Estimating Private Cost of Commuting in Metropolitan Lagos

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Abstract: *The recent focus on how to internalize the external costs of commuting have open a frontier of researches in estimating the private cost of commuting, however, there is still the dearth of knowledge on what constitute social cost of transportation in developing countries. This study estimates the private costs of commuting in Metropolitan Lagos. Data were collected on the socio-economic characteristics of commuting households (income, wages, modal choice, commuting expenditures, trip purpose, trip origin and destination, travel time, public transport service availability and car ownerships status) using questionnaire and review of documentary records. A combination of descriptive and inferential statistics was used for the analysis. The result shows that there is a general poor understanding and underestimation of immediate costs of private car use, such as travel time, stress, parking fees, insurance, depreciation, maintenance and repairs. The ignorance of real cost of car ownership and use explains the reason why though car ownership is lower in Nigeria than advanced countries, its rate of use is higher. Furthermore, the study shows that the values of commuting time in some Local Government Areas are higher than the hourly wage rate of the resident because of the relatively high commuting time, implying that commuters are not adequately compensated for commuting. On the whole the average commuting time of 1.26 hours, hourly wage rate of ₦1, 000 and commuting value of time ₦1, 260 is higher than hourly average wage rate by ₦260. The study recommended that the Lagos megacity planners should coordinate housing and transport policies by building affordable houses near existing planned public transport hubs or targeting transportation improvement on areas with large numbers of moderate-income workers with long and expensive commuting to workplace destinations. Finally, Policy strategies like parking charge, congestion pricing and fuel tax should be adopted to internalize the external cost of motor car usage as it is the case in Singapore and United Kingdom.*

Key Words: Commuting Cost, Metropolitan, Private Cost.

I. Introduction

Commuters incurred private costs in satisfying their mobility needs, but in addition to these private costs, which are directly borne by motorists and commuters, motorists also impose external costs on each other and the society at large in terms of environmental pollution, noise, accidents and travel delays (CIE 2006, Ogunsanya 2002 and Arosanyin 2001). The combination of the private and external cost constitutes the social costs of urban transportation. There has been a growing interest in the efficient pricing of the social cost of transport; this is because for a long time, major decisions about building and financing highway were left in the hands of engineers, who rarely understand the need for social-cost benefit analysis of transportation projects (Maitri and Sarkar 2010). Therefore, limited measures have been put in place to mitigate the consequences of the use of transport system, the growing concern for the externalities generated by the provision of transportation and the need for peoples mobility ushered in the recent awareness of the human and environmental costs of transport facilities and infrastructure and hence the growing debate on the importance of identifying and measuring these costs.

There is little agreement in literature about which costs should be included in social cost analysis and which aspect of social cost is directly relevant to emerging economies. In addition, methods used to estimate these costs also vary widely and often produce very different numerical estimates, depending on which metropolitan areas such studies are carried out (Litman 2003). The major challenge in literature on the use of social cost for transport planning research is that there is still lack of knowledge of the true social cost of transportation in cities across the world, but more importantly, limited efforts through research have been made to estimate and value social cost of transportation in cities of developing countries, particularly in Africa. It is against this backdrop that this paper attempts to analyze and estimate the private costs of commuting in Metropolitan Lagos with a view to recommending measures at reducing them. To achieve this aim a hypothesis was tested that:

H_0: The average monetary cost of commuting to work Lagos is not higher than internationally recognized affordable level.

II.   Literature Review

1.2.1 Concept of Social and Private Costs

The existence of negative externalities introduced the divergence between private cost which is experienced solely by the decision makers (transport operators and service users) and social cost which is the full social cost experienced by the society at large (Bamford 2006). Lipsey and Chrsytal (1999) illustrated the important distinction between private cost and social cost from the view point of a transport operator (such as commercial bus operator) and other members of the society who may not use its services. The transport operator will take into consideration the financial cost of his operation (cost of labour, vehicle, fuel, utilities and premises) and of course his profit or return on investment in determining the fare for his services, these are private costs which directly fall on the transport operator as a result of its operation. However, the transport operators cannot make use of the pollution, noise which they impose on the society at large. These are external costs which are not directly paid for by the transport operators who generate such costs or indirectly by the users of the services.

This conceptualization of social cost is different from accountant's limited perception of private cost in term of financial cost of providing goods and services. It is when the price paid for the service cover the full social costs that resources are best allocated and social welfare is maximized. The existence of negative externalities causes market failure in which marginal private revenue differs from marginal social cost causing output (volume of services) to diverge from the socially optimum level. It has been therefore observed that none internalization of external cost undermines the welfare that people enjoy (Arosanyin 2001, Murphy and Delluchi 1998).

1.2.2   Concept of Annualized Cost of Motor Vehicle Use

Delucchi, (1996) used the term annualized costs of motor vehicle use rather than social cost of motor vehicle use. It is a method whereby the total cost is equal to "operations and maintenance costs" plus annualized capital replacement costs. Conceptually, economic analysis "costs" means "opportunity costs". For some resource to count as a cost of motor vehicle use, it must be true that a change in motor vehicle use will result in a change in the use of that resource. Thus, gasoline is cost of motor-vehicle use because a change in motor-vehicle use will result in a change in gasoline use, all other things being equal.

However, for the purpose of planning, Delucchi (1996) suggested that analysts should care not only whether something is a cost of motor vehicle use, but if it is a cost, exactly how is it related to motor-vehicle use. For example, pollution is a direct, immediate cost of motor-vehicle use. If you change motor-vehicle use a little, you will immediately change pollution a little. In order to capture all the costs of motor-vehicle use, Delucchi (1996) identified many of the impacts and resources of motor-vehicle use: health, aesthetic, environmental and similar impacts of motor vehicle use. The social benefits of motor vehicle use are the value that the beneficiaries ascribe to motor vehicle use. What transport economists referred to as the total "willingness to pay" for motor vehicle use (Zegras and Litman 1997). The estimates of total social cost of motor-vehicle use are useful for evaluation, efficient price determination and prioritization of funding for transport services, projects and researches.

Consequently, if social cost estimates is to be useful to policy makers who want improvement in the efficiency of the use of transportation system, then cost should be analyzed and categorized on the basis of economic efficiency in production and consumption (Carvigni et'al (2013). Classification with respect to the efficiency condition implies Marginal Social Value equals to the Price and also equal to Marginal Social Cost i.e. *MSV = P*

= *MSC*. However, most real market do not allocate resource efficiently, according to *MSV = P = MSC*, because most production and consumption invests some sort of externality and most prices are influenced by distortionary (non- optimal) taxes (Carrutiers et' al (2005). There are a variety of reasons why market might not allocate resources optimally; these reasons are natural organizing principle for a social - cost analysis, because there are prescriptions for every kind of inefficiency. To organize costs with respect to efficiency or inefficiency of allocation is tantamount to organizing costs with respect to prescriptions for maximizing efficiency. This is useful to policy makers. The principle of this efficiency oriented classification of cost is that to account for a cost, a commuter knows its magnitude and be required to bear it (Carvigni et'al 2013).

The emphasis on price and on individual resource-use decision keeps the analysis property focused on economic efficiency. Theoretically, the social cost of any item x (tyres, roads, disturbance by noise, suffering from asthma caused by air pollution) is equal to the quantity X (number of tyre, kilometers to roads, excess decibel or exposure, days of suffering from asthma) multiplied by the unit cost of X (₦) tyre, ₦/road-kms, ₦/exess decibel, ₦/day of suffering) (Carrutiers et' al (2005). This also brings the need for distinction between "monetary" and "non-monetary" costs. An item is classified as "monetary" cost if we can observe or estimate N/unit cost (or value) directly from market transactions. Thus, because we can observe the ₦/unit cost of building roads, tyre and roads are classified as monetary costs. By contrast, we cannot observe directly the unit cost of noise or air pollution (₦/decibel or ₦/per day of suffering), because noise disturbance and suffering are not traded and valued in the market. However, protective or ameliorative measures, such as ear plugs or asthma medicine, often are valued in markets.

This distinction is methodologically important because, it is much more difficult to estimate ₦/unit cost of non-monetary items than for monetary items. Although transport economist have a variety of techniques (hedonic-price analysis, stated preferences and willingness to pay analysis) to estimate the ₦/unit costs of demand for non-monetary items of all, the techniques can be problematic and as a result the social non-monetary cost of motor vehicle use are often very uncertain at least much more uncertain than the monetary costs. With the above efficiency oriented consideration Delucchi (1996) identified six general cost categories namely: Personal monetary costs of motor vehicle use, motor vehicle goods and services priced in the private sector, estimated net of producer surplus and taxes and fees, motor-vehicle goods and services bundled in the private sector, motor-vehicle infrastructure and services in support of motor vehicle use, monetary externalities of motor-vehicle use and non-monetary costs of infrastructure.

1.2.3 The Value of Time

Matri and Sarkar (2010), provided an empirical framework for the estimation of value of time as a basis for computation of travel time cost of commuting. The theoretical underpinning of the concept is that it is an accepted fact that one method for optimizing the benefits from available time in one's life is to minimize commuting time. Two types of costs are incurred in a journey: trip costs (monetary cost) and time expended on the journey called travel time cost. Matri and Sarkar (2010) submitted that in most cases travelers choose to bear higher trip cost. This implies that commuter associate time saving with some benefits or some monetary gain or some utility, the weight given to travel time saving is called Value of Time (VOT). VOT is also referred to as Travel Time Cost (TTC) and is the value of time spent on a journey (including in-vehicle time, waiting time and accessibility time). Hogg (1970) defined value of time as the maximum amount of income an individual in a given situation would be willing to give up in order to save time in commuting.

For individual commuter and motorist, value of time depends on the importance he/she gives travel times in different situation, location, travel purpose and income. The value attached to travel time savings by the inhabitants of an urban area indicates the potential effectiveness of congestion pricing as a mechanism for reducing vehicle congestion on urban roads. Kadiyali (1979) and Reddy, et al (2003), identified three methods for empirical measurement of value of time, namely: wage rate, willingness to pay and revealed preference approach. In wage rate method the earnings of commuters are used to measure value of time. In this method, average earnings of commuters of different mode of travel are considered. Data related to purpose of travel,

occupation, monthly income, origin and destination are collected by interviewing commuters in a traffic corridor, Kadiyali (1979), suggested that monetary benefit like bonus, pensions, insurance etc. as provided by the employers should be added to earnings. Quarmby (1967), also included the value of accessibility, waiting and in-vehicle time. He suggested that if a vehicle is given a weight of 1, then accessibility and waiting time should be valued at 2 and 3 respectively. For the purpose of analysis the travel time cost is based on the average hourly wage rate of the vehicle occupants. In the willingness to pay approach, questionnaire method is used to ask the commuters how much they are willing to pay with respects to their earnings for reducing their travel time. The principle is that the premium commuters are willing to pay to reduce travel time (and other externalities) is a surrogate of the cost of travel time (and other externalities). Revealed or stated preference approach is based on studying what choices are made by people when they are faced with a number of alternatives for their journey. Revealed preference methods uncover estimate of the value of non-market goods by using evidence of how people behave in the face of real choices of mode, route, destination and location of home.

III.   The Study Area

Lagos Metropolis lies in the South Western part of Nigeria on the West Coast of Africa. It is bounded in the North and East by Ogun State, in the West by Republic of Benin and in the South by Atlantic Ocean. The boundaries of Lagos lies within latitude of 6º 23' N and 6º 41' N of the equator and longitude 30º 9'E and 3º 28' E of Greenwich Meridian. Lagos Metropolitan Area originated on Islands separated by creeks and Lagos Island, fringing the South Western part of Lagos Lagoon projected from the Atlantic Ocean by long sand spits, Bar Beach, which stretch up to 100 kilometers East and West. The metropolitan Lagos was defined by Ayeni (1975) as the stretch of continuously built-up land beginning from Agege in the North to Maroko in the South and extending from Lagos Lagoon in the East to Amuwo-Odofin and FESTAC town on the Badagry road. The area constitutes less than 2.5% of Nigeria's total land area of about 923,760km^2.

The Metropolitan Lagos extends over 16 of the 20 LGAs namely: Agege, Ajeromi-Ifelodun, Alimosho, Amuwo-odofin, Apapa, Eti-Osa and Ifako-Ijaye. Others are Ikeja, Kosofe, Lagos island, Lagos Mainland, Mushin, Ojo, Oshodi-Isolo,Somolu and Surulere. The area contains about 88% of the population of Lagos State and includes some semi-rural areas (Adalemo 1981). The 2006 National Population Census of Nigeria put the population of the metropolitan area of Lagos 7,937,932. Fig 1 shows the metropolitan area of Lagos. The study area has one of the largest and most extensive road networks in West Africa. It also has suburban trains and some ferry services. It is naturally endowed with creeks, lagoon and navigable water bodies that are suitable for urban transit service. The rail line runs, longitudinally along the south-north axis of the metropolis. Highways are usually congested in peak hours, due in part to the geography of the city, as well as to its explosive population growth. Taiwo (2005) noted that there are about 2,600km of roads in Lagos that are usually congested with over million people plying them daily. Oni (2004), observes that while Lagos State has the potential to benefit from a seamless multi-modal transportation system, the road transportation still dominates more than 90% of intra-urban movement in the State.

Figure 1: Lagos Metropolitan Area

The economic dominance of Lagos in Nigeria foreign trade remained at about 70% in 1967 and further rose to 90% during and after the civil war (1967-1970) (Badejo, 1990).. Lagos is Nigeria's economic focal point, generating a big significant portion of the country GDP. The geographical location of Lagos State as a coastal state is a major selling point which makes international trade easy. Lagos port handles substantial volume of about 60% of the trading activities of the port across the country. The 180km coastline of Lagos presents enormous opportunities for tourism. As a major financial centre of the country, Lagos provides infrastructure and access not only to financial services that international business depend upon but also the leisure that the international operators will need. The Ikeja, Apapa, Opebi, Ilupeju, Ogba, Matori and Oregun are the industrial zones in Lagos ranging from multi-national, large, medium and small scale industries.

IV. Methodology

Primary and secondary sources were used to source the data. The primary data were collected through administration of questionnaires to households in Lagos Metropolitan Area, the data types include: socio-economic characteristics of commuting households (income, wages, commuting modal choice, household expenditures on Commuting, trip purpose, origin and destination, travel time, public transport service availability and household car ownerships status). The secondary sources were obtained from the records of Federal Road Safety Corps, Lagos Metropolitan Transport Authority (LAMATA), Lagos State Bureau of Statistics and Ministry of Physical Planning and Urban Development.

The sampling frame used for the survey is the households' records of the LAMATA. The total projected population of Lagos metropolitan areas by 2014 census was 7,937,932. A report of survey of water supply, sanitation and refuse services in Urban Areas of Lagos (2012) shows that the average household size of metropolitan Lagos is 6 persons. Thus the estimated number of household in metropolitan Lagos is 7937932/6 which is 1,322,989. The study therefore, sampled 3,307 households representing 0.0025 of the estimated number of households. This is in line with Borg and Gall (1983), who suggested that researchers should weigh the factors of accuracy, cost, time available for the survey, homogeneity of the accessible population, type of

sampling and land of study to determine the best size for his study using the sample size rule of thumb, given the above consideration this sample size is considered adequate. Furthermore, Odugbemi and Oyesiku (2000), posited that, when sampling frame is large and resources are limited, representation is the best option. Therefore, out of 3,307 questionnaires administered 3,061 were returned completed giving a response rate of 92.56%. The Stratified sampling technique (using each Local Government areas as stratum) was employed. The number of questionnaires administered to each Local government areas is proportional to the population size as shown in Table 1.

Table 1. Sampled Population by Local Government Area

LGA	Population size	Sampling frame (household)	Sample size (selected households)	Completed questionnaires
Agege	459,939	76,657	192	177
Ajeomi/Ifelodun	684,106	114,018	285	264
Alimosho	1,277,714	212,952	532	493
Amuwo-Odofin	318,166	53,028	132	122
Apapa	217,363	36,227	90	83
Etiosa	287,785	47,964	140	111
Ifako-Ijaiye	427,878	71,313	178	165
Ikeja	313,196	52,199	130	121
Kosofe	665,393	110,899	277	257
Lagos Island	209,437	34,906	87	80
Lagos Mainland	317,720	52,953	132	122
Mushin	633,009	105,502	264	245
Ojo	598,071	99,679	249	231
Oshodi/Isolo	621,509	103,585	259	240
Shomolu	402,673	67,112	168	156
Surulere	503,975	83,996	210	194
Total	**7,937,932**	**1,322,989**	**3,307**	**3,061**

Sources: Adapted From National Population Commission Records (2015)

The data were analyzed through descriptive and inferential analysis. Quantitative data generated from the questionnaires were presented in percentages, tables, charts and graphs. Furthermore, Statistical Package for the Social Science (SPSS) was used to do critical analysis of the variables relevant Components of personal and external costs of commuting. Based on the concepts of divergence between private and social cost of transport and annualized cost of motor vehicle use, the private cost components of social cost were determined, namely, monetary cost and time cost of commuting trip.

With regards to monetary cost subcomponents analysis, the average fare paid for commuting by workers using public transport were used, while the operating cost for the use of the private cars collated from the questionnaire were used for workers using private cars for commuting. The time subcomponent of private cost component of social cost was operationalized by collating commuting time of workers in Lagos Metropolis, which was then summarized and presented in term of tables and charts. Using empirical framework for the estimation of value of time provided by Matri and Sarkar (2010), average commuting value of time using wage rate method were computed separately for workers using public transport and those using private car for commuting. Stated Preferences Analysis was also used in the willingness to pay approach for estimating the value of commuting time. This approach was anchored on the value of time model provided by Matri and Sarkar (2010). The student t-test statistical tool was used to test the hypothesis.

V. Results and Discussions

1.5.1 Personal Monetary Cost of Commuting

Personal monetary cost of commuting consists of expenditures made by commuters in travel to work. For households using car/private vehicles for commuting user costs include vehicle ownership and operating costs,

while public transport mode (LAGBUS/BRT, other commercial buses, train, ferry, taxi and commercial motorcycles) commuting costs are fares paid by the commuters. Thus, this study assumes that overall average fares cover public transport operating cost including driver's salaries. The private cars user cost can be categorized into fixed costs and variable costs, fixed cost items are depreciation, vehicle registration, insurance and licensing fee, while the variable costs consist of fuel expenses, maintenance, tyres and hourly/daily parking fee. Once a vehicle owner has paid fixed cost, he or she has an incentive to maximizing his/her driving in order to get his/her money worth. There is often a difference between perceived and actual car/ private vehicle costs. Private vehicles tend to perceive immediate costs such as travel time, stress, parking fees and fuel, while costs that are npt paid frequently like insurance, depreciation, maintenance, repairs and residential parking are often underestimated. This ignorance or non-consideration of real cost of car ownership and use in developing countries such as Nigeria explains why even though car ownership is lower in Nigeria than advanced countries, the use rate in Nigeria is higher than that of advanced countries.

1.5.2 Average Monthly Operating Cost for Car/Private Vehicle User
An important aspect of personal commuting cost incurred by commuters using private car is the operating costs. Table 2 shows that 21% of workers who use car/private vehicle for commuting expend below ₦10,000 monthly, while 35.6% of commuters spend between ₦10,000 and ₦25,000 monthly. Only about 15.9% spend above ₦45,000 monthly for personal commuting to work.

Table 2 Average Monthly Operating Cost for Private Vehicle User

S/N	Average Monthly Operating Cost	Frequency	Percentage (%)
1	Below ₦10,000	628	21.3
2	₦10,001 – ₦25,000	1047	35.6
3	₦25,001 – ₦45,000	802	27.2
4	Above ₦45,000	468	15.9
Total		**2945**	**100.0**

Source: Authors' Field Survey (2016)

Another factor affecting the social cost of commuting is travelling distance for commuting. The result of the investigation is presented in table 3.

Table 3 Commuters Traveling Distance to Work (Km)

KM Ranges	Frequency	Percentage
1-5 Km	693	23.8
6-10 Km	479	16.5
11-15 Km	463	15.9
16-20 Km	486	16.7
21-25 Km	397	13.7
26 Km and above	389	13.4
Total	**2907**	**100.0**

Source: Authors' Field Survey (2016)

As observed, about 40% of workers commute not more than 10 kilometers to work while 43.8% of workers commute more than 16 kilometers daily to work. The weighted average travel distance to work (kilometers) by Lagos Metropolitan workers is 13.8 kilometers. The average travel distance to work for Lagos metropolis is shorter than 2001 National Household Transport Survey (NHTS) study which reported that average commuting time for USA cities as 10 miles or 16 KM.

Table 4 Average Monthly Operating Cost for Private Vehicle Users by L.G.A.

LGA	Average Monthly Operating Cost	Average Monthly Commuting distance to Work(Km)	Operating Cost /Km
Agege	₦32612	500	₦ 65
AjeromiIfelodun	₦ 38247	375	₦102
Alimosho	₦ 29699	625	₦ 48
AmuwoIdofin	₦ 36216	375	₦ 97
Apapa	₦ 38833	325	₦119
EtiOsa	₦ 21273	175	₦ 122
IfakoIjaye	₦ 5036	150	₦ 34
Ikeja	₦ 31346	125	₦251
Kosofe	₦ 24678	150	₦165
Lagos Island	₦ 25500	175	₦146
Mainland	₦ 28260	375	₦ 75
Mushin	₦ 32000	425	₦ 75
Ojo	₦ 44966	750	₦ 60
Osodi-Isolo	₦ 23673	450	₦ 53
Somolu	₦ 27159	200	₦136
Surulere	₦ 30160	425	₦ 71
Metropolitan	₦29354	350	₦ 84
*Assumption: 25 working days per month			

Source: Authors, Field Survey (2016)

From Table 4, average monthly operating cost for car/private cost ranges from ₦5,036 in Ifako/Ijaye to ₦44, 966 in Ojo. The average monthly operating costs in the Local Government Area depend on average monthly commuting distance in kilometer to work among other factors. Thus the relative low average monthly commuting distance to work (150km) accounted for low monthly operating cost, while Ojo with the highest average monthly operating cost also have its residents having the highest average monthly commuting distance to work (750 km). The operating cost per kilometer varies from ₦34 in Ifako/Ijaiye to ₦251 in Ikeja. The relatively high operations cost in the relatively upscale local government area of Lagos Metropolitan Area (Eti-Osa, Ikeja, Apapa and Lagos Island) is directly related to the high engine capacity (with capacity for high fuel consumption) of the vehicle used by the residents of these areas). The average monthly operating cost of private vehicle in Lagos Metropolitan areas as a whole is ₦29, 354 with average monthly commuting distance to work of 350 kilometers and an average operating cost per kilometer of ₦84.

1.5.3 Composition of Private vehicle Annual Operating Cost
Table 5 shows fuel expenses constitute the highest proportion of total private vehicle annual operating cost (45.8%), followed by maintenance cost (16.9%). The other cost items with significant proportion are tyres (9.5%) and lubricant (9.2%).

Table 5 Composition of Private Vehicle/Car Annual Operating Cost

Composition of Operating Cost	Percentage (%)
Fuel	45.8
Lubricant	9.2
Spare part	6.1
Maintenance	16.9
Depreciation	2.1
Registration (vehicle)	1.1
Tyres	9.5
Insurance	3.6
Parking	2.4
Licensing	3.3
Total	**100.0**

Source: Authors' Field Survey (2016)

It is important to note that the cost of ownership of a private vehicle represented by annual depreciation constitute almost the lowest proportion (2.1%). Thus, average annual cost of running a motor car (fuel expenses, maintenance cost, tyres and lubricant) is far larger than cost of purchase (whose annual cost represented by depreciation cost is just 2.1% of the total operation cost). The deduction from this result is that while workers consider the purchase price of vehicle in acquiring a private car, the more important decision factor should be the cost of operating the vehicle.

1.5.4 Commuting Time and Value of Time Commuters Spent in Travelling to Work

The need to examine commuting and value of commuting time was to be able to carry out multivariate analysis of the variable that have significant effect on commuting time/cost component. Table 6 and Figure 2 shows the proportion of commuters in the different total one-way commuting time range for residents of different Local Government Areas

Table 6 One Way Commuting Time for Residents of Lagos Metropolis

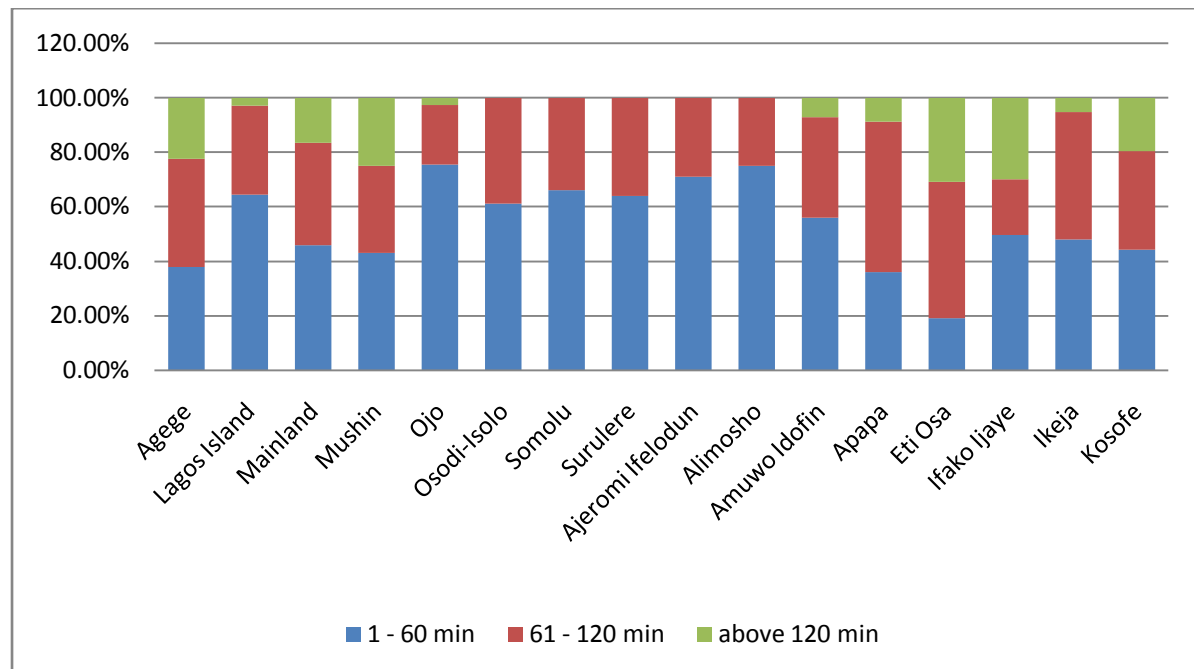| L.G.A	Freq.	1 - 60 min	61 - 120 min	above 120 min	%
					100%
Agege	177	37.8%	39.8%	22.3%	100%
Lagos Island	264	64.5%	32.6%	2.8%	100%
Mainland	493	45.9%	37.7%	16.4%	100%
Mushin	122	43.0%	32.0%	24.9%	100%
Ojo	83	75.6%	21.9%	2.4%	100%
Osodi-Isolo	111	61.1%	38.9%	0.0%	100%
Somolu	165	66.0%	34.0%	0.0%	100%
Surulere	121	63.9%	36.1%	0.0%	100%
Ajeromi/Ifelodun	257	71.0%	28.9%	0.0%	100%
Alimosho	80	75.0%	25.0%	0.0%	100%
Amuwo/Idofin	122	56.1%	36.8%	7.0%	100%
Apapa	245	35.9%	55.5%	8.6%	100%
EtiOsa	231	19.1%	50.0%	30.9%	100%
IfakoIjaye	240	49.7%	20.4%	29.8%	100%
Ikeja	156	48.0%	46.9%	5.0%	
Kosofe	194	44.3%	36.1%	19.7%	
Total	**3,061**	**50.1%**	**36.9%**	**12.9%**	**100%**

Source: Authors' Field Survey (2016)

Figure 2: One Way Commuting Time for Residents of Lagos Metropolis

In general, 50.1% of commuters in Lagos metropolis spend between 1 – 16 minutes for one way commuting to work while only 12.9% of household travel spends above 120 minutes to work. Local Government Areas (LGA) where household spend low one way commuting time to work are Lagos Island, Ojo, Oshodi/Isolo, Somolu, Surulere, Ajeromi/Ifelodun and Alimosho. In these LGA's more than 60% of the household spend 60 minute and less to get to their work places. On the other hand more than 20% of resident of Agege, Mushin Etiosa and Ifako/Ijaiye spend as much as 120 minutes (2 hours) to commute to work daily. This reflects the distance of the various LGAs to the Central Business Districts (CBD) located in Lagos Mainland, Lagos Island, Apapa and Ikeja.

1.5.5 Commuting Value of Time

Table 7 computes the value of time for commuting by Lagos metropolitan households using public transport.

Table 7 Value of Time for Commuters Using Public Transport by Wage Rate Method

Metropolitan LGA	Median salary (N/month) (9)	Commuting Time by Public Transport (Min) (b)	Wage rate per hour= C=9/200	Commuting Time by Public Trans per hour =	VOT for Commuting by Public Transport per hour: e = C x d
Agege	₦ 100,000	94	₦ 500	1.6	₦ 800
AjeromiIfelodun	₦ 200,000	72	₦ 1,000	1.2	₦ 1,200
Alimosho	₦ 150,000	87	₦ 750	1.5	₦ 1,125
AmuwoIdofin	₦ 200,000	116	₦ 1,000	1.9	₦ 1,900
Apapa	₦ 150,000	54	₦ 750	0.9	₦ 675
EtiOsa	₦ 350,000	55	₦ 1,750	0.9	₦ 1,575
IfakoIjaye	₦ 100,000	69	₦ 500	1.2	₦ 600
Ikeja	₦ 200,000	58	₦ 1,000	1.0	₦ 1,000
Kosofe	₦ 200,000	30	₦ 1,000	0.5	₦ 500
Lagos Island	₦ 200,000	44	₦ 1,000	0.7	₦ 700
Mainland	₦ 200,000	70	₦ 1,000	1.2	₦ 1,200
Mushin	₦ 75,000	56	₦ 375	0.9	₦ 338
Ojo	₦100,000	97	₦ 500	1.6	₦ 800
Osodi-Isolo	₦ 100,000	89	₦ 500	1.5	₦ 750
Somolu	₦ 150,000	61	₦ 750	1.0	₦ 750
Surulere	₦ 50,000	92	₦ 250	1.5	₦ 375
Metropolitan	**₦ 150,000**	**72**	**₦ 789**	**1.2**	**₦ 947**

Source: Author's Field Survey (2016)
* Assumption: 8 working hours and 25 working day

The Lagos Metropolitan LGAs with excessive value of time (value of commuting time > hourly wage rate) are Agege, Ajeromi/Ifelodun, Alimosho, Amuwo Odofin, Etiosa, Mushin, Ojo, Oshodi – Isolo, and Surulere Local Government Areas with moderate value of time devoted to commuting (i.e. value of commuting time almost equal to hourly wage rate) are Apapa, Ikeja, Kosofe, Lagos Island, and Lagos Mainland while Ifako/Ijaiye, and Shomolu spent their hourly wage rate on commuting. For the Lagos Metropolitan Area as a whole the average commuting time is 72 minutes, hourly wage rate of ₦789 and value of time for commuting by public transport per hour is ₦947.

Table 8 Commuting Value of Time of Commuters Using Private Vehicle by Wage Rate Method

Metropolitan LGA	Median salary (₦/month) (a)	Average Commuting Time in hour by car owners (b)	Occupancy (assume 1) (c)	Salary ₦/hour =9/200	VOT (₦/hour) d=b x d
Agege	₦ 100,000	0.91	1	₦ 500	₦ 455
Ajeromi/Ifelodun	₦ 200,000	1.48	1	₦ 1,000	₦ 1,480
Alimosho	₦ 100,000	1.29	1	₦ 500	₦ 645
Amuwo/Odofin	₦ 100,000	1.96	1	₦ 500	₦ 980
Apapa	₦ 200,000	1.82	1	₦ 1,000	₦ 1,820
Eti-Osa	₦ 400,000	0.77	1	₦ 2,000	₦ 1,540
IfakoIjaye	₦ 100,000	0.86	1	₦ 500	₦ 430
Ikeja	₦ 100,000	0.77	1	₦ 500	₦ 385

Kosofe	₦ 200,000	0.67	1	₦ 1,000	₦	670
Lagos Island	₦ 300,000	0.90	1	₦ 1,500	₦	1,350
Mainland	₦ 400,000	0.85	1	₦ 2,000	₦	1,700
Mushin	₦ 150,000	1.19	1	₦ 750	₦	893
Ojo	₦ 300,000	2.07	1	₦ 1,500	₦	3,105
Osodi-Isolo	₦ 100,000	2.10	1	₦ 500	₦	1,050
Somolu	₦ 200,000	0.92	1	₦ 1,000	₦	920
Surulere	₦ 200,000	1.55	1	₦ 1,000	₦	1,550
Lagos Metropolitan	₦ **200,000**	1.26	1	₦ **1,000**	₦	1,260

Source: Authors' Field Survey (2016)
* Assumption: 8 working hours and 25 working day

From the computation of value of commuting time by wage rate method in Table 8, it is clearly shown that the values of commuting time in some Local Government Areas are higher than the hourly wage rate of the resident because of the relatively high commuting time. This implies that commuters are not adequately compensated for commuting. The Local Government Areas with moderate commuting value of time (i.e. where commuting value of time < hourly wage rate) are Apapa, Eti-Osa, Ifako/Ijaiye, Ikeja, Kosofe, Lagos Island, Mainland, and Shomolu. The Local Government Areas with excessive monetary time devoted to daily commuting (i.e. where commuting value of time > hourly wage rate) are Agege, Ajeromi/Ifelodun, Alimosho, Amuwo/Odofin, Mushin, Ojo, Oshodi, Isolo, and Surulere with resident of Ojo devoting more than double their hourly wage rate to commuting. For Lagos Metropolitan as a whole, the average commuting time is 1.26 hours, hourly wage rate of ₦1, 000 and commuting value of time ₦1, 260 implying commuting value of time is higher than hourly wage rate by ₦ 260 on the average.

1.5.6 Testing of Hypothesis

H_o: The average monetary cost of commuting to work in Lagos is not higher than internationally acceptable affordable level.
H_1: The average monetary cost of commuting to work in Lagos is higher than internationally acceptable affordable level.

Using an alpha level 0.05, an independent samples t-test was conducted to evaluate whether the average transportation affordability index for Lagos metropolis differed significantly from the global index. The test was significant, $t = -5.328$, $p < 0.05$. The result shows a significant difference between the average transportation affordability index for Lagos metropolis and the global acceptable standard index. An examination of the group means above indicate that global acceptable standard for transportation affordability index (M = 1.0) is significantly greater that affordability index for Lagos metropolis (M = 8.75, SD = 6.96).

VI.   Recommendations and Conclusion

1.6.1 Recommendations

An important outcome of the study is the reality that working families in Lagos metropolitan areas make complex decision about where to live and where to work, thus balancing their preferences for factors of their home against location and financial remuneration of their jobs, since, the choice each household makes greatly affects the family's quality of life. Moreover, the location and accessibility of affordable neighborhoods and transportation options play key role in shaping the landscape of Lagos metropolis. In order to influence workers and other stakeholders' decision making toward socially desirable options, the following recommendations are hereby advanced:

- Lagos megacity planners should coordinate their housing and transport policies to ensure they fully reflect the needs of working households (especially the poor). In otherworld, they should build more

affordable houses near existing and planned public transport hubs. Another example is targeting transportation improvement on areas with large numbers of moderate-income workers with long and expensive commuting to workplace destinations like Ajeromi/Ifelodun, Alimosho, Kosofe, Agege, and Ojo.

- The finding that there is a direct positive correlation between commuters income and average monthly cost for private vehicle use and the fact that the car use rate in Lagos metropolis is higher than most developed countries is a warning signal to policy makers. Therefore, Policy strategies that can be used to internalize the external cost of motor car use (to make the users of motor cars bear the full social cost of using motor cars) ranges from parking charge to congestions pricing or increased fuel tax should be considered as a remedial measure as it is currently been practice Singapore and United Kingdom.

However an important factor that will determine how effective these strategies will be in Lagos metropolis is the elasticity of demand for the use of motor car for urban commuting. Where the elasticity of demand is high, the strategies are likely to be more effective. On the other hand if the demand for car travel is price inelastic, demand for car ownership and use will not respond to an increase in price and so pricing strategy will be less effective. The alternative or complementary supply oriented strategy to cope with pervasive traffic congestion problem is for policy makers to induce greater patronage of public transport mode such as Bus Rapid Transit (BRT) which is already in place in Lagos metropolis; it can do so by introducing subsidy to reduce the fare paid by commuters.

1.6.2 Conclusion

An important point established by the study is that commuting provides a key link to economic mobility for the working poor. With access to affordable transportation options, the working poor are able to commute to opportunities - find better jobs, lower household expenses and increase their earnings. Another important aspect of this study is the estimation of external cost of commuting. The awareness of these external costs should expose the need to explore policy changes that might bring efficiency gains by correcting for road use externalities. Since there is little agreement in literature about precisely which costs should be counted in a social analysis of commuting cost and which aspect of social cost is directly relevant to Metropolitan Cities in developing nations, where in most cases there have not been appropriate tax and subsidies for public transportation and there is paucity of relevant secondary transportation data. This study therefore has provided framework for analysis and estimation of private cost of commuting that is appropriate to Nigerian cities and other developing cities. The work has been able to come out with appropriate cost elements to be included in private costs of commuting in Lagos Metropolis which can be used as a guide for policy decisions aimed at providing affordable public transport system for Lagos metropolitan area.

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