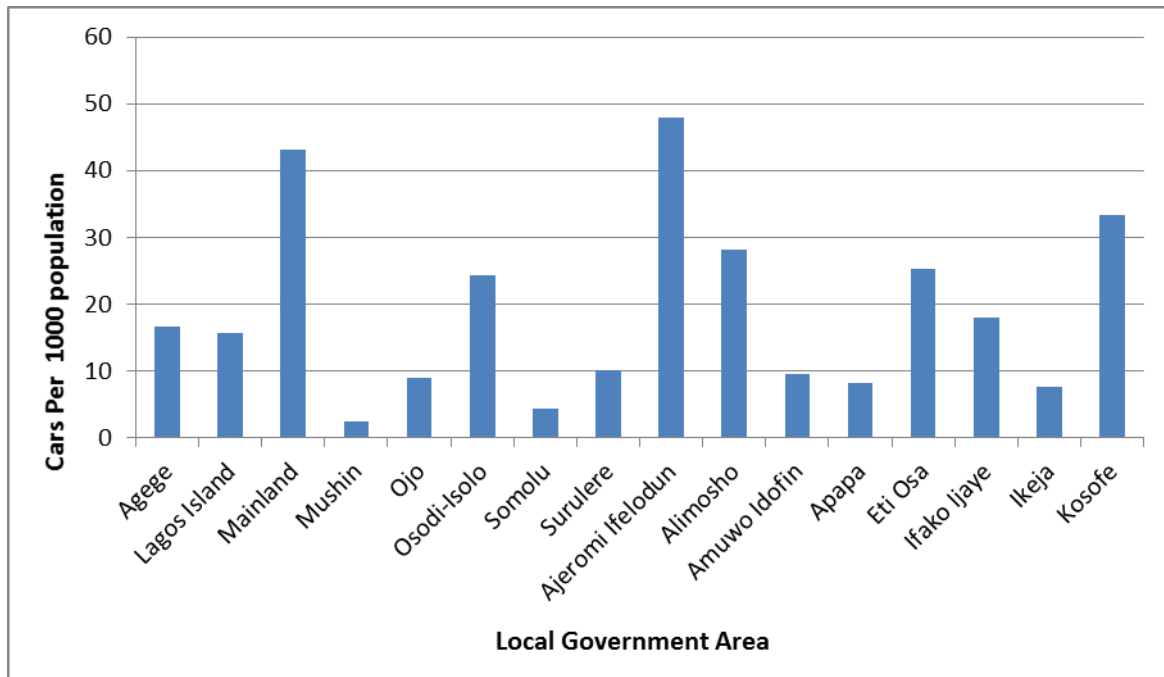


Figure 6: Car Ownership by Local Government Area

Figure 6 shows that car ownership is relatively high in Mainland Local Government Area and Ajeromi Ifelodun Local Government Area at 43 and 48 cars per 1000 population respectively. Other local government areas with substantial car ownership figure are Oshodi –Isolo, Alimosho, Eti-osa and Kosofe local government areas. Saturation levels of car ownership in developed nations are considered to be around 450 cars per thousand populations (NHTS, 2003). Expected growth of ownership and resulting demand for road space in Lagos metropolis will be one of the major challenges to Lagos city administrators.

1.3.7 Transport Acceptability

Transport acceptability is an important quality of public transport planning and operation. Even if a bus has qualities of affordability, availability and accessibility, potential traveler may be deterred by the state of the vehicle, lack of personal security on buses or trains, driver attitude, lack of waiting facilities and other attributes of public transport system. Table 7 shows the reasons respondents gave for rarely or never using a specific mode of transport for commuting. As can be seen 56% rarely or never use car/private vehicle because this mode of transport is not available to them obviously due to income constraint. 21.7% of the respondents, stated that car/private vehicle ownership and use is too expensive and this is expected because beyond fueling, other maintenance cost could impose some financial burden on users, 61.9% percent of respondents claimed that BRT/LAGBUS services are not available to them and only a negligible number of respondents (1.4 percent) stated that the mode is expensive. 8 percent of respondents stated that they rarely/never use BRT/LAGBUS due to the fact that there is no direct service for them along their route of residence/work. Most respondents (24.4 percent) rarely/never use commercial bus services because of traffic congestion since they do not have dedicated lanes liked BUS/LAGBUS. Other reasons stated by substantial number of respondents for not using commercial bus services include 'Journey too Slow (18.9%), no direct service (18.5%) and no nearby services (14.8%)'.

The overriding reason why most Lagos residents do not use taxi as commuting mode is that, it is too expensive. 92.5 percent of respondent gave this reason for rarely/never using taxi service to commute. 42.4 percent of respondents do not walk to work because it requires too much physical effort. Other important reasons for not using walking/trekking as commute mode include "Takes too long" (21.3%), and "Concerns over personal facility" (19.3%). 11.2% percent of respondents never walk/ trek to work or school due to personal disability. Concern over personal safety is the main reason why most respondents never/rarely used commercial motorcycle as a commute mode. 76.8 percent of respondent do not use this mode of commuting due to concerns over personal safety.

Ferry services is not available to 85 percent of respondent due to naturally limited coverage of waterway, most respondent do not use train as commute mode (63.6 percent), due to the fact that train service is not available to them and 11.5 percent do not use the service because there is no direct train services to their destinations.

Table 8: Public Transport Choice Preference by Local Government Area in Lagos Metropolis

	Car/Private vehicle		BRT/LAGBUS		Commercial Bus Services		Taxi Services		Walking		Commercial motorcycle		Ferry services		Inter city services	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
Not available to me	1013	35.2	939	36.2	467	15.8	454	16.6	0	0.0	371	13.0	1833	70.9	1313	49.5
Unreliable	331	11.5	294	11.3	235	8.0	330	12.1	0	0.0	0	0.0	141	5.5	219	8.3
Too expensive	576	20.0	217	8.4	242	8.2	1383	50.5	0	0.0	0	0.0	0	0.0	0	0.0
No direct service	0	0.0	295	11.4	584	19.8	343	12.5	0	0.0	0	0.0	120	4.6	301	11.4
Traffic congestion	387	13.5	257	9.9	711	24.1	228	8.3	0	0.0	0	0.0	0	0.0	0	0.0
Journey too slow	0	0.0	288	11.1	586	19.8	0	0.0	593	21.4	0	0.0	0	0.0	169	6.4
lack of parking facilities	224	7.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	175	6.6
Personal disability	0	0.0	0	0.0	0	0.0	0	0.0	454	16.3	0	0.0	0	0.0	0	0.0
Concerns over personal safety	0	0.0	0	0.0	0	0.0	0	0.0	566	20.4	1804	63.4	0	0.0	0	0.0
Require too much physical effort	0	0.0	0	0.0	0	0.0	0	0.0	884	31.8	115	4.0	0	0.0	0	0.0
Exposed to weather	0	0.0	0	0.0	0	0.0	0	0.0	280	10.1	277	9.7	0	0.0	0	0.0
Poor information about service	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	181	7.0	170	6.4
Too much waiting time	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	122	4.7	138	5.2
Others	343	11.9	304	11.7	129	4.4	0	0.0	0	0.0	280	9.8	188	7.3	166	6.3
Total	2874	100.0	2594	100.0	2954	100.0	2738	100.0	2777	100.0	2847	100.0	2585	100.0	2651	100.0

Source: Authors Field Survey (2017)

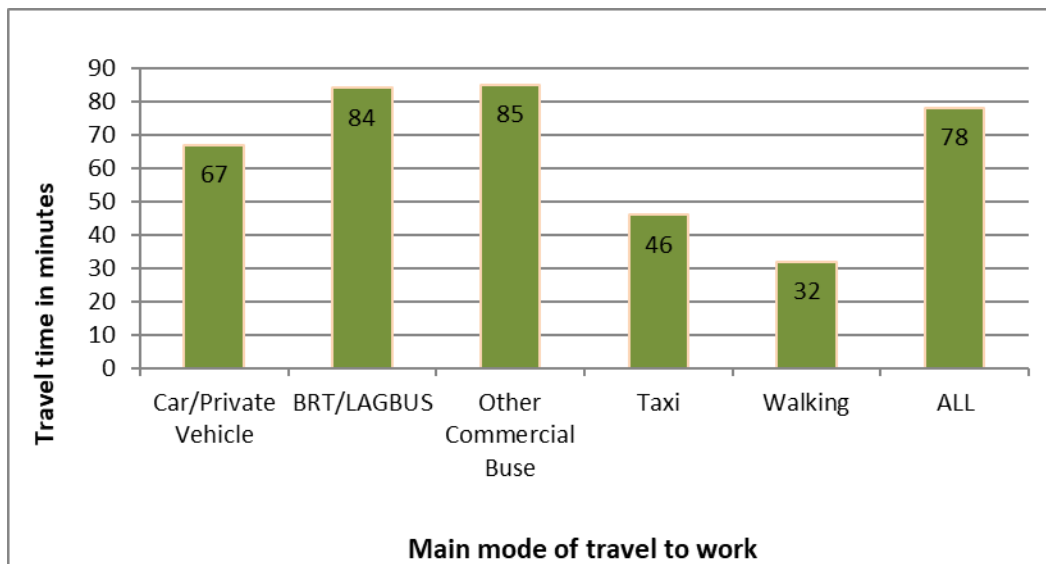


Figure 7: Average Commuter Travel Time By Mode

Figure 7 above shows commuters travel time by mode. It is evident that the service travel times of popular form of public transport used by Lagos metropolis commuters (BRT/LAGBUS and other commercial Buses) are disadvantaged by long access times. Hence total travel time by commuters using public transport mode as the main mode spend longer time to work (average of 84 minutes and 85 minute for BRT/LAGBUS and other commercial buses respectively). Car/private vehicle owners also spend more time in commuting to work since they follow same the congested route as the commercial buses even though the accessibility time is zero. Commuter, who used taxi as their main mode for commuting are able to reduce their commuting time (46 minutes) because taxi drivers usually look out for less congested routes at any point in time.

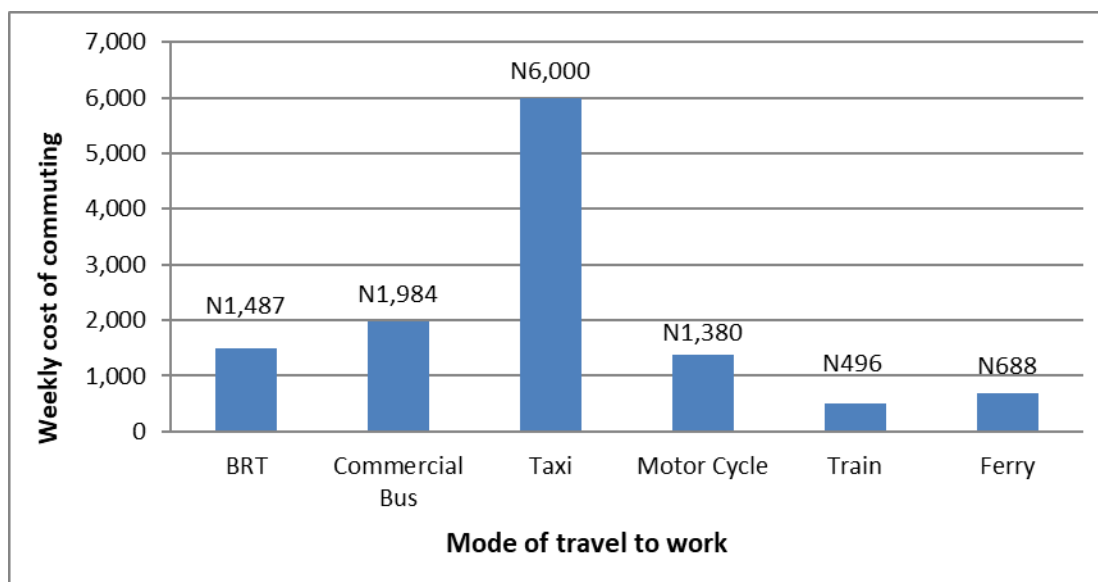


Figure 8: Cost of Commuting by Public Transport

Figure 8 shows the average weekly cost of commuting by public transport. The most serious concerns about cost of intra urban transport are related to the cost of travel to work particularly for low income earners. The average cost of commuting for each of the different modes varies as indicated above. Fares paid by commuting are influenced by the extent of subsidy of the services. The subsidized modes BRT/LAGBUS, train and ferry services have lower average cost while the non-subsidized mode taxi and other commercial Buses have relatively higher fare. Thus respondent spent average of 6000 weekly on taxi (the highest) and 1,984 weekly on other commercial bus services.

1.3.8 Effect of Socio-Economic Characteristics Using Multinational Logit Model

Table 9 shows the likelihood ratio tests, which indicates the contribution of the variables to the overall relationship between the dependent variable & the independent variable in this model given 0.05 significant level. 15 of the 18 independent variables tested were significant. While (three) variables do not significantly contribute to explaining the differences in the modal choice of commuters in Lagos metropolis. These variables include; income group of ₦300001 and above and the variable self-employed.

Table 9 Likelihood Ratio Tests for the Socio Economic Characteristics of respondents

S/N	Effect	Model Fitting Criteria	Likelihood Ratio Tests		
		-2 Log Likelihood Of Reduced Model	Chi-Square	Df	Sig.
	Intercept	1120.784	.000	0	.
1	Age	1206.886	86.102	2	.000
2	Household_Member	1189.295	68.511	2	.000
3	Less_Than_18_Yrs	1177.920	57.137	2	.000
4	Distance_To_Work	1115.661	87.355	2	.000
5	Commuting_Time_To_Work	1030.634	52.328	2	.010
6	Sex	1355.511	234.728	2	.000
7	Monthly Income Level	1338.790	218.007	2	.000
8	Commuters Job Status	1155.325	34.541	2	.000
9	Accommodation Status	1227.726	106.942	2	.000
10	Congestion_Often_Experienced	1105.139	76.833	4	.000

Source: Authors' Field Survey (2017)

Table 10 Summary of the Results

Parameter Estimates of Socio Economic Characteristics of Commuters			
	Car/Private Vehicle	BRT/LAGBUS	Commercial Vehicle
Intercept	-	-33.3	-12.308
Age	-	-0.147	-0.137
Household Member	-	0.615	0.214
Children Less Than 18 Yrs Of Age	-	-0.616	-0.179
Sex	-	3.745	-0.780
N100000_Below	-	0.570	4.34
N100000_N300000	-	4.21	-1.337
N300001 And Above	-	-	-
Unemployed	-	13.5	31.76
Organised_Private	-	14.91	17.2
Public_Servant	-	16.89	16.9
Rented_Apartment	-	4.09	-1.371
Owner_Apartment	-	3.65	0.478
Staying With Parent	-	-12.94	-14.239
Distance Travel To Work/School	-	-	-
Commuting Time To Work	-	-	-
Do You Experience Serious Traffic Congestion In The Past One Week	-	-22.31	-33.5

Source: Author's field survey (2014)

In Table 10 parameters estimation are labeled by the group, they relate to the reference group "Car/private vehicle". The first equation is labeled "BRT/LAGBUS" and the second equation labeled "Commercial vehicle". The coefficients for each logit equation are found in the table above. The estimated multinomial logit model examines the factors that impact upon commuters in their decision on modal choice. The result from the model shows that age decreases the probability of commuters to use BRT/LAGBUS and other commercial vehicle compared to using car/private vehicle. This implies that commuters that are too young or too old might prefer car/private vehicle to other commercial vehicles. The result also shows that the number of household member will increase the likelihood of using BRT/LAGBUS and other commercial vehicle compare to using car/private vehicle. i.e. the larger the household member the higher the probability of using BRT/LAGBUS and other commercial vehicle compare to using car/private vehicles. Families with children less than 18 years of age tend to move towards using of car/private vehicle i.e. decrease in the likelihood of using BRT/LAGBUS and other commercial vehicle. The income group ₦100000 and below increases the likelihood of using Commercial vehicle and those who earn between ₦100000 and ₦300000 increases the probability of using BRT/LAGBUS but reduces the likelihood of using other commercial vehicle. The result shows that commuters distance to work, Travel time to work and income group N300001 and above do not have impact effect on the choice of commuter's mode of transport. The table above shows the detail information of the result.

1.3.11 Results of Multinomial Logit Model on Modal Choice of Commuters in Lagos Metropolis

Giving a type one error of 0.05 significant level, the result of the estimated multinomial logit model of commuters' socio and demographic characteristics on modal choice in Lagos metropolis is given in Table 10 below.

Table 11 Model Fitting Information

Model Fitting Information of Socio Economic Characteristics of Commuters				
Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2059.653			
Final	1120.784	938.869	24	.000

Source: Computer Computation (2017)

From the table above, It can be concluded that there is a significant relationship between the dependent variable and set of independent variable.

Table 12: Pseudo R-Square

Cox and Snell	0.520
Nagelkerke	0.650
McFadden	0.456

Source: Computer Compilation (2017)

Table 12 shows the result of Nagelkerke R^2 , which reveals that the model accounts for about 65% of variance of the dependent variable i.e. the modal choice of commuters in Lagos metropolis. While table 11 above shows the model fitting information of the model. The presence of a relationship between the dependent variables (mode of transportation) and contribution of independent variables (socio economic characteristics) is based on the significance of the final model chi-square. In this analysis the probability of the chi-square (938.869) is 0.000 which is less than the level of significant of 0.05.

Table 13 Modal Commuting Cost and Time

Communing Modes	Frequency	Average Weekly Commuting Cost	Average Daily Commuting Time (Minutes)
Car/Private Vehicle	621	₦7,333	67
BRT/LAGBUS	378	₦1,487	84
Other Commercial Vehicles	1311	₦1,984	85
Taxi	398	₦6,000	46
Train	170	₦496	91
Ferry	83	₦688	82
Total	2961		

Source: Authors' Field Survey (2017)

Table 13 shows that commuters who use car/private vehicle spend highest average weekly commuting cost ₦7,333 while workers who commute by urban train spend the least on the average for commuting ₦496. Workers who commute by BRT/LAGBUS and other commercial vehicles spend ₦1,487 and ₦1,984 weekly respectively on the average for commuting. In terms of commuting time taxi users commute an average of 46 minutes, while train users commute the highest daily commuting time (91 minutes) per trip.

1.4 Conclusion and Recommendations

The study has shown that majority of Lagos residents do not commute by train and quite larger proportion do not even commute by ferry services despite the huge potential that these modes of transportation offers in the study area, therefore making the road transport mode the dominant mode of transport for commuting in the metropolis with its attendant negative consequences. It is hereby recommended that Policy makers should intensify its efforts at having an accessible network of metro line railway system for mass transportation of workers at affordable fare. This recommendation is anchored on the fact that access to affordable transportation options is a key factor in the economic mobility of the working poor. Consequently, there is need to adequately invest in all modes of public transportation (rail, inland waterways and road) as this will not only ensure that there is a balanced transportation system in Lagos metropolis but mass movement of workers at most affordable cost and quality environmental sustainability will be guaranteed.

References

- Boarnet, M.E., and Grone, R. (2001). *Travel by design: The influence of urban form on travel*. Oxford university, oxford. UK
- Cervero, R. and Wu, K. (2002). Polycentrism, Commuting and Residential Location in the San Francisco Bay area. *Environmental and Planning A* 29, pp. 865-886.
- Clark, J. (1987). *Estimating the Demand for public Transport in Developing World* Land Transport, Governors Publishers, U k pages 408-411.
- Frank, L.D., and Pivo, G. (1994). Impact of Mixed Use and Density on Utilization of Three Modes of Travel, *South- Occupant Vehicle transit and walking*. Transportation research record 1466, 44-52
- Fujiri, S., and Kitamura, R.(). What does a one month free bus ticket do to habitual drivers? An experimental analysis of habits and attitude change transportation 30, 81-95.
- Golob, T.A., and Hensher, D.A. (1998). Greenhouse gas emission and Australian commuter attitude and behavior concerning abatement policies and personal involvement transportation research D3, 1-18.
- Hagman, O. (2003). Mobilizing meanings of mobility: car user's constructions of the goods and bad of car use. Transportation research D8, 1-9.
- Handy, S. (1996). Methodologies for exploring the link between urban form and travel behaviour. *Transportation Research D: Transport and Environment* 1, pp. 151-165.

- Handy, S.L. (1996). "Urban form and Pedestrian choice: study of Austin neighborhood, transportation research record 1552, 135-144.
- Oyesiku, O. (2010). New Cities in Urban and Regional development Planning. Longman Nigeria Plc, Lagos Nigeria
- Schwaram, T., and Mokhtarian, P. (2004). What affects commuters mode choice, neighborhood physical structure or preference towards neighborhood? *Journal of Transport Geography* 13, 83-99.
- Semons, M.W., and Seredich, W. (2001) Travel responsiveness to Land and Location Based Accessibility and Mobility Solutions, Research D6 417- 428.
- Srinivasanis-Ferrera, J. (2002) "Traveler behavior at the household level, Understanding linkages with residential choice. Transportation Research D7, 225-242.
- Train, K. (1986). A Structured Logit Model of Auto Ownership and mode choice, Review of Economic studies 47:2, 357-370.