Faculty of Operation and Economics of Transport and Communications
University of Žilina
Žilina, Slovakia

TRANSPORT AND COMMUNICATIONS

Scientific journal

tac.uniza.sk

I/2021 Volume IX ISSN 1339-5130

TRANSPORT AND COMMUNICATIONS

Scientific journal intended to combine theory and practice in the field transport and communications and thus advancement of transport and communications sciences

DOI: 10.26552/tac.J.2021.1
ISSN 1339-5130

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DOI: 10.26552/tac.C.2021.1.1

Socio-Economic Characteristics and Taxis Services Patronage in Lagos State, Nigeria

Oluwaseyi Joseph Afolabi[1], Taiwo Kareem Alli[2], Bukola Temitope Falayi[1]

[1]Department of Management Technology, Bells University of Technology, Ota, Nigeria
[2]Department of Transport Management, Olabisi Onabanjo University, Ago-Iwoye, Nigeria

Abstract Taxi service is a pivotal instrument in public transport and its dominance is highly felt in providing door to door service in place and time utility. It is in respect of this importance that this study examined the socio-economic characteristics influence on taxis services patronage in Lagos State. 304 completed questionnaires were used in seeking information from the passengers on their socio-economic characteristics and variation in patronage using multistage sampling technique. Descriptive statistics were used in describing socio-economic characteristics while inferential statistical tools of multiple regression analysis were used to determine the influence of socio-economic characteristics on patronage. It was observed from the findings that there is a strong correlation between the passenger patronage of the Taxi companies and socio-economic characteristics of age (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) with R = 0.986) in Uber, R = 0.983 in Oga Taxi and R = 0.974 in Bolt Taxi. Hence, it is recommended that strict rules and regulations guiding routine operation and service delivery to the populace must be adhere to, recruitment and selection of drivers be considered on merit with high level of scrutiny

Keywords Transportation, Taxis, Patronage, Services, Passenger

JEL H54, H59, N77

1. Introduction

Transport is the backbone of urban life. It is one of the main factors that determine the socio-economic and political development of a city. Accessibility and mobility provided by the efficient transport system have been playing a significance role in shaping cities, influencing the location of economic and social activity, by facilitating trade, permitting access to resources and people, and enabling greater economies of scale globally [1]. In every aspect of man's activities, transportation has come to play a vital role, which ranks it among the most important determinants of any success in such human activities. The transportation of goods and services has become vital to the Nigerian economy due to foreign exchange earnings to this sector of the economy. Transportation is a good and very strong backbone for a vibrant and growing nation [19].

The major modes of transport in any urban and rural areas of a country either developed or developing include road, rail, air and water which are used in conveying both passengers and freight transport [4]. The freight transport is the conveyance of goods from origin to destination while passenger transport is the movement of people from one location to another all at the right time [23]. The passenger transports can be examined through it types and capacity which are public transport and private transport. Private passenger transport is the movement of passengers through private owned vehicles while public passengers transport is operated by government or individual for a share ride or group ride for the public and usually on commercial basis [3].

Shared taxis are common in many developing and several developed and developing countries. They can be seen either as a part of conventional public transport or a separate segment or as a form of street market taxi. The mode occurs in many forms with varying degrees of legality and regulation. Shared taxis are a form of conventional public transport, between mass transit systems and ordinary taxis. In some places it operates on predefined lines, as an unscheduled bus service, in other word, the taxi picks up passengers along the way after the first passenger give the direction [6]. Shared taxis will typically have larger overlapping market segments with scheduled public transport than metered taxis [10].

Reference [5] in their study of taxis services were of the opinion that taxis provide a point- to- point service available to the public and as such a part of public transport which is so even, if the lack of regular schedules, routes set stations and subsidies characterizing the main part of the public transport, gives it a semi-private character. They further assumed that, taxis constitute an accessibility component, in that they provide mobility for persons who, for geograph-

ical or disability reasons cannot use the conventional public transport system.

2. Literature Review

Taxis as a form of public transport in urban settings have been studied in diverse dimension based on the thoughts and submissions of different scholars as far as public transport research is concern. Reference [15] observed that the use of taxi is widespread in most African cities, like Nigeria, Ghana, South Africa, etc. and they dominate the urban transport market. While Reference [10] emphasized that taxis constitute about 65% or more of all passengers' journeys and render mobility service to about 3 to 5 million people on a daily basis and also National Survey posits that 46% of Africans in urban areas of South Africa travel by taxis, followed by bus (20%) and train (13%).

Reference [17] described the taxi driver's operation patterns and difference between top drivers and ordinary drivers' behaviour in Shenzhen and discussed taxi drivers' behaviour based on the taxi daily GPS traces data; they analysed the drivers' spatial selection behaviour, operation behaviour, and route choice behaviour. Reference [24] focused more on the spatial distribution of taxi services in one day, while [13] mainly analysed the one-day taxi temporal distribution of customers' pick-up and drop-off times in Guangzhou, China.

Reference [13] investigates road safety and older taxi drivers' behaviour in Monaghan. The study reports that although habits such as drunk driving and speeding, which are major risk behaviour on roads, are common among older taxi drivers, but they still drive more carefully on roads than young taxi drivers. Reference [22] also investigate relationship between demographic characteristics of drivers and driving behaviour using prevention magazine data from 1994 to 1995 on four-way ANOVA model. Study shows that only female drivers were more law-abiding compared with the male. The research, however, shows that severity of punishment and consistent penalty to offenders substantially impact driving behaviour.

Reference [14] observes the relationship between risky driving behaviour, attitudes, and accident involvement. The study notes that attitudes of drivers contribute significantly in predicting driving behaviours and involvement in accident. Many people all over the world are killed and severely injured in road traffic crashes due to incessant deviant driving behaviour of drivers particularly, commercial drivers.

Reference [20] stated that "Call taxi have a greater value in the community, the taxi industry is regulated in various ways by the state Governments through their respective Departments of Transport. Through this regulation the Government is able to exert some control over the activities of the industry, with the ultimate objective of providing a higher level of service (a complex construct in itself) to the public. This study is mainly used to identify the awareness towards call taxi services, factors influencing the choice of call taxi services, satisfaction towards the call taxi services, and the challenges faced by commuters while using call taxi services.

Reference [12] suggested that high quality service can increase customer satisfaction. Quality factors in taxi service such as comfort, reliability, safety, price affordability and driver's attitude, nonstop service influence the taxi passenger satisfaction. Reference [24] inferred that there is a relation between service quality and satisfaction in taxi industry. The results of their study showed that improved service quality can increase satisfaction of taxi passengers.

Reference [7] focuses on analyzing the cab company's customer dataset which will help company to analyze its frequent customers so that the company can understand its customers and can provide different offers to them.

Reference [21] stated that "Every other day in India, there is a new start up offering efficient cab service to the citizens operating in urban and rural lifestyles. This raises a question that is India going through a possible 'Taxi Revolution'.

Some scholars argued that the prices were the direct factors, which included monetary costs, travel time, discomfort and risk. The changes of price influenced the consumption of transport a lot. From the results of those studies, the demand for transport decreased gradually as the prices went up, [16] while [8] provided a basic model to show optimal levels of taxi prices and service quality. On the other hand, several researchers together analysed how car ownership, land use, population, employment and wider transport policies affected the demand for public transport in the Britain. They planned to produce a document to assist cost-effective schemes for improving public transport services [2].

Reference [11] argued that the development of society, urban natural conditions and urbanization level had effects on taxi passengers' demand for the taxi and they concluded that the demand would increase dramatically if society in China developed better, urban natural conditions were friendlier for taxi to run, and the urbanization level rose up.

Studies have thus been centred on types and form of market, operations, regulations; service quality as well as accidents occurrence as far as taxi industries is concern. But there is no in-depth knowledge and contribution regarding comparison of the service quality of one taxi company to one another especially in developing world which Nigeria is among and hence this creates a vacuum in public passenger's transport research.

3. The Methods

3.1. Data Collection

The primary data mainly comprised of physical observation and questionnaire administration to the customers of each taxi company at their various head offices in Lagos state. The questionnaire was used to examine the socio-economic characteristics of the passengers while the secondary data involved information gathered from reconnaissance survey in form of population of study area collected from National Bureau of Statistics (NBS) and Lagos state ministry of

DOI: 10.26552/tac.C.2021.1.1

Science and Technology, brief history of the Taxi companies involved form the various archives of the companies (Uber, Oga Taxi, Bolt) as well as existing and current journals and articles relating to taxis service quality to passengers.

3.2 Study Population

The projected and estimated population of Lagos state as at 2019 is estimated at 26,435,405 and the whole 20 recognised local governments were involved in the study that is questionnaire was administered to all the local governments. Based on the overall total of sample size, a total of 400 questionnaires were administered and 304 questionnaires were returned for the analysis. The distributions were based on the basis of the fraction of individual population to the overall population of Lagos.

3.3 Sampling Techniques

A multistage sampling technique was adopted which involve the combination of quota and simple random sampling techniques analysis till the questionnaires got exhausted for the individual local government. The administration was done by placing them in the vehicles for each and every trip between origin and destination of the Taxis companies to the passengers' final destinations while the whole exercise lasted for a period of two months.

3.4 Method of Data Analysis

The descriptive tools of frequency distribution, graph, table and simple percentages were used in presenting, interpreting, explaining and describing the effect of socio-economic characteristics of passengers of the services rendered by the Taxi companies. The inferential statistical tool of multiple regression analysis was used to analyse the influence of socio-economic characteristics of passengers on patronage of the Taxis companies.

4. Results and Discussions

4.1 Socio-Economic Characteristics Influence on Taxis Services Patronage

The socio-economic characteristics of the passengers go a long way in establishing taxis services patronage in the study area. The most important and critical attributes of socio-economic status investigated in the study which efficiently influence and determine taxis services' patronage include age distribution, gender composition, educational qualification, income distribution and Occupation.

4.1.1 Age Distribution of Passengers of Taxi Companies

The study observed that out of the 304 passengers examined in the study area, out of which 37.50% (114) were from Uber taxi, 22.37% (68) from Oga taxi and 122 passengers from Bolt taxi forming 40.13%. The age distribution among these taxi shows that an average of 48.34% of the passengers was between the ages of 31 – 40 years of age while 27.72% belonged to the age range of 41 – 50 years as shown in Table 1. The similar table adequately revealed that 19.37% was between 18 – 30 years of age and 4.57% fall within 51 years and above.

Table 1. Age Distribution of Passengers of Taxi Companies

Age	Uber	%	Oga	%	Bolt	%	Total	Average (%)
18 - 30 years	17	14.91	16	23.53	24	19.67	58.11	19.37
31 - 40 years	47	41.23	31	45.59	71	58.20	145.01	48.34
41 - 50 years	45	39.47	18	26.47	21	17.21	83.16	27.72
51 years above	5	4.39	3	4.41	6	4.92	13.72	4.57
Total	**114**		**68**		**122**	**304**		
Percentage	**37.50**		**22.37**		**40.13**			

Author's Field Survey, 2021

Further investigation showed that, age grade between 31 – 40 years dominated Uber passengers with 41.23% and 51 years and above was the minimum passengers' age examined 4.39% (5). The highest age range in Oga and Bolt taxi were 31 – 40 years with 45.59 % and 58.20% respectively while the lowest age range surveyed were 51 years in Oga taxi and Bolt with 4.41% and 4.92% accordingly. The study hence observed that majority of the passengers who patronised the taxi companies fall between the ages of 18 – 50 forming 95.43% of the surveyed samples and by implication they belong to the active working force of the population of Lagos state.

4.1.2 Gender Composition of Passengers of Taxi Companies

The gender composition from the study area showed that the proportion of female is greater than the male counterpart. It was revealed that, 53.78% of the passengers were female and 46.22% were male. In the same vein, 52.63% (60) are female and 47.37% (54) are male in Uber; 45.59% (31) are female and 54.41% (37) are male in Oga taxi and 63.11% (77) are female and 36.89% (45) are male in Bolt taxi as shown in figure 1. This submission may be as a result that, most women do have flair for luxury and comfort and resulted to

the use of the taxi instead of riding in their private and personal cars.

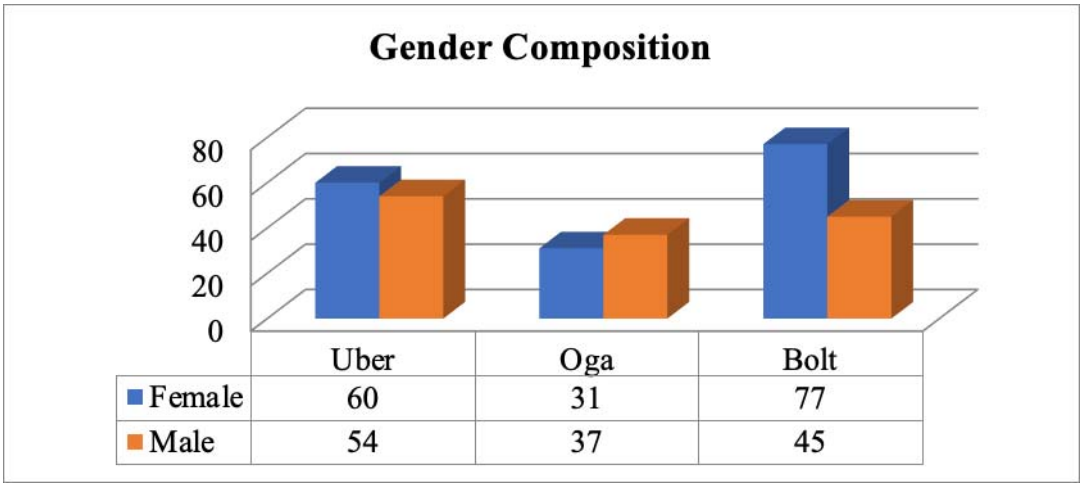

Figure 1. Gender Composition of Passengers of Taxi Companies

4.1.3 Education Qualification of Passengers of Taxi Companies

The educational status of the passengers is depicted in Table 2 with majority of the passengers have high level of educational background which ranges from higher national diploma (HND) to doctorate degree (Ph.D). 81.94% of the passengers held one or more of these while the remaining 18.06% had a brief stint of primary, secondary and other form of education in the surveyed sample. More importantly, the tertiary form of education is common with the passengers of the taxi companies in the following proportions: Uber – 97 (85.09%), Oga – 53 (77.94%) and Bolt - 101 (82.79%) as shown in Table 2.

Table 2. Educational Qualification of Passengers of Taxi Companies

Education	Uber	%	Oga	%	Bolt	%	Total	Average (%)
Primary	0	0	3	4.42	1	0.82	5.23	1.742
Secondary	4	3.51	6	8.82	2	1.64	13.97	4.66
Tertiary	97	85.09	53	77.94	101	82.79	245.82	81.94
Others	13	11.40	6	8.82	18	14.75	34.98	11.66
Total	**114**		**68**		**122**			**100**

Author's Field Survey, 2021

In all, the minimum level of education which is primary school and recorded with the least proportion with 3 (4.42%) in Oga and 1 (0.82%) in bolt taxi while Uber recorded nil. This can be assumed that majority of the passengers who fall within the active working population and highly educated use these taxi services to office, workplaces and so on within the study area.

4.1.4 The Occupation of Passengers of Taxi Companies

The profession of the passengers speaks volume of the capability and ability of patronage of the taxis companies, and this is indicated in the Table 3. The categories of passengers' occupations which dominated the study area are people who are privately employed and those on self-employment forming a proportion of 43.35% and 32.09% respectively. However, the dominance of these two, civil servants working with government ministries, agencies and department are also represented in the study with 11.84% while students and other forms of jobs were 3.73% and 3.93% respectively and unemployed people were 5.05%

DOI: 10.26552/tac.C.2021.1.1

Table 3. Occupation of Passengers of Taxi Companies

Occupation	Uber	%	Oga	%	Bolt	%	Total	Average
Student	4	3.51	3	4.41	4	3.28	11.20	3.73
Civil Servant	11	9.65	7	10.29	19	15.57	35.52	11.84
Private Employment	52	45.61	29	42.65	51	41.80	130.06	43.35
Self Employed	42	36.84	17	25.00	42	34.43	96.27	32.09
Unemployed	2	1.75	8	11.76	2	1.64	15.16	5.05
Others	3	2.63	4	5.88	4	3.28	11.79	3.93
	114		**68**		**122**	**265**		**100**

Author's Field Survey, 2021

The similar table equally reflected that, passengers who are private employees dictate in the three taxi companies with the following values Uber – 52 (45.61%), Oga – 29 (42.65%) and Bolt – 51 (41.80%). On the other hand, the least occupation status of the passengers in the study area is as follows; Unemployment in Uber and Bolt with 1.75% and 1.64% respectively while student in Oga taxi with 4.41%. The share of other various form of passengers' works in the study area are as follow for individual taxi company as indicated in same table 3: {Uber – students (3.51%), civil servant (9.65%), self-employment (36.84%), and other (2.63%); Oga – civil servants (10.29%), self-employment (25%), unemployment (11.76%) and others (5.88%) while for Bolt – students and others (3.28%) each, civil servant (15.57%) and self-employment (34.43%).

3.1.5 Income Distribution of Passengers of Taxi Companies.

The incomes, earnings or salaries suggest and determine the patronage capacity and power of the taxi companies' services by the passengers. Table 4 revealed that passengers with high earned incomes has the purchasing power of these taxi services as bulk of them received between ₦50,000 - ₦100,000 and ₦100,000 & above as either wage or salary with 25.47% and 46.87% respectively.

Table 4. Income Distribution of Passengers of Taxi Companies

Occupation	Uber	%	Oga	%	Bolt	%	Total	Average (%)
Below ₦5,000	2	1.75	0	0.00	3	2.46	4.21	1.40
₦5,000 - ₦20,000	8	7.02	9	13.24	7	5.74	25.99	8.66
₦20,000 - ₦50,000	29	25.44	8	12.76	19	15.57	52.78	17.59
₦50,000 - ₦100,000	30	26.32	14	20.59	36	29.51	76.41	25.47
Above ₦100,000	45	39.47	37	54.41	57	46.72	140.61	46.87
Total	**114**		**68**		**122**	**265**		**100**

Author's Field Survey, 2021

The findings of the study further revealed that, a very minute proportion of the sample surveyed who uses the service of the taxi company earn below ₦5,000 with 1.40% which maybe as a result of emergency and exigency situations at hand. The distributions of rest of the income were as follows: Uber has the highest income of passengers with ₦100,000 and above with 39.47%, lowest with below ₦5,000 (1.75%), ₦5,000 - ₦20,000 (7.02%), ₦20,000 - ₦50,000 (25.44%) and ₦50,000 - ₦100,000 with 26.32%. The trend in income of Bolt is similar to that of Uber as follows; Bolt has highest of ₦100,000 and above (42.527%) and lowest of below ₦5,000 (2.46%), while others are ₦5,000 - ₦20,000 (5.74%), ₦20,000 - ₦50,000 (15.57%) and ₦50,000 - ₦100,000 with 29.51% while Oga taxi's highest passengers' income is also ₦100,000 and above 54.41% and lowest of ₦20,000 - ₦50,000 12.76% and ₦5,000 - ₦20,000 with 13.24%, ₦50,000 - ₦100,000 with 20.59% but with no passengers with income of below ₦5,000.

4.2 Test of Hypothesis

Hypothesis of the study state that socio-economic characteristics of passengers do not have influence on patronage of the Taxi companies.

4.2.1 Uber Taxi Passengers' Patronage Analysis

Passengers' patronage of the Uber taxi company (PpU) effect was analysed with multiple regression analysis and the results on socio-economic predictors of age (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) revealed that, there is a strong relationship between passengers patronage and independent socio-economic factors which is statistically significant with F – ratio of {$F(5, 14) = 98.75$, $p < 0.001$} as shown in Table 5. The multiple corre-

lation coefficient R = 0.986 indicates that there is a strong correlation between the passenger patronage and predicted by the regression model components. In terms of variability in passenger patronage accounted for by the fitted model, this amounts to a proportion of R2 = 0.972, or 97.2% while R2 will increase when further terms are added to the model even if these do not explain variability in the patronage.

The adjusted measure leads to a revised estimate that 97.2% of the (PpU) of Uber Taxi Company can be explained by the five explanatory contributing components. In other words, the five components together explain 97.2% of the variations in the (PpU) while 2.8% observed relationships are not explainable by the selected independent variables. Also, the output shown in the same table 5 also provides estimates of the regression coefficients, standard errors of the estimates and t-tests of a coefficient. That is, there can be an increase in patronage (PpU) when there is an increase of ten units in age (Age) from 0.616 to 6.16 and also an increase in patronage for every additional score recorded in occupation (Occ) scale (or by 10.43 for an effect of 10 units Occ scale) provided that all other predictors are the same and increase of 3.18 in PpU score for every one unit of (Inc) assuming that all other variables in the model are held constant while a decrease in PpU for one unit increase in gender (Gen) and Education (Edu) with 10.02 and 0.01 increment respectively as shown in the equation model 1.

$$(PpU) = 0.737 + 0.616(Age) - 1.002(Gen) + 1.043(Occ) - 0.001(Edu) + 0.318(Inc) + \varepsilon\ldots \text{ (Eq. 1)}$$

Table 5. Multiple Regression Analysis of Uber Patronage

Dependent variable (PpU)	Coefficient	Std Error	t - Statistics	Prob.
Variable				
C	0.737	0.321	2.299	0.037
Age (Age)	0.616	0.211	2.919	0.011
Gender (Gen)	-1.002	0.258	-3.885	0.002
Occupation (Occ)	1.043	0.298	3.495	0.004
Education (Edu)	-0.001	0.156	-0.006	0.995
Income (Inc)	0.318	0.165	1.929	0.074
R	0.986			
R – Squared	0.972			
Adjusted R- Squared	0.963			
F – statistics	98.747			
Prob. F – statistics.	0.000			

Dependent Variable: PpU, Predictors: (Constant), Inc, Age, Edu, Gen, Occ.

Author's Field Survey, 2021

The study therefore conclude that at least one of (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) contribute in predicting and determining passengers' patronage. In this regards we reject null hypothesis and accept alternative hypothesis meaning that there is significant influence of socio-economic characteristics of passengers on patronage of the Taxi companies. Conclusively, the model implies that β_1Age(0.616), β_2Gen(-1.002), and β_3Occ(1.043) are significant in predicting patronage of Uber Taxi company with the following p – values 0.011, 0.002 and 0.004. More so, there could be some other factors which can explain patronage (PpU) than (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) which could be for a further study.

4.2.2 Oga Taxi Passengers' Patronage Analysis

The multiple regression analysis results of socio-economic of age (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) on patronage of Oga Taxi passengers' patronage (PpO) revealed that, there is a strong relationship between passengers' patronage and independent socio-economic factors which is statistically significant with F – ratio of {F (5,14) = 77.917, $p < 0.001$} as shown in Table 6. The multiple correlation coefficient R = 0.983 indicates that there is a strong correlation between the passenger patronage and the predicted by the regression model components. In terms of variability in passenger patronage accounted for by the fitted model, this amounts to a proportion of $R^2 = 0.965$, or 96.5% while R^2 will increase when further terms are added to the model even if these do not explain variability in the patronage.

DOI: 10.26552/tac.C.2021.1.1

Table 6. Multiple Regression Analysis of Oga Taxi Patronage

Dependent variable (PpO)	Coefficient	Std Error	t - Statistics	Prob.
Variable				
C	0.163	0.217	0.751	0.465
Age (Age)	0.031	0.185	0.170	0.868
Gender (Gen)	0.358	0.145	2.466	0.027
Occupation (Occ)	0.359	0.147	2.450	0.028
Education (Edu)	0.388	0.109	3.566	0.003
Income (Inc)	0.200	0.137	1.455	0.168
R	0.983			
R – Squared	0.965			
Adjusted R- Squared	0.953			
F – statistics	77.917			
Prob. F – statistics.	0.000			

Dependent Variable: PpO, Predictors: (Constant), Inc, Age, Edu, Gen, Occ.

Author's Field Survey, 2021

The adjusted measure leads to a revised estimate that 96.5% of the (PpO) of Oga Taxi Company can be explained by the five explanatory contributing components. In other words, the five components together explain 96.5% of the variations in the (PpO) while 3.5% observed relationships are not explainable by the selected independent variables. More importantly, the output table 6 provides estimates of the regression coefficients, standard errors of the estimates and t-tests of a coefficient. That is, there can be an increase in patronage (PpO) when there is an increase of ten units in age (Age) from 0.031 to 0.31 and also an increase in patronage for every additional score recorded in Gender (Gen) scale (or by 0.358 for an effect of 10 units Gen scale) provided that all other predictors are the same and increase PpO with a unit increase in score for every one unit of (Occ) to 3.59 assuming that all other variables in the model are held constant, an increase in PpO for one unit increase in Education (Edu) and Income (Inc) with 3.88 and 2.00 increment respectively as shown in the equation model 2.

$$(PpO) = 0.163 + 0.031(Age) + 0.358(Gen) + 0.359(Occ) + 0.388(Edu) + 0.200(Inc) + \varepsilon\ldots \quad \text{(Eq. 2)}$$

The study therefore concludes that at least one of (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) contribute to predicting and determining passengers' patronage. In this regards we reject null hypothesis and accept alternative hypothesis meaning that there is significant influence of socio-economic characteristics of passengers on patronage of the Taxi companies. Conclusively, the model implies that β_2Gen(0.358), β_3Occ(0.359) and β_4Edu (0.388) are significant in predicting patronage of Oga Taxi company with the following p – values 0.027, 0.028 and 0.003. In this regard, there could be other factors which can explain patronage (PpU) than (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) which could be for a further study.

4.2.3 Bolt Taxi Passengers' Patronage Analysis

The multiple regression analysis results of socio-economic of age (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) on patronage of Bolt Taxi passengers' patronage (PpB) revealed that, there is a strong relationship between passengers' patronage and independent socio-economic factors which is statistically significant with F – ratio of $\{F(5,14) = 51.270, p < 0.001\}$ as shown in Table 7. The multiple correlation coefficient R = 0.974 indicates that there is a strong correlation between the passenger patronage and the predicted by the regression model components. In terms of variability in passenger patronage accounted for by the fitted model, this amounts to a proportion of R2 = 0.948, or 94.8% while R2 will increase when further terms are added to the model even if these do not explain variability in the patronage.

The adjusted measure leads to a revised estimate that 94.8% of the (PpB) of Oga Taxi Company can be explained by the five explanatory contributing components. In other words, the five components together explain 94.8% of the variations in the (PpB) while 5.2% observed relationships are not explainable by the selected independent variables. More importantly, the output table 7 provides estimates of the regression coefficients, standard errors of the estimates and t-tests of a coefficient.

Table 7. Multiple Regression Analysis of Bolt Taxi Patronage

Dependent variable (PpB) Variable	Coefficient	Std Error	t - Statistics	Prob.
C	0.276	0.442	0.625	0.465
Age (Age)	0.199	0.196	1.016	0.868
Gender (Gen)	0.119	0.185	0.640	0.027
Occupation (Occ)	0.363	0.157	2.316	0.028
Education (Edu)	0.543	0.166	3.277	0.003
Income (Inc)	0.226	0.138	1.638	0.124
R	0.974			
R – Squared	0.948			
Adjusted R- Squared	0.930			
F – statistics	51.270			
Prob. F – statistics.	0.000			

Dependent Variable: PpB, Predictors: (Constant), Inc, Age, Edu, Gen, Occ.

Author's Field Survey, 2021

That is, there can be an increase in patronage (PpB) when there is an increase of ten units in age (Age) from 0.199 to 1.99 and also an increase in patronage for every additional score recorded in Gender (Gen) scale (or by 1.19 for an effect of 10 units Gen scale) provided that all other predictors are the same and increase PpB with a unit increase in score for every one unit of (Occ) to 3.63 assuming that all other variables in the model are held constant, an increase in PpB for one unit increase in Education (Edu) and Income (Inc) with 5.43 and 2.26 increment respectively as shown in the equation model 3.

$$(PpB) = 0.276 + 0.199(Age) + 0.119(Gen) + 0.363(Occ) + 0.543(Edu) + 0.226(Inc) + \varepsilon\ldots \text{ (Eq. 3)}$$

The study therefore concludes that at least one of (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) contribute in predicting and determining passengers' patronage. In this regards we reject null hypothesis and accept alternative hypothesis meaning that there is significant influence of socio-economic characteristics of passengers on patronage of the Taxi companies. Conclusively, the model implies that β_3Occ(0.363) and β_4Edu (0.543) are significant in predicting patronage of Bolt Taxi company with the following p – values 0.036 and 0.006. Therefore, there are some other factors which are not consider in the study than (Age), gender (Gen), income (Inc), occupation (Occ) and education (Edu) which could be for a further study.

It can therefore be concluded that socio-economic characteristics of passengers highly influenced the patronage of the Taxi companies by the passengers. The contribution of the independent socio-economic characteristics varies with the Taxi companies in predicting their patronages.

4. Conclusion and Recommendations

The empirical findings indicate that there is significant relationship between socio-economic characteristics and passengers' patronage of the Taxi Companies. The study further concluded that: In terms of patronage, Bolt Taxi Company is far better than the Uber and Oga taxis, as it recorded the maximum number of patronages of 122 passengers compare to that of 114 and 68 from Uber and Oga taxis respectively. Also, all the predictors of socio-economic characteristics in Bolt taxi are significant in explaining the level of patronage but significant level varies with both Uber and Oga taxis.

The consideration of the literature relating to taxi as a form of public transport as contributed immensely to the examination and investigation of the topic at hand. Hence this study aims to recommend among other thing, in order to foster high standard of service delivery to passenger/customer in the area of public transport in general and taxi service in particular. The recommendations are as follow:

Seeking for rules and regulations that guide routine operation and service delivery to the populace and high adherence to it implementation by government agencies.

Recruitment and selection process and procedures of drivers should be considered on merit with high level of scrutiny.

Sanction on free entry and exit of the Taxi Company into the industry, in order to guide against quack operators.

DOI: 10.26552/tac.C.2021.1.1

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An Appraisal of Intercity Commuting Pattern Using Railway Services in South-Western Nigeria

Bashiru Adisa Raji[1], Adeolu Dina[1], Muse Olayiwola Solanke[1], Taiwo Kareem Alli[1]

[1]Department of Transport Management, Olabisi Onabanjo University, Ago-Iwoye, 120107, Nigeria

Abstract Tracking the influence of service improvements on passengers particularly is an important component of transport management. This study examined the characteristics of intercity travellers in the Economy Class Units (ECU) and recently introduced Diesel Multiple Unit (DMU) service within the Lagos District Nigeria Railway Corporation in south-western Nigeria. A structured questionnaire was randomly administered to 1206 passengers traveling on these trains over two months with analysis in-volving the use of the regression model. The findings of the study indicate the socio-economic characteristics of passengers accounted for about 90.3% and 88.2% of the variation in volume trips made by passengers using DMU and ECU service respectively. Significant socio-economic predictors of trip volume on DMU train are Occupation (0.137), Vehicle Ownership (0.218), and Type of vehicle (0.218). On the other hand, significant socio-economic attributes of ECU passengers that affect trip volume are Age (0.274), Education (0.970), Occupation (-0.918), Income (0.435), Vehicle Ownership (0.249), and type of Vehicle (-0.165). The result further indicates Trip Purpose explained 83.5% and 86.7% of the variation in the trip volume of both services. The trip purpose that significantly influences the volume of trips on the ECU trains are Business (0.210), Shopping (0.447) Leisure (-0.463), and other trip purposes (0.775). For the DMU train, only Other-trip forms of purpose (0.753) is significant in explaining the volume of passengers using that service. The study shows similarities in the use of the two services while several useful recommendations on ways to improve both services of the corporation were proffered.

Keywords Intercity, Railway, passengers, Commuting, South-West, Nigeria

JEL R4, R41

1. Introduction

In most African countries including Nigeria, railway transportation is not growing rapidly as they have not been encouraged or allowed to respond to changes in the economies they serve [22]; [17]. Nigeria railway transport development in similitude has for long been heavily criticized in the studies of [10]; [7]; [5]; [21]; [21]; [27]; [2]; [26]; [4]; [9]; [3] and many others for a good reason. Despite the long history of rail travel in the country that spans about 123 years, the existing track network and rolling stock is largely a relic inherited from its colonial administrators in 1960. Failure to invest in the sector for several decades led to a moribund operation. The railways also lost most of its traffic to its road mode competition with skeletal operations in most regions of the country except South-Western Nigeria.

The operation of the corporation within the Southwest region of Nigeria for several decades remains the busiest among the geo-political zones of the country. There are 16 daily mass transit train trips operated between the Lagos megacity and several sub-urban settlements within the region. Estimated daily passenger traffic of 18,000 passengers are moved on the mass transit service of the corporation on Economic Class Units (ECU) trains that target low-income earners.

The operation of the refurbished fleet of ECU Trains has however been much criticized for lacking the requisite service quality to make train travel an attractive alternate mode of travel within the region. “[9]” noted the need to adapt Nige-ria’s colonial railway to modernism which must involve the provision of rail infrastructure and services to a wider public spectrum of users across socio-economic groups. The outlook of overcrowded trains, rooftop riding has for long reinforced a popular saying that train travel in the country is for the poor. “[28]” report estimated two-way road passenger traffic crossing of the three main bridges between mainland and Lagos Island in Lagos state per day to be around 1.59 million lending credence that the train service is grossly underutilized and unattractive to the public. Comparatively [16] noted that within its first seven years of operation, ECU operation, an average of 810,622 passengers is moved yearly by the service within the region.

[20]” further noted that the NRC Management is mandated to operate in a manner that will ensure continuous growth by marketing an efficient technically competent transportation service in pursuit of the country's socio-economic development. As part of wider reforms being implemented to revive

DOI: 10.26552/tac.C.2021.1.2

and modernize train service in the country, the management of the corporation in 2014 introduced the service of 2 units of Diesel Multiple Unit (DMU) to its operations in the Lagos District in Southwest Nigeria. Each unit of DMU with a 540 passenger is intended to improve inter-urban service quality and make train passenger travel more attractive to higher economic class commuters within the region. The operation of the DMU service comes with minimal stops at selected stations and a fare regime three times higher than that of the ECU service.

Six years into its introduction of the service, it is unclear how far the DMU operation has impacted commuter movement in the region. It is unclear how the different socio-economic groups make use of both services. This becomes more important following the recent completion of the standard gauge mainline and test run of operations between Lagos and Ibadan in Southwest Nigeria in the year 2020. It is necessary to understand and track how improving services reflects on socio-economic groups in the country.

This study has the following objectives:

1. To understand the effect of passenger socio-economic on the use of commuter service of NRC in the Southwest Region of Nigeria.

2. Compare the influence of trip purpose on the use of trains among DMU and ECU passengers.

3. Compare the influence of socio-economic characteristics among DMU and ECU passengers.

2. Literature

Several authors have outlined factors of transport patronage among passengers generally. “Reference [11]” observed that socio-economic characteristics of trip makers remain crucial to trip frequency, cost, length of trip, and their modal choice of trips. “[12]” also observed that urban trips are often affected by variables such as higher occupational status, household size, income, and level of education. Since the quality and types of coaches in use for passenger traffic by NRC now vary, there may also be an implication for the pattern of patronage of the rail services by commuters. “[13]” noted that the relationship between transport fares of public transport and their patronage tend to be inverse. Such inverse relationship according to [14] is not similar in all public transport modes as changes in fares alone did not explain changes in demand for public transport in Mexico City. The study showed more significant improvements in service qualities on patronage than changes in fares.

Studies such as [10]; [7]; [5]; [21]; [21]; [27]; [2]; [26]; [4]; [9]; [3] have made heavy criticism to railway development in Nigeria noting problems such as inadequacies of policy, rolling stock, lack of maintenance, staff depletion, vertical integrated management and failure to deregulate the sector among others as reasons for the failure of the sector of transportation in Nigeria. The neglect of the railway system by successive post-independence governments further culminated in a precipitous decline in railway patronage both in passengers and freight traffics. A survey by the Nigerian Statistical Association (NSA, 2000) showed that the railway began to lose its once pre-eminent position in the mid-1970s. By the end of the 1990s, the study noted the use of rail transport in Nigeria had fallen insignificantly [18].

“References [25], [23], [29],[16] and [1];” observed that rail transport provides the most cost-effective, affordable, energy-saving, and environmentally friendly form of travel available to man especially in areas where traffic densities are known to be high. “[6]” further observed that when railway systems are properly integrated with other modes of transportation, economic levels of traffic can be consolidated to enable the railway to provide efficient services for high-density flows of homogenous traffic to be carried over relatively long distances. Access to rail transport is regarded as one of the main strategies for coping with some of the critical effects of urbanization at the town, city within the regional level.

Among the studies so far reviewed, only reference [8] had investigated the socio-economic influence on the patronage of train service in the region in 2011. The time lag of study [8] coupled with the introduction of DMU trains service altered of service offered in the region. The dynamics and changes remain a research gap and the focus this study intends to fill is to understand how commuters have responded to the service options available to them.

3. Methodology

The study area is the Lagos District of the NRC. The administrative district of the corporation is the smallest and the busiest of the 7districts of the corporation in the country. The district has a total mainline track length of about 41km with about 16 stations from Iddo terminus to Ifo Junction in Ogun state (figure 3.1). The active line in the district is barely 1.1% of the 3505km of single-track network of narrow-gauge line in the country.

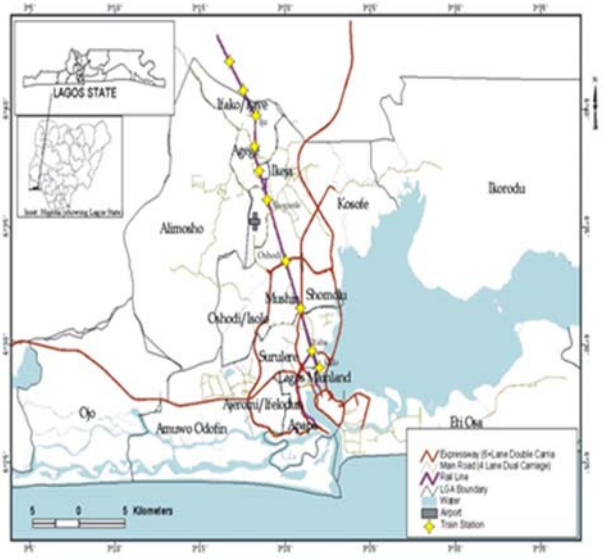

Figure 3.1: Rail Track and Stations within Lagos District

Source: [30]

The district runs two types of train service; the economic class trains are made up of salvaged coaches that previously formed part of the rotted rolling stock of the corporation. These run a total of 16 daily train trips in the district moving an average of 1000 passengers per trip. The district also operates 2 new Diesel Multiple Units (DMU) a service that targets middle-income commuters within the district.

The DMU trains run 6 daily trips between Apapa in mainland Lagos and Ijoko a suburb township in neighbouring Ogun State. The district operates mixed traffic of freight and passenger within and outside the state to other regions of the country. The service run by the corporation is the only train service available within the megacity of Lagos, the most densely populated area of Nigeria which is home to an estimated 18 million inhabitants. There is about 95% reliance on the road network for daily commuting, there is a consistent drive to expand and improve access to rail travel at the state and federal level of government.

The study employed a descriptive research survey through the use of a structured questionnaire. Variables used are premised on the objectives of the study which include socio-economic characteristics, types of trip generated, and problems encountered by passengers using the DMU and ECU class of NRC service. An interview guide elicits in-formation on the challenges facing the management of railway transport as well as the possible ways of improving the railway transport system that was sent to the top officials of NRC. The questionnaires were randomly administered to 1206 passengers on board between the origin and destination of train trips covering Ijoko – Itoki – Alagomeji and Iddo. The sample frame emanated from seat numbering on board the DMU and ECU train services operated by NRC. The DMU has three coaches with each coach capacity of 72 passengers while ECU ten coaches with a capacity of 99 passengers.

Therefore, the sample size for the study is 1206. This implies that a copy of 1206 questionnaires was distributed at train stations from Ijoko, Itoki, Alagomeji, and Iddo. Data collected were analysed using both descriptive and inferential statistical methods. Descriptive statistics include the use of frequency, percentage, and pictures and was used to explain the socio-economic characteristics of the DMU and ECU passengers. Multiple regression analysis was used to (i) estimate the influence of socio-economic characteristics on the volume of trips generated by the passengers at the aggregate level. (ii) estimate the four purposes on the volume of trips generated by DMU and ECU passengers. (iii) examine the influence of socio-economic characteristics on the volume of trips generated by DMU and ECU on a disaggregated level.

The regression equation usually used for the analysis is:

$Y = a + b_1X_1 + b_2X_2 + b_3X3 + b_nX_n + c$ .....*(eq 1)*

Where:

Y=dependent variable (Volume of trips generated.)

a = constant

$X_1 \rightarrow Xn$=independent variables (gender, age, marital status, education, employment, and income)

$b_1 b_n$=coefficients of independent variables

c=random error term measuring the deviation of the observed trips *(Y)*

Where:

Y=dependent variable (Number of trips generated) (1 – 3 times, 3 – 5 times, and above 5 times).

$X_1 \rightarrow X_n$=independent variables (gender, age, marital status, education, employment, and monthly income).

4. Results and Discussion

A. Socio-Economic Characteristics of Passengers

The result of the passenger survey as indicated in the table 4.1showed that 817 respondents out of 1206 sampled are male while the remaining 389 were female representing 67.7% and 32.3% of the total response respectively. Furthermore, 33 out of 1206 (2.7%) were under the age of 18 years, 252 (20.9%) are between the ages of 18 and 25 years, while 789 (65.5%) are between the ages of 26 and 50 years. There are 132 (10.9%) respondents above 50 years of age, this revealed that the majority (65.5%) of the respondents are between the ages of 26 and 50 years.

The educational pedigree of respondents indicates that 60 out of 1206 representing 5 % of the total population had no formal education. There are 88 (7.2%) of the respondents with primary education, while 488 (40.5%) had secondary education, 570 (47.3%) had post-secondary education. The majority of the respondent had post-secondary education with a percentage of 47.3%. The occupational status of respondents also showed that 143 respondents making up 11.8% are employees. 367 (30.5%) are civil servants, 22 (1.8%) indicated teaching as their occupation, 197 (16.4%) are students, 428 (35.5%) are self-employed and 49 (4.1%) are unemployed. Most of the respondents are self-employed with a percentage of 35.5%.

The income stream of respondents showed that 203 of the 1206 respondents representing 16.8% earned a monthly income below 18,000. Another 554 (45.9%) earned a monthly income of between 18,000 and 50,000 Naira while 148 (12.3%) earned a monthly income between 51,000 and 83,000 Naira. 175 (14.5%) of the respondents earned a monthly income between 83,000 and 115,000 naira, 126 (10.5%) earned a monthly income above 115,000 naira. The study revealed that most of the respondents earned a monthly income between 18,000 and 50,000 Naira with a cumulative percentage of 45.9%. Response on vehicle ownership indicates 691 out of the 1206 respondents representing 57.3% of total responses indicated ownership of vehicles. Another 515 (42.7%) indicated non-ownership of vehicles. The study thus revealed that most of the respondents owned one form of vehicle or the other with a percentage of 57.3%. On the types of vehicles owned by the respondents, 647 representing 53.6% indicated car ownership as their type of vehicle. An-other 203 (16.8%) indicated buses as their type of vehicle, 88 of the respondents (7.3%) indicated truck ownership as their type of vehicle, 203 (16.8%) indicated motorcycle as their type of vehicle owned and 66 (5.5%) indicated that they owned other types of vehicles. The study revealed that most

DOI: 10.26552/tac.C.2021.1.2

respondents indicated car as their type of vehicle owned with a percentage of 53.6%.

Table 4.1. Socio-Economic Characteristics of Passengers

N/S		Freq	%
	Sex		
1	Male	817	67.7
	Female	389	32.3
	Total	**1206**	**100**
2	**Age Group**		
	Below 18 years	33	2.7
	18 - 25 years	252	20.9
	26 - 50 years	789	65.6
	50 years and above	132	10.9
	Total	**1206**	**100**
3	**Educational Level**		
	No Formal education	60	5
	Primary education	88	7.2
	Secondary education	488	40.5
	Post-secondary education	570	47.3
	Total	**1206**	**100**
4	**Occupation**		
	Employee	143	11.8
	Civil servant	367	30.5
	Teaching	22	1.8
	Student	197	16.4
	Self-employed	428	35.5
	Unemployed	49	4.1
	Total	**1206**	**100**
5	**Income Level**		
	Below 18,000	203	16.8
	18000 – 50,000	554	45.9
	51,000 – 83,000	148	12.3
	83,000 – 115,000	175	14.5
	Above 115,000	126	10.5
	Total	**1206**	**100**
6	**Ownership of Vehicle**		
	Yes	691	57.3
	No	515	42.7
	Total	**1206**	**100**
7	**Type of Vehicle Owned**		
	Car	647	53.6
	Buses	203	16.8
	Truck	88	7.3
	Motorcycle	203	16.8
	Others	66	5.5
	Total	**1206**	**100**

Source: Authors' Field Survey

B. Socio-economic Characteristic of Train Passengers and Travel

The study first sought to understand the overall effect of passenger socio-economic variables on the combined response from both the DMU and ECU passengers. The variables considered in the regression model include Gender, Age, Education, Occupation, and income of passengers. The hypothesis postulated below was tested to establish if one or more of these variables can explain the choice of usage of trains along the route.

From the result, the coefficient of determination R^2 indicates that the model can only account for 2.8% of the variation in the volume of the trip by train passengers as indicated in table 4.2. The model is unable to account for the remaining 97.2% variation in the volume of trips generated, a residual associated with variables not imputed into the model. Furthermore, variables considered such as Gender, Age, Education, Income with exception of Occupation have negative coefficients. However, the age of the train travellers appears to be the most important in determining the choice of travel among the socio-economic variable considered in the model. The regression result of the study's model suggests that the socio-economic characteristics of train passengers in the study area do not have any impact on the volume of trips generated. Hence, the postulation that there is no significant relationship between the socio-economic characteristics of passengers and the volume of trips generated is valid at a 5% level of significance.

Table 4.2. Volume of trips generated and socio-economic characteristic

Dependent variable: Volume of Trips					
Variable	**Coef.**	**F-Stat**	**Sig.**	**T-Stat**	**R^2**
Constant	2.408	1.227	0.000	5.435	0.028
Gender	-0.161		0.372	-0.895	
Age	-0.208		0.140	-1.482	
Edu. level	-0.088		0.446	-0.731	
Occupation	0.077		0.908	-0.116	
Income level	-0.066		0.421	-0.806	

Source: Authors' Field Survey

The study further revealed the fitness of the study model in terms of the trip purpose of both DMU and ECU train passengers. The coefficient of determinations R^2 indicates that the volume of trips generated by DMU passengers in terms of fitness of the study model is 83.5 % of the variations in trip purpose can be explained by the combined influence of trip purpose characteristics in the regression model as shown in tables 4.3a.

Table 4.3a. Volume of Trip generated and Trip purpose of DMU

Dependent variable: Volume of Trips					
Variable	**Coef.**	**F-Stat**	**Sig.**	**T-Stat**	**R^2**
Constant	0.027	64.826	0.917	0.104	0.835
Visitation	-0.066		0.656	-0.447	
Business	0.311		0.071	1.835	
Shopping	0.107		0.304	1.035	
Leisure	-0.126		0.593	-.537	
Others	0.753*		0.000	9.176	

*significant at 5% Source: Authors' Field Survey

The remaining 16.5% are variables not factored into the model. Details of the result showed that variables considered such as visitation and leisure trips have a negative relationship with the dependent variable; only "Others" had a

significant relationship among the five variables considered. The ECU passengers on the other hand equally exhibited the same effect as "visitation" and "leisure" trips of DMU passengers as they both had a negative relationship with the volume of trips. However, trip purpose such as business trips, shopping, leisure trip, and others all had a significant relationship with trips volume among ECU passengers, only trips made for visitation was insignificant. Meanwhile, overall, 86.7% of the variation in trip purpose can be accounted for by the model while the remaining 13.3% are associated with variables not imputed into the model as indicated in the table 4.3b. In all, "other trip" purpose is the most important variable effect on the trip of passengers using the two classes of service.

The individual DMU and ECU passenger characteristics were also examined in terms of trip volume generated. Variables at this stage include Gender, Education, Income, Age, Occupation, Ownership of Vehicle, and type of Vehicle Owned.

Table 4.3b. Volume of Trip generated and Trip purpose of ECU

Dependent variable: Volume of Trips					
Variable	**Coef.**	**F-Stat**	**Sig.**	**T-Stat**	**R^2**
Constant	0.006	187.864	0.975	0.031	0.867
Visitation	-0.057		0.424	-0.802	
Business	0.210*		0.000	4.055	
Shopping	0.447*		0.000	4.821	
Leisure	-0.463*		0.000	-4.467	
Others	0.775*		0.000	11.268	

*significant at 5% Source: Authors' Field Survey

The model result showed that the coefficient determination R^2 for DMU is 90.3% which implied that the variations in the volume of trips generated are explained by the combined influence of socio-economic characteristics in the study model. The remaining 9.7% may be attributed to other variables not accounted for in the model. All coefficients of the independent variables are positive except Age and Income while Occupation and Vehicle Ownership were the only significant contributors to the model at a 5% level of significance as shown in table 4.4a. The ECU service also showed that the combined influence of the independent variables considered to be 88.2% implying the outstanding 11.8% unaccounted for by the model may be due to variables not imputed. The coefficients of independent variables such as Gender, Occupation, and Vehicle Ownership have negative while the remaining are positive as shown in table 4.4b. Age, Education, Occupation, Income, and Ownership of vehicle are significant contributors to the model at 5%. Vehicle Ownership is the most important contributor to the variation in passenger trip frequency on DMU services while the occupation of respondents is most important for ECU services.

Table4.4a. Volume of Trip Generated and Socio-economic Characteristics of DMU

Dependent variable: Volume of Trips					
Variable	**Coef**	**F-Stat**	**Sig.**	**T-Stat**	**R^2**
Constant	0.378	82.163	0.403	0.839	0.903
Gender	0.060		0.372	0.894	
Age	-0.055		0.446	-0.763	
Educ.	0.018		0.809	0.242	
Occup.	0.137*		0.055	1.926	
Income level	-0.007		0.927	-0.091	
Ownership of Vehicle	0.218*		0.002	3.113	
Veh. Ownership Type	0.103		0.135	1.501	

Source: Authors' Field Survey

Table4.4b. Volume of Trip Generated and Socio-economic Characteristics

Dependent variable: Volume of Trips					
Variable	**Coef**	**F-Stat**	**Sig.**	**T-Stat**	**R^2**
Constant	-0.69	51.996	0.644	-0.463	0.882
Gender	-0.018		0.854	-0.185	
Age	0.274*		0.000	4.997	
Educ.	0.970*		0.000	8.363	
Occup.	-0.918*		0.000	-9.191	
Income level	0.435*		0.000	4.754	
Ownership of Vehicle	-0.165*		0.042	-2.052	
Veh. Ownership Type	0.249		0.084	1.741	

Source: Authors' Field Survey

DMU: TRIP FRQ = 0.37 + (0.060)Gender – (0.055)Age + (0.18)Education + (0.137)Occup – (0.007)Income + (0.218)Vehicle Ownership + (0.103)Veh. Ownership Type

ECU: TRIP FRQ = - 0.69 – (0.18)Gender + (0.274)Age + (0.970) Education – (0.918)Occup + (0.435)Income - (0.165)Vehicle Ownership + (0.249) Veh. Ownership Type

Train travel appears to be dominated by male passengers as there was twice as much male commuting by trains than females. Train use is also dominated by the most active working age group between 25-50 years. It is not immediately clear why more males use this medium however the dominant age groups are those in the economic class or working-age group (see figures 4.1 and 4.2 for ECU and DMU Trains).

The introduction of the DMU service is targeted at middle-income commuters along the route under study. A Reconnaissance Survey report in 2011 suggests these classes of Nigerian citizens earn an average monthly income in the range of N75,000-100,000 ($480- 645). Although the report suggests the middle class makes up about 23% of the Nigerian

DOI: 10.26552/tac.C.2021.1.2

population only about 25% of commuters surveyed in this research fall within this income category.

Figure 4.1. ECU Trains used in the Study Area

Figure 4.2a. DMU Trains used in the Study Are

Figure 4.2b. DMU Trains used in the Study Area

This suggests train travel particularly by the DMU service is yet to adequately capture its target audience along the route. The negative coefficient of income as shown in table 4 above further suggest that the more or less passenger earn the more it affects their choice of travel in both services, however, the negative coefficient of age may also be suggestive that younger travellers are more attracted to the service than older travellers. It also not clear if this is related to the near absence of platforms at most train stations which can make embarking/disembarking difficult for the elderly.

The significant relationship between socio-economic characteristics of passenger and trip purpose such as business shopping leisure and other trip purpose suggest the varying reason for the use of the ECU trains in particular. Business and related activity are the main generators of train travel in both cases for DMU and ECU service the relationship between these trip purposes and the socio-economic attributes of train commuters are positive. In other words, the more business and shopping trips the more likelihood of generating a train trip. However, leisure trips are seemingly un-attractive to train travel, it is not clear if this can be associated with the comfort and convenience of NRC services or other service quality attributes of their operations. It is however noteworthy that while no significant pattern of use is established for the DMU service, ECU trains must accommodate accompanying loads of business travellers on such trips and ensure minimal in-convenience to other travellers.

In terms of the effect of passenger socio-economic characteristics on the frequency of train trips, the positive coefficients of regression from the survey on DMU passengers and key socio-economic variables are worthy of note. For example, the significant relationship between ridership, occupation, and vehicle ownership suggests the service may be attracting its target audience. Occupation and vehicle ownership are associated with higher economic earners who remain the main targets for modal shift to the railway from road travel by NRC authorities. It is expected more of this category of commuters will utilize the park and ride facilities in some strategic stations. The regression result from the ECU service suggests Age, Education, Occupation, income, vehicle ownership, are significant socioeconomic variables associated with trip frequency of passengers. The result on another hand suggests the frequency of patronage of ECU service increases with Age, Education, and Income while the type of occupation and vehicle ownership may also explain the frequency of passenger ridership on the ECU trains. The result particularly that of ECU confirms the position of [11] who had opined that socio-economic characteristic of trip makers remain crucial to their trip frequency, length of trips, and their modal choice of trips. “[12]” had also observed that urban trips are often affected by variables such as higher occupational status, household size, income, and level of education. In other words, the ECU trains may be attractive to multiple age and income groups in the study area.

5. Summary and Conclusion

This study aims to compare the socio-economic attributes of intercity train travellers using the NRC DMU and ECU service in South-Western Nigeria. The study established a comparative difference in passenger's socio-economic characteristics and their patronage of the ECU and DMU service of NRC in the study area. The study established that the socio-economic attributes of ECU train users significantly

influenced passenger trip purpose and the frequency of such than that of the DMU service where occupation type plays the only key role in a train trip. In conclusion, although socio-economic characteristics play a crucial role in transport patronage globally, the role played by the variable particularly for DMU service in South-Western Nigeria is limited which is attributable to the high cost of the service and limited coverage of tracks within the region along the route.

The first recommendation emanating from this study follows that of [8] who had suggested trip cost be subsidized or reduced to increase the trip frequency of passengers which will allow for more defined use of the DMU service in the sub-region. Another recommendation is that the management of NRC must ensure station infrastructure such as platform area is constructed at each of its stations to ensure no age group is marginalized from its service. The present difficulty of climbing vertical staircases into ECU will not encourage the fiscally challenged persons to use the mode. Such a gesture will make train travel more attractive to the aged and physically challenged persons. There must be a concerted effort to ensure the extension of rail tracks into other catchment areas within the South-West Region particularly in Lagos as a measure to boost passenger traffic and relevance of train travel. Furthermore, the single-track network operation is currently a major challenge to efficient operation; mainline tracks should be expanded to double track to improve travel time, service quality, and attractiveness of train travel. Finally, the management of NRC must target and understand the passenger user mix of its service to optimize the satisfaction of all users. The significance of business travel and office travel suggests passengers have varying needs of convenience and possibly load onboard trains. Managing the mix will maximize convenience for these classes of travellers who may have varying needs.

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Pedestrians' Sidewalk Development and Level of Safety in Ikeja Area, Lagos Nigeria

Bashiru Adisa Raji[1], Muse Olayiwola Solanke[1], Taiwo Kareem Alli[1]

[1]Department of Transport Management, Olabisi Onabanjo University, Ago-Iwoye, 120107, Nigeria

Abstract Safe and accessible pedestrian sidewalk is significant to sustainable infrastructural development and industrialisation of core of cities in world over. Studies have shown that safety of pedestrian on walkways aid their ability to shop more than sitting in the comfort of their vehicles. The study modelled the influence of lateral separation (LS) (sidewalk separation); volume of motor vehicles (VM); speed of motor vehicle (SM) and vehicular access to adjoining properties (VA) on pedestrians' level of safety (PLS) along the streets of core area of Ikeja. Fifty-six (56) road segments were observed, measured and field information obtained analysed. Though, LS, VM, SM and VA contributed about 58.1% to (PLS) in Ikeja, the results further revealed that PLS increased with LS distant vehicles (β_{sd}=0.60, t_{sd}=5.14), but decreased with higher VM (β_{vv}=0.20, t_{vv}=1.73) and SM (β_{sp}=0.07, t_{sp}=0.76). It was recommended that a standardised distance of LS from moving traffic and its wideness; the required SM of vehicles and increased investment on pedestrian facilities in urban centre will improve pedestrian safety and as well promote sustainable industrialisation since pedestrian form major traffic of the industries.

Keywords Inc Level of Service, Lateral Separation, Volume of Vehicles, Adjoining properties

JEL R4, R41

1. Introduction

Spatial movement comprises of both motorized and non-motorized mode, while motorized mode includes cars, trucks, buses, motorcycles, and so on, non-motorized mode include pedestrians and bicycling [14]. In world over, roadways consist of dissimilar kinds of motorised and non-motorised vehicles that operate at diverse accelerating capacities [6].

For the most vulnerable populations the trend towards increased motorization is harmful. Increase automobiles use; do add to road traffic accidents which often escalate the well-being of commuters in terms of environmental externalities. Crash statistics has shown that the growing pattern of motorisation has endangered exposed motorway consumers such as bikers and walkers due to their neglect over the years [8].

Sustainable transportation systems involve mobility and accessibility planning that also focuses on pedestrians and cyclists, not vehicles only. Pedestrians and cyclists also use these spaces, to move toward their right-of-way which gives room for easy movement. Inaccessibility and immobility pedestrians and cyclists space deficiencies have increased pedestrian and cyclists' level of safety [12]. "[2]" described pedestrians as people who use other means of movement apart from automobiles such as walking, riding model cycles on designated walkways and people who descending from other means of transportation. "[1]" sees pedestrian as "any person wishing to travel by foot, wheelchair, or electric scooters, throughout the community. In modern times, pedestrian is mostly referring to as people traveling on foot especially in an area also used by cars. Concisely, pedestrian is any person that travels by foot, and this involves walking [13].

Lagos is among the world's fastest-growing cities. It is projected to be the world's third largest megacity with an annual growth rate of 6% and population that falls between 18 million and 20 million. Lagos GDP growth in dollars was in excess 80 billion in 2010. It could have been eleventh largest economy in Sub-Saharan Africa if it were to be a country. It is the fiscal powerhouse of Nigeria, with wide-ranging financial activities, which added about 62% to non-oil of the nation's GDP [5].

A good transportation network connects people and improves the economy of a city. It was meant to be socially, politically, and environmentally friendly. Major urban problems particularly in Lagos arises due to the fact that most inhabitants prefer to use personal vehicles as means of transportation in order to ease and improve their social status thereby increases motorization and congestion. Increase motorization thus encourages decentralization, space extension and infrastructural expansion [15].

Goal 9 of the SDGs is to develop robust infrastructure, encourage comprehensive and justifiable development and nurture modernization. By 2030 one of the objectives is to develop efficient, effective, and improved industrialization,

DOI: 10.26552/tac.C.2021.1.3

facilities nationally and internationally in order to promote growth and social well-being for all. But the available infrastructure in Lagos especially road is greatly overstretched and if this trend persists; negate Goal 9 of SDGs that promotes sustainable infrastructural development and industrialization.

Adequate mobility and accessibility are necessary for sustainable transport infrastructure and services. This is because mobility is the ability of people to move from one point to the other in terms of distance and prompt arrival times. Therefore, social and economic opportunities depend on accessibility that is determined by money, time, dis-comfort and the risks associated with it. Non-motorised mode (walking and bicycling) thus provides simple and friendly environment to gain entrance to public transport and many facilities [6].

In recognition of the targets of Goal 9 of SDGs and the role of pedestrian traffic in activities such as businesses, public institutions, commercial activities, trading, residential, recreational and creation of employment, Lagos State Government (LSG) of Nigeria in April 2018 design Non-Motorised Transport (NMT) policy is to aid wellbeing, care and convenience of walking and use of bicycles in the state in Lagos through allocation of reasonable motorway space in transport projects that accommodate non motorised and communal conveyance in the development, and strategy [6]. Achieving NMT policy, LSG aims at creating judicious access to communal conveyance and discourages the usage of private automobiles, by constructing not less than 470 km of Mass Rapid Transit (MRT), 900 km of walkways, and 300 km of bicycle paths. However, the existing traffic situations in Lagos involve heavy vehicular traffic and motorists experience difficulties to move and park. Consequently, cars are parked in a disorderly manner along sidewalks, street corners and pedestrian thresholds creating serious bottlenecks and traffic congestion within the city. These difficulties are more pronounced in the city's central business district.

The phenomenon also presents itself in suburban business centers as well. In relation to these problems is the increase demand for pedestrian trips, inadequate pedestrian facilities, and non-availability of pedestrian trips information as well as model that can assist in the decision processes. Therefore, this study is an attempt to model the existing situation in order to contribute to policy direction of NMT policy of the state by creating insight into NMT users' (particularly the pedestrian) likely safety problem in the use of available facilities and areas NMT policy needs to give priority when upgrading existing facilities in order to achieve sustainable infrastructural development and industrialization in the state.

2. The Study Area

Pedestrian activities occur all over Nigeria, but they are more noticeable in urban areas. Ikeja (Figure 1) in the city of Lagos is chosen for this study.

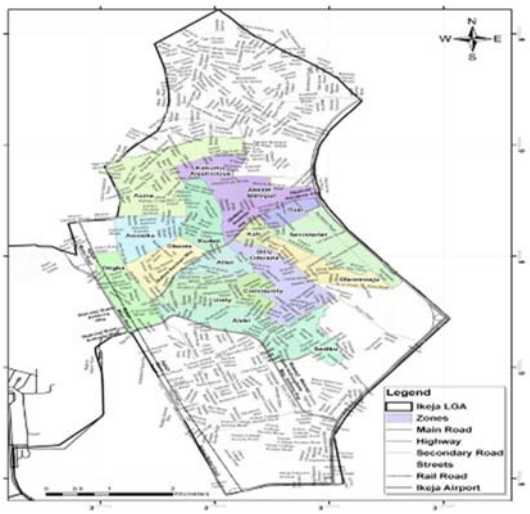

Figure 1. Map of Ikeja with carved zones

Lagos stands out as one of the 36 states in Nigeria with the highest concentration of industries and commercial activities with explosive population.

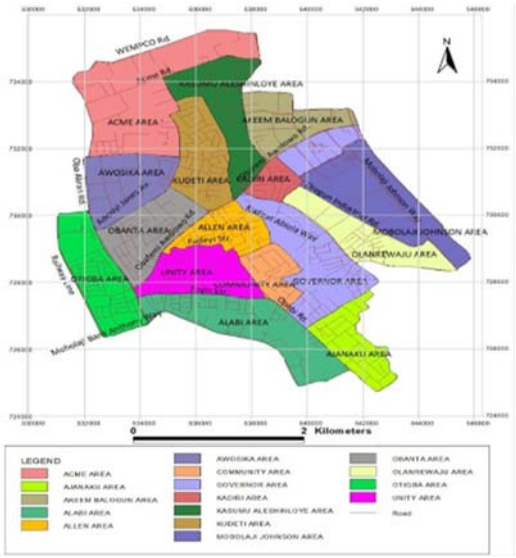

Figure 2. Map of carved zones

The choice of Ikeja is due to its high intensity of businesses and commercial activities, its roles as the capitals of Lagos state's attribute as the country's commercial nerve also makes it the most unpredictable in terms of pedestrian and vehicle traffic [10, 11]. Lagos is also ranked as one of the fastest growing urban area in Africa and 7th in the world [4]. Lagos State and Ikeja Local Government Area, the amount of pedestrian and vehicular traffic generated daily in and out of Ikeja, has made pedestrian and vehicular congestion a recur-

rent problem, parking problems is clearly prominent while pedestrian circulation during the day is critical.

The study area is the core economic area of Ikeja. It is bounded in the west by Lagos-Abeokuta and Agege Motorway, in the east by Lagos – Ibadan expressway, south by Mobolaji Bank Anthony way, north by WEMPCO road (Figure 2). The area was however delineated into seventeen zones and each zone is named after a popular street in the zone.

3. Methodology

In LSG 2018 NMT policy, safety of pedestrians as well as cyclists is one of the most basic necessities desired to support and expand non-motorised mode of transport. In an attempt to model NMT users' particularly pedestrian level of safety (PLS) multiple regression analysis and modified [7] model was adapted.

3.1. Variables Affecting Pedestrian Walking Environment

Modelling non-risk level of people walking depends solely on the threshold (Level of Service) along roadside walking environment and this entails: (i) provisions of sidewalks and walkways with buffer zones to separate pedestrians from the roadway; (ii) provisions of street furniture and marked crosswalk; (iii) provisions of curb ramps and transit stop; (iv) provisions of roadway lighting and (v) provisions of pedestrian underpasses and overpasses. There is also a general believe that PLS in a road strip is centred on a composite variable. These independent variables had been quantified as performance measure by Landis et al, 2001 which has also been subjected to extensive research. The variables are:

1. Sidewalk Availability
2. Pedestrian segregation from automobiles
3. Obstructions and shield between foot-travelers and automobiles
4. The number and composition of motor vehicles
5. Impact of speed of vehicles, and
6. Driveway frequency and magnitude.

The following variables, however, appear in a long list of variables thought to have affected the degree of protection of pedestrian (pedestrian's level of safety-PLS) in the streets and they are:

1. *Side Segregation - substructure that demarcate people from automobiles traffic*: These include (i) availability of sidewalks, (ii) breadth of walkways, (iii) shields demarcating walkway and automobile ways, (iv) availability of blockades in the shield area, (v) availability of on-street parking, (vi) breadth of motorbike lane aside main mobile lane.
2. *The volume of vehicular traffic*
3. *Speed effect of automobiles*
4. *Influx of vehicular traffic that is proportion of automobiles in the traffic*
5. *Incidence and capacity of Driveway access*

In section 3.2, variables itemised in this section were used to explain pedestrian safety level in Ikeja area of Lagos.

3.2. Analysis of Pedestrian Safety Level Model in Ikeja Area

Pedestrian level of service is a threshold for free flow of pedestrian movement on walkways and this serves as surrogate for determining pedestrian level of safety along roadside [3, 9]. Developing the model, fifty-six (56) road sections where pedestrian activities predominate were selected in the seventeen (17) zones understudy. Field measurements and observations rather than pedestrian perceptions were employed in developing the model under the following subheadings:

3.2.1 Availability of Walkway and Side Segregation

In facilitating pedestrians' protection and ease of movement on roadway, provision of a privately demarcated space to walk is highly significant. The presence of a sidewalk greatly affects pedestrian's sense of protection or comfort. In addition, the importance of walkway varies depending on the location substructure guarding it (i.e., side segregation) with respect to automobiles traffic [7]. For example, where there are walk-ways in Ikeja, the lateral separation changes as a result of buffer zones that either serve as drainage or on-street parking.

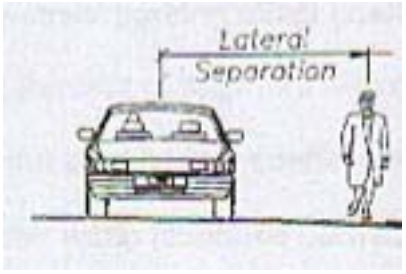

Figure 3. Walking along with vehicle

In general, side segregation termed lateral separations by [7] is presented in figure 3, figure 4, figure 5, figure 6 and 7. Figure 4 and figure 5 showed the effect of lateral separation, which has influence on pedestrian sense of safety with distance from moving traffic. Figure 5, figure 6 and figure 7 showed typical barriers within the roadside buffer and figure 8 showed pictorial depiction of roadway in Ikeja that lacks buffer zone and walkways.

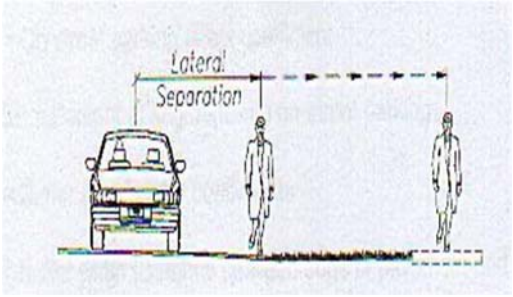

Figure 4. Separated by buffer zone

DOI: 10.26552/tac.C.2021.1.3

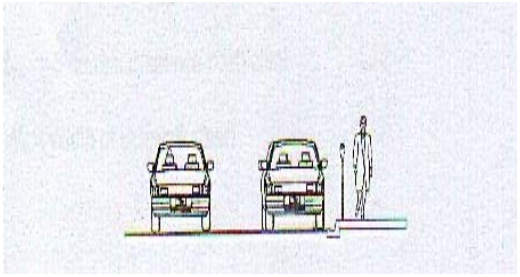

Figure 5. Separated by parked vehicle

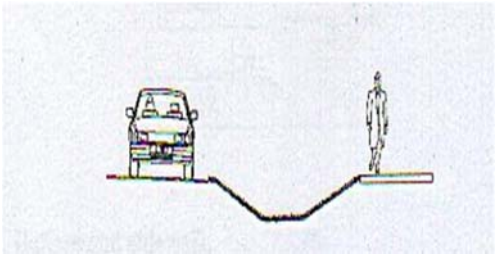

Figure 6. Separated by parked vehicle

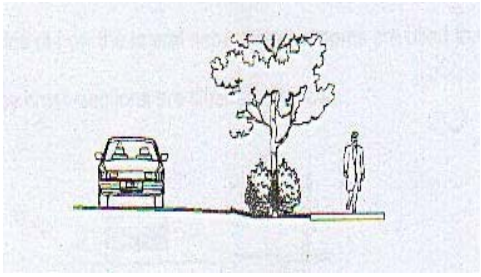

Figure 7. Separated by trees

Figure 8. Typical roadway in Ikeja

Mathematical expression that explains elements of lateral separation, barriers, buffers, and presence of walkways as expressed by [7] and modified to reflect the situation in Ikeja is presented in next equation (1):

$$LS = W_{OL} + W_{SBL} + f_{OPC}(\%OSP) + f_{BAC}(W_{BW}) + f_{SWC}(W_{WOS}) \quad (1)$$

Where:

LS = Lateral separation

W_{OL} = Breadth of outside lane (metre)

W_{SBL} = Width of shoulder or bike lane (metre)

f_{OPC} = Coefficient of roadside parking

$\%OSP$ = Percentage of a section of roadside parking

f_{BAC} = Barrier area coefficients

W_{BW} = Barrier breadth (distance between edge of pavement and sidewalk, feet)

f_{SWC} = Sidewalk availability coefficient

W_{WOS} = Breadth of walkway (feet)

Quantifying the basics of lateral separation as shown in equation 1 is illustrated in figure 9.

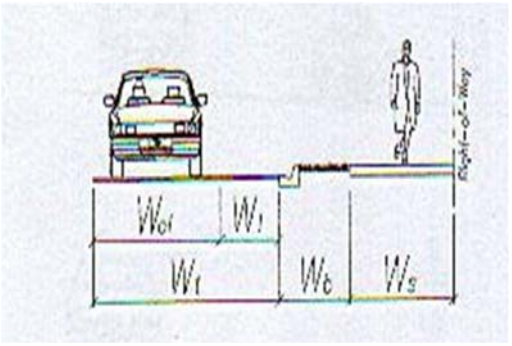

Figure 9. Quantification of Lateral Separation Basics
Source: Landis et al (2001)

Where, $W_{OI} = W_{ol}$, $W_{SBI} = W_l$, $W_{BW} = W_b$ and $W_{WOS} = W_s$. From previous equation, when there is no roadside parking, the % OSP becomes nothing. Then the lateral separation equation (2) becomes:

$$LS = W_{OL} + W_{SBL} + f_{BAC}(W_{BW}) + f_{SWC}(W_{WOS}) \quad (2)$$

In situation where there is roadside parking, its consequence as an obstruction is measured in equation above. But where there are no barred shoulders or scenery barrier, then the terms W_{SBL} and W_B becomes zero. Then, the lateral separation equation is shortened into next equation (3).

$$LS = W_{OL} + f_{OPC}(\%OSP) + f_{SWC}(W_{WOS}) \quad (3)$$

In the circumstance where there is on-street parking, but there is no bike lane, W_{SBI} equal zero then the lateral separation equation is streamlined into next equation (4).

$$LS = W_{OL} + f_{OPC}(\%OSP) + f_{BAC}(W_{BW}) + f_{SWC}(W_{WOS}) \quad (4)$$

In the case where there is no sidewalk, no bike lane, no striped shoulder or buffer, then lateral separation equation becomes equation 5.

$$LS = W_{OL} + f_{OPC}(\%OSP) \quad (5)$$

In the case where there is no sidewalk, no bike lane, no striped shoulder or buffer, and no on-street parking then lateral separation equation change to equation 6.

In the 56 points of the road sections in the study area, many of the road networks or streets are characterised with no sidewalk, no bike lane, no striped shoulder or buffer and with the operation of Lagos State Traffic Management (LASTMA)

officers in Ikeja roadways, most of the roadways and streets are free of on-street parking.

In the road sections where there are sidewalks, equation 2 was used to compute LS. Where there are no sidewalks, no bike lane and no striped shoulder or buffer, equation 5 was used to obtain the values of LS. Furthermore, equation 6 was used where there is no on-street parking, no sidewalks, no bike lane and no striped shoulder or buffer. The equations used to compute LS Ikeja road segments are equations 2, 5 and 6 that is

$$LS = W_{OL} + f_{OPC}(\%OSP) + f_{SWC}(W_{WOS})$$

$$LS = W_{OL} + f_{OPC}(\%OSP) \quad \text{and} \quad LS = W_{OL}$$

3.2.3 Motor Vehicle Volume

The rate at which automobiles passes people walking on roadside is represented by the outside lane increases and also serves as variable. As the moving rate of vehicles increases, pedestrians' safety level may rise or decline. So, the outcome of vehicular increase was computed using equation 7:

$$TV = \frac{Vol_{15}}{L} \qquad (7)$$

Where:

TV = Traffic Volume

Vol_{15} = Average traffic during a fifteen (15) minute period

L = Total number of (through) lanes (for road or street)

Equation (7) assumes a 50/50 directional (manoeuvring) distribution. In cases where the directional distribution is other than 50/50, equation (8) was used. The difference between the two equations (i.e. 7 and 8) is that while equation 8 uses a directional factor with "L_d" (total number of directional through lanes), equation 7 uses "L" (totals number of through lanes).

3.2.3 Effect of Speed

Pedestrians' safety level may be raised or decline as vehicular speed increases. Thus, vehicular traffic is established as a variable likely to influence people walking. Therefore, the speeds of moving vehicles along 56 road segments were recorded using speed radar gun.

3.2.4 Driveway Access Rate and Capacity

Influx of vehicles into adjoining properties on road has shown in many studies to have influence on pedestrian level of safety. In this study, drive access frequency to adjoining properties was recorded through observations of passing motor vehicles along the road segments. Based on the measurement of the discussed variables, PLS in Ikeja is model in the mathematical expressions in equation 8.

$$PLS = C + b_1 f(\text{lateral separation factors}) + b_2 f(\text{traffic volume}) + b_3 f(\text{speed}) + b_4 f(\text{driveway access frequency and volume}) + b_n f(x_n) + \alpha \qquad (8)$$

Result of field measurements and observations using equation 8 is discussed in next section 4.

$$TV = \frac{Vol_{15}}{L_d} \times D \qquad (9)$$

Where:

Vol_{15} = Fifteen (15) minutes traffic average

L_d = Number of road or street with through lanes

D = Manoeuvring influence

In this study equation 7 that is: $TV = \llbracket Vol \rrbracket\_15/L$ was used to compute the values motor vehicle volume along each road sections selected in the study area.

4. Results and Discussion

The results of the observations and measurements of 56 road sections in Ikeja using equation 9.is presented in table 1. and provide values obtained for LS, MV, SM and VA during field observations.

Table 1: Effects of Pedestrian Level of Safety on Explanatory Variables along Road Segments in Ikeja

Variables	**Coefficients**	**t-statistics**	**p>value**
Lateral Separation lin (LS)	0.596	5.139	0.000
Motor Vehicle Volume (MV) lin $(\frac{Vol_{15}}{L})$	0.204	1.732	0.000
lin (Speed of Motor Vehicle) (SM)	0.072	0.756	0.089
lin (Driveway access frequency and volume (VA)	- 0.067	- 0.745	0.453
Constant	-2.355	- 4.363	0.460
Model Adjusted (R^2)	0.581		
Model F-Ratio	20.089		
Level of Significance	0.05		

Source: Authors' Field Survey

Table 1, shows that two of the explanatory variables (LS and MV) used in the model are statistically significant at 5% confidence level. The results of PLS model of road sections

DOI: 10.26552/tac.C.2021.1.3

in Ikeja area of Lagos is in line with statistical significance of LS and MV and in paltriness with VA in works of Landis et al, 2001 but not in SM. Although, increase in speed influence PLS and this is shown in the positivity of the regression coefficient of the variable. Thus, the model for Pedestrian Level of Service (PLS) of road sections in Ikeja is given as:

$$PLS = -2.355 + 0.596lin\left[Wol + f_{OPC}(\%OSP) + f_{SWC}(W_{WOS})\right] + 0.204lin\left(\frac{Vol_{15}}{L}\right) + 0.072lin(SMV)$$

From the model, lateral separation is significant (β_{sd}=0.60, t_{sd}=5.14). The result shows that lateral separation increase pedestrian level of safety. As lateral separation increases, pedestrians' level of safety increases. In other words, the availability of sidewalk ensures level of safety which is aided by the presence of barriers such as roadside swale, on street parking and a line of trees. Figure 5 to 9 show that, the distance between motor vehicle traffic and pedestrian is much, therefore, pedestrians feel protected and safe.

The outside lane which indicates the volume of automobiles moving pass people walking in the results was also significant (β_{vv}=0.20, t_{vv}=1.73). As volume of motor vehicles passing pedestrians along road segments in the study area increases (β_{vv}=0.20, t_{vv}=1.73) the pedestrians' level of safety decreases. This often occurs when barriers at the buffer area are removed or there is no sidewalk and pedestrians shared width of outside lane *(W_{OL})* with motor vehicles as shown in Figures 10 and 11. Pedestrians' level of safety tends to decrease because pedestrians are exposed to road traffic accident. In other words, lateral separation increases pedestrian level of safety while motor vehicle volume decreases it.

Figure 10. A section of road in Ikeja

The results of the model also revealed that speed of motor vehicle traffic is insignificant (β_{sp}=0.07, t_{sp}=0.76) in the model but has positive coefficient which implies that pedestrian safety level is strongly influenced by automobiles. Pedestrians' sense of safety tends to be high when there seems to be for instance congestion (Figure 8). This is because the speed of vehicle is lower in the study area.

In case of vehicular access to adjoining properties, pedestrian level of safety increases with decline of vehicular access to adjoining properties along roadside walking environment in the study area. Despite statistical insignificance of the explanatory variable, decrease in vehicles accessing adjoining properties will increase pedestrian sense of safety because of lack of sidewalks and buffer that can protect pedestrians from being knocked down by vehicles accessing adjoining properties. Thus, increase or decrease in vehicular access to ad-joining properties along pedestrian roadside walking environment will definitely has effect on the level of safety of pedestrians.

Figure 11. Another section of the road in Ikeja

The adjusted R-square of the model (R^2=0.581) revealed a goodness fit of the explanatory variables to the level of safety along the sampled road segments in Ikeja. It indicated that the explanatory variables (lateral separation, automobiles volume, speed of vehicle, rate and capacity of driveway access) contributed (58.1%) justification to pedestrian sense of safety along roadside walking environment in Ikeja. Similarly, the F-Ratio ($F_{52}^{3} = 20.089$) of the model is also significant at 5% confident level. The results of the model show that the level of explanations ($R^2 = 0.581$) and variability ($F_{52}^{3} = 20.089$) of pedestrian level of safety is high across road segments in Ikeja.

5. Summary and Conclusions

The safety level of people walking by roadside model in Ikeja showed that distance of pedestrian from moving vehicle (lateral separation) and volume of vehicles are significant. Speed of moving vehicles and driveway access frequency and volume are insignificant in the explanation of factors that influence pedestrian safety on roadside walking environment in Ikeja. The study further showed that pedestrian sense of safety increases as the distance between vehicle and pedestrians increases. The study further revealed that pedestrian's level of safety decreases with increasing volume of motor vehicles and motor vehicle's speed. The results of pedestrian level of safety along road segments in the study area showed that heavy presence of traffic does affect pedestrian level of

safety and social network; thereby discouraging people not to walk.

In spite of insignificance of two of the explanatory variables, the variables jointly contributed about 58.1% to ex-planation to pedestrian level of safety along roadside walking environment in Ikeja thereby left 41.9% variables that are not accounted for. Thus, a search into unexplained variation will assist in examining comprehensive variables that influence pedestrian sense of safety along roadside walking environment. The knowledge will assist policy makers particularly in LSG NMT policy that has just being written during implementation.

Pedestrian footpaths or sidewalks are very important in road network design. The aspect of our route, however, is the most neglected. Regarding the targets of Goal 9 of SDGs that intend to promote upgrading of infrastructure and overhaul industries to make them sustainable, safety and security of pedestrians that form the ingress and egress of industrial, institutional, residential, and commercial activities of the core urban areas needs the attention of decision makers during upgrade. In any road network that involves human and vehicular movement, safety and security, comfort and quality of the footpath and other pedestrian facilities influence the decision of pedestrians to walk and as well make use of such facilities.

In order to safeguard pedestrians and cyclists for sustainable transportation that encourages infrastructure development and industrialisation of the city like Lagos, it is essential for proper implementation LSG NMT policy. Pedestrian *Level of safety model in Ikeja* thus provides a guide to urban and transport planners and LSG NMT policy decision makers to look on: (i) the distance between sidewalks and moving traffic; (ii) the type protective device that should be provided at any given time and place; (iii) the breadth sidewalk (iv) when and where to allow on-street parking or shoulder lane and (v) when, where to pedestrianized urban centre in order to discourage vehicular movement and encourage walking as well as cycling.

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Transport and Communications, 2021; Vol. I.
ISSN: 1339-5130

Intra-Urban Trip Generation Factors in Developing World: A Study of Ogun State, Nigeria

Muse Olayiwola Solanke[1], Bashiru Adisa Raji[1]

[1]Department of Transport Management, Olabisi Onabanjo University, Ago-Iwoye, 120107, Nigeria

Abstract Intra-urban travel is basic to urban residents. It is occasioned by the need of urban residents to carry out their activities in different places either by necessity or by choice. The magnitude of trips generated depends on the complex interaction of socio-economic characteristics of the cities and those of their residents. However, existing knowledge on the subject matter seems to concentrate on the latter to the sheer neglect of the former. This study therefore examines factors of intra-urban trip generation with emphasis on socio-economic characteristics of urban centres as well as those of urban residents. The study is based on both secondary and primary data from 14 selected urban centres of the state. Secondary data on 16 factors of growth of city were collected. These include population, industrial establishments, educational institutions, recreation and sporting services, postal and telecommunication services, health care services and shopping services. Primary data, through questionnaire survey were collected on socio-economic characteristics of urban residents and their trip generation frequency. 2,100 well completed questionnaires were analysed for this study. Simple bivariate correlation and multiple regression analyses were employed to examine the relationships between socio-economic characteristics of urban centres and trips generation. Similar analyses were also employed in the examination of the nature and extent of relationship between socio-economic characteristics of residents and trips generated. Principal component analysis was used in reducing socio-economic variables of the urban centres. The socio-economic characteristics of urban centres provide a greater explanation of the criterion with 53.80 % ($F=13.982$ $P \leqslant 0.05$) while socio-economic characteristics of residents provide 46.20% ($F=137.62$ $P \leqslant 0.01$) of the explanation. The study establishes the need for caution among transport researchers in using socio-economic characteristics of urban residents as major determinants of urban travel especially in the developing countries.

Keywords Intra-urban travel, trip generation, socio-economic factors, urban centres, Ogun State, Nigeria.

JEL R4, R41

1. Introduction

Human travel is inevitable; it represents an expression of an individual's behavior and as such, has the characteristics of being habitual. As a habit, it tends to be repetitive and the repetition occurs in definite pattern [9].

Worldwide, urban travel takes place when inhabitants of urban centres carry out their different activities in different places either by necessity of by choice. Studies [38]; [40]; [33] and [37] have shown that, in general people tend to travel in order to obtain access to a variety of other peoples' services and facilities that are not available at the origins of their journeys.

In most traditional studies, cost-minimizing or utility maximizing principles have been applied in explaining and predicting travel and spatial choice behavior. For instance, economic decision criteria used to be the central issues in analysing regional and urban travel behavior. However, with increasing industrialization as well as urbanization amongst nations, locational and mobility choices are increasingly less guided by purely economic-oriented criteria. Rather, spatial choice behaviour is increasingly being influenced by such factors as socio-economic characteristics and environmental factors. In addition, allocation and choice pattern have displayed on increasing heterogeneity and diversity among spatial actors, hence the question of scale of analysis becomes crucial [24].

Individuals in various urban centres are known to generate complex trip patterns, almost all the world's urban areas face difficulties in accommodating the complex variety of movements that are made in response to individual felt needs and desires [36]; [39]; [41] and [33]. The descriptions of such travel activity patterns provide considerable insight into the nature of daily life and into variations in the quality of life experienced by different groups of people.

An important observation from existing works on urban travel is that the relationship between travel and individual characteristics implies among other things, that those individuals with greatest extent, variety, and frequency of travel are those with the fewest constraints imposed upon them. Constraints can be imposed by a person's socio-economic status, by one's household and societal roles, by one's location vis-à-vis the size and density of settlements.

[15] recognized importance of location as determinant factor of travel behavior, [11]; [12] and [21] recognized the significant influence of physical factors such as size and density of settlement. In a similar vein, [6]; [35]; [4] and [40] really emphasized that a combination of socio-economic and spatial variables was desirable in future research on household trip generation in urban centres. It is therefore clear that trip generation in urban centres is logically a function of complex interaction of socio-economic characteristics of urban centres and those of their residents. Meanwhile the past works on intra-urban trip generation especially in the developing world demonstrated the influence of socio-economic characteristics of urban residents on urban travel while a lot of lip-service has been paid to the importance of the effect of socio-economic characteristics of urban centres. This study therefore is designed to contribute to the knowledge on intra-urban trip generation by further identifying the influence of socio-economic characteristics of urban centres on one hand and those of their residents on the other hand on intra-urban trip generation. The implications of the findings for urban transport planning are analysed. This study is premised on the hypothesis that the propensity to generate trip in urban centres of the developing world depends more on the socio-economic characteristics of the urban centres than the socio-economic status of the individual resident.

The study intends to contribute to our knowledge on how different household socio-economic characteristics as well as urban development variables relate to the travel behavior of urban residents. As a matter of fact, generating solutions to intra-urban travel challenges will depend on level of understanding of this rather complex relationship. In order to understand and be able to model trip generation on cities, there is need for a basic knowledge of the determinants of intra-urban travel from socio-economic perspective of urban residents as well as the city itself as attempted by this study.

2. Study Area

2.1. Geographical Location and Socio-economic Activities

The study area, Ogun State is one of the fast developing states in Nigeria. It is in the South western part of the country within latitudes 6°N and 8°N and longitudes 3°E and 5°E. The state is bounded on the west by the Republic of Benin and on the east by Ondo State. To the north is Oyo State, while Lagos State and the Atlantic Ocean are to the south (figure 1). The state covers about 16,762 square kilometres which is approximately 1.81 percent of Nigeria's land mass of about 923,768 square kilometres.

2.2. Geology and Relief

The geology of the state comprises the sedimentary and basement complex rocks. According to [3] about 1,200km^2 of the state is of sedimentary formation while about 400km^2 is of basement complex rocks of pre-Cambrian formation. The relief of the state, like other parts of the country is more or less coincide with the major rocks types.

There are two main relief regions: first, the creeks and lagoons forming a small section in the south eastern part of the state, the altitude of which ranges from 0 to 40 meters above the sea level. Second, the undulating coastal plain and the low lands with the elevation increasing northwards from about 30 to 250 meters above sea level. The plain is broken by sand stone cresta especially towards the western part of the state. There are pockets of rock outcrops dotting the landscape especially around state capital (Abeokuta). The whole state is drained by flowing coastal rivers such as Ogun, Yewa, and Shasha from Oyo state through the thickly vegetated western part of the state. Numerous small rivers and streams are at the south eastern parts flowing perennially through the swampy terrain.

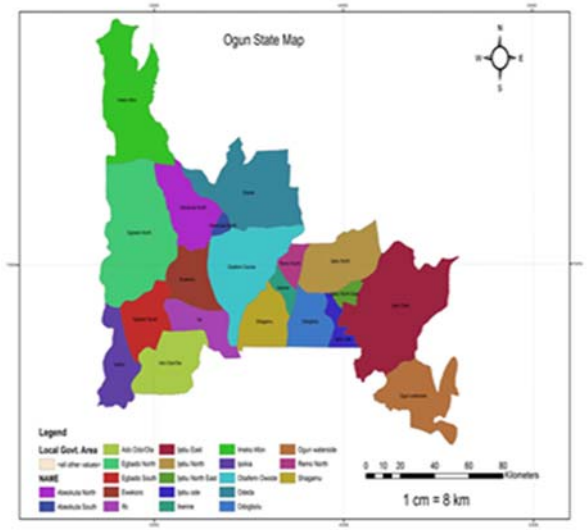

Figure 1. Ogun state map (Source: Authors' field survey)

2.3. Climate and Vegetation

The state is within the tropical humid climatic zone of Nigeria, which is generally characterized, by high rainfall and high relative humidity. This is attributable to the prevalence of moisture laden tropical Maritime air mass over the state for about nine months in a year. The mean relative humidity varies from 66.2% in January to 88.4% in July [3]. The rainfall shows a double maxima distribution reaching the peak during the months of June and September.

The average monthly rainfall for the state ranges between 7.1mm in the month of January to 208.27mm in the month of June. The mean annual temperature is 26°C; although with some variations over time. The mean diurnal minimum temperature varies from 21.8°C in December to 24.34°C in April while the mean diurnal maximum temperature varies from 33.92°C to 37.10°C at the onset of the wet season (March and April) [3].

On the basis of climatic features, the state is characterized by two distinct weather seasons: the wet and dry. The wet season marked by lower mean temperature, higher total rainfall and higher relative humidity is usually experienced between the months of February and October. However, little dry season is sometimes experienced in August, a phenom-

DOI: 10.26552/tac.C.2021.1.4

enon characterized by drastic reduction in the frequency and intensity of rainfall and referred to as August break. The dry season sets in by November and persists till the end of January. It is usually accomplished by harmattan cold, brought by the prevailing north-west winds.

In terms of vegetation, the state can be divided into three distinctive zones. Where the state shares a boundary with the Atlantic Ocean, the vegetation is of a swampy type with mangroves and other edaphic trees. There is also rainforest vegetation in some section of the state while the state capital (Abeokuta) and some areas are characterized by derived forest vegetation, having been altered by human activities.

2.4. Socio-Economic Activities

In the pre-colonial era, the economy of the state, like those of most other traditional Nigerian towns in Nigeria was characterized by farming, craft production, trade and town administration [35; 2].

The establishment of colonial rules in the state brought new forms of economic activities which are characteristics of western economy, and there has also been some modifications to the traditional system of production. Thus, several identifiable modern economic activities including banks, insurance, houses, modern and traditional markets, petrol stations, motor companies, commercial enterprises, light and heavy industrial organizations are now found in different urban centers in varying degrees.

Some settlements, especially the capital (Abeokuta) benefited immensely from their early contact with the European population (the missionaries) who helped in the development of such areas by establishing mission houses, schools, churches, dispensaries and hospitals.

Agriculture the mainstay of the economy provides the major single occupation for the people of the state especially those in the rural areas. Arable crops like maize, yam, cassava, rice, cocoyam, groundnut, melon, banana plantain, oranges, pineapple, sugarcane and kolanuts are produced in the state. The major export crops produced are cocoa, coffee, rubber and palm kernel. In the Riverine areas, people engage in extensive fish farming, lumbering activities also thrive because the state is endowed with appreciable forest resources. This perhaps accounts for the high number of sawmills in the state.

An important economic activity in the state is extensive trading and light commercial merchandising. The people are engaged in buying and selling of all types of goods ranging from local household utensils in food, beverage and manufactured goods.

The industrial sector constitutes another economic activity. Among the major industrial types in the state are: food, beverages and tobacco, textile, weaving apparel and products, fabricated metal products, wood and wood products, chemical products, pulp, paper products, printing and publishing, non-metallic minerals, motor vehicles and miscellaneous assemblies, domestic/industrial plastic and rubber products and electrical and electronics [26]. The potentials of the state for industrial development are as a result of her natural, agricultural and forestry resources and proximity to Lagos the former capital as well as commercial and industrial nerve of the country [26; 27].

People in the state also engaged in paid employment of the local, state and federal government agencies, others engage in business activities which are dominated by distributive trade, personal services, transportation, finance and insurance services.

To complement the socio-economic development of the state are education, health, telecommunication, postal and insurance institutions and other socio-economic services and infrastructures that exist in many towns. For instance, the state has about 1424 public primary schools, 474 public, secondary schools, 7 government technical colleges, 1,120 registered private nursery and primary schools, 257 registered private secondary schools, 2 colleges of education, 4 polytechnics, 3 public universities and 8 private universities.

Also there are 88 hospitals/clinics (public and private) 210 maternity centers, 202 dispensaries, 16 comprehensive/primary health centers, 4 dental centers and 1 university teaching hospital. Notable tourist attractions in the state are Olumo Rock at Abeokuta, BirikisuSungbo Shrine at Oke-Eri, Ebute-Oni Beach, Oronna Shrine and the Celestial city at Imeko.

The socio-economic characteristics of the state reveal the dynamic and buoyant nature of Ogun state with a lot of potentials for trip generation in cities. A notable observation on the state shows that almost all Ogun state government budget speeches since its creation in February1976 emphasized social policy of distributive equity, balanced development and egalitarianism .However, the general develop-mental pattern of the state as revealed by field investigations suggests unusual access of her citizenry to basic facilities/amenities. The level of accessibility of individuals to some basic needs of varies considerably. This variation seems to appear not only between rural and urban areas, but also from local government to local government and from city to city. The authors' familiarisation with the study area and evidence from published and unpublished materials on the state tend to suggest a multifaceted and multi-dimensional problem of inequality among the various units to which the state could be demarcated, thus making the socio-economic development activities of the state to metaphorically wear what [34] referred to as many colours.

The spatial variation that can be intuitively observed in the distribution of socio-economic facilities/services among various urban centres of the state coupled with their hierarchical pattern make Ogun state a fertile and appropriate ground for this study of variation in trip generation patterns among urban centres at a regional level.

3. Methodology

Both secondary and primary data were used in order to achieve the goal of this study. The secondary data are the socio-economic variable/development indicators of the urban centres. Various government publications on Ogun state such as the state's statistical yearbook and abstract of statistics, local Government Digests, technical reports, academic

journals and other periodic publications of Ogun state ministry of finance and economic planning provided the bulk of secondary information for this study. The federal office of statistics and national population commission also provided some information on the population figures of the cities.

In the literature, little agreement exists on the range of indicators to be included in the measurement of development level of an area unit. A review of research works on regional development in the developing societies for instance reflect the concatenation of social and economic variables in various forms [32; 1; 14; 2] among others and thus, serve as antecedents to this study.

In all, sixteen socio-economic variables considered paramount and relevant as potentials of urban trip generation were collected. They are: (1) Rateable hereditaments (2) population (3) telephone subscribers (4) nursery/primary schools ((5) secondary school (6) tertiary institution, (7) public health center, (8) private health centres (9) traditional market, (10) modern market, (11) industrial establishment (12) post offices (13) postal agencies (14) stadia/sport centres (15) hotels and (16) tourist/recreational facilities. These variables and services were chosen because they were measurable, relatively avail-able and they have been recognised as measures of urban socio-economic growth [34; 2].

The primary source of data is questionnaire survey for urban residents on household basis, following the works of [28; 35; 12; 41 and 42] household is a well-known key decision-making unit for the general movement pattern and constitutes the major point of origin of urban travel. An urban centre is defined as the settlement with a total population of 20,000 people or more in conformity with the United Nation and the definition of urban centres in the Nigeria national population census of 1963, 1991 and 2006.

On the basis of this definition, there are 22 urban centres in the state. 14 of these in different categories (such as large, medium, and small) in terms of population sizes were randomly selected. They are: Abeokuta (the state capital), Ijebu-Ode, Sagamu, Ilaro, Ago-Iwoye, Ota, Ijebu-Igbo, Ayetoro, Ifo, Iperu, Ado-Odo, Idi-Iroko, Owode-Yewa and Alagbado.

A household survey was conducted in each of these selected urban centres to generate data on socio-economic characteristics of urban residents and their frequency of intra-city travel. Each urban centre was divided into residential quarters along the demarcation of the town into residential neighbourhoods by the Town Planning Authorities (TPA). In each of the neighbourhoods, random selection of streets and systematic sampling of the housing unit were made. The size of household interviewed was based on the estimate for each urban centre. There are about 513,770 households in all the selected urban centres out of which 2,877 were sampled in proportion to the number of households in each city (Table 1). 2,100 fully completed copies of the questionnaire were used in this study.

The questionnaire dealt among others with socio-economic characteristics of residents and frequency of trip in each urban centre. In this study, socio-economic characteristics are used to refer to social and economic status of the households. Following the works of [5], [19], [28], [31], [35], [25], [21], [40], [41] and [37] among others, multiple item indices were used to measure socio-economic status of respondents. These are: sex, age, marital status, educational level, occupation, occupational category, monthly income and automobile/vehicle ownership.

Table 1. Urban centers in Ogun State, estimate number of household and sample sizes

S/N	Urban Center	Est. Population	Est. No. of household	Household sample size
1.	Abeokuta	853420	170684	956
2.	Ijebu-ode	299368	59874	335
3.	Sagamu	308511	61702	346
4.	Ilaro	94172	18834	105
5.	Ago-iwoye	71685	14337	80
6.	Ota	250006	50001	280
7.	Ijebu-ogbo	157081	31416	176
8.	Ayetoro	72971	14594	82
9.	Ifo	126895	25379	142
10.	Iperu	55971	11194	63
11.	Ado-odo	55629	11126	62
12.	Idi-iroko	42119	8424	47
13.	Owode	95205	19041	107
14.	Alagbado	85818	17164	96
	Total	**2568851**	**513770**	**2877**

Source: Estimated from records of ministry of finance and economic planning (Statistics Division) Abeokuta, Ogun State by Authors, 2019

Other important measures considered as potentials of household trip generation in this study are: length of stay, number of workers, mode of travel and estimated annual rent paid. The annual rent paid is considered here as another measure of economic power aside income as previous studies have shown that in survey research, respondents often inflate incomes for ego boosting or deflate them for tax evasion. In all, twelve socio-economic characteristics of households are considered important measures of intra-city travel behavioural pattern and determinants of trip generation. Urban residents were requested to construct their trips within the past one week to date of survey. The immediate past week to date of survey was chosen in order to collect the information from them while they are still fresh in their memory; thus enhance the accuracy of the information.

Also, in this study, frequency of trip is defined as the mean trip generated by individual households in urban centres for a period of time (e.g. a week). This is estimated by dividing the total trips generated by households within a designated period by the number of households sampled in the city.

The simple bivariate correlation, multiple regression analysis and principal components analysis were used to process the data generated. The simple bivariate correlation was used to examine the nature and degree of relationships between

DOI: 10.26552/tac.C.2021.1.4

household frequency of trip and socio-economic variables of urban centres on one hand and socio-economic characteristics of urban residents on the other hand. Multiple regression analysis was used to examine the contribution of socio-economic variables of urban centre on one hand and the socio-economic characteristics of urban residents on the other hand to the trips generated.

The multiple regression is of the form:

$$Y = a_0 + b_1x_1 + b_2x_2 \ldots b_nx_n + e$$

where:

Y = the criterion or dependent variable (frequency of household trip)
a = the intercept of the regression plane
b_i = regression co-efficient
x_i = the predictor or explanatory or independent variables (socio-economic variables of urban centres on one hand and socio-economic characteristics of urban residents on the other hand).
e = stochastic disturbance or error term

The stepwise version of the model was used because it derives the best regression equation from a set of explanatory parameters in a step-by-step version. The explanatory variables are considered one after the other on the basis of their partial correlation with the criterion (dependent variable). The independent variable which exhibits the highest partial correlation with the criterion variable is considered first in the regression equation while the one with the greatest proportion of the residual variance is considered next.

At every stage of the analysis, a significant test is carried out using 'f' and 't' test statistics to ascertain the reliability of the variance that is contributed by any newly entered independent variable in the overall relationship. The principal components analysis was used to resolve some of the problems met in order to satisfy the assumption of the multiple regression analysis as well as for data parsimony.

4. Results and Discussion

4.1. Socio-economic variables and Intra-urban trips

The relationships between trip generated and socio-economic variables of urban centres are presented in Table 2. The mean trip generated is positively correlated with each of the socio-economic variables of urban centres. This indicates a positive interaction pattern between trip generated and socio-economic variables of urban centres, thus, confirms the potentials of these variables for spatial interaction within cities.

Table 2. Relationship between mean trip generated and socio-economic variables of urban centers

Socio-economic variables	Relationship with trip generated
Hotel	0.724**
Industry	0.396
Modern market	0.279
Primary school	0.734**
Population	0.737**
Postal agency	0.643*
Post offices	0.531
Private health centers	0.761**
Public health centers	0.688**
Rateable hereditament	0.679**
Secondary school	0.772**
Sport centers	0.700**
Telephone subscribers	0.744**
Tertiary institution	0.569*
Tourism	0.628*
Traditional markets	0.703**

**Correlation is significant at the level 0.01 level
**Correlation is significant at the 0.05 level

There is a strong positive correlation coefficient of not less than 0.70 between mean trips generated and the following variables: hotels, primary schools, population, private health centres, secondary schools, stadium/sport centres, telephone and traditional markets. Fairly high positive correlations of between 0.5 and 0.6 exist between mean trips generated and each of the following variables: postal agency, public health centres, ratables hereditaments, tertiary institutions, tourist centres and post offices. Furthermore, a very weak positive correlation exists between mean trips generated and industrial establishments (0.396) as well as modern markets (0.279).

The strong to fairly high positive correlations between mean trip generated and all variables other than industrial establishments and modern market is noteworthy. It shows that with high concentration of such variables, the urban centres tend to generate more intra-city trips. This funding agrees with earlier studies such as those by [13] in United States of America and [22] in Taiwan where positive relationship was established between trips generated and socio-economic variables in general. The contribution of the socio-economic variables to the trip generated was established through Regression analysis.

In applying the model, the traditional multi-collinearity problems amongst intercorrelated independent variables were eliminated using [17] rule of pairwise correlation in excess of 0.80 as widely used in research [35; 30; 40].

An examination of the zero-order correlation matrix of explanatory variables (socio-economic variables) (Table 3) shows that a very strong positive correlation in excess of 0.80 exists between population and each of the following variables hotels (0.928), primary schools (0.979), postal (0.968), private health facilities (0.944), public health facilities (0.937), reteable hereditaments (0.975), secondary schools (0.990), telephone facilities (0.951), traditional market

(0.955), post offices (0.818), sport facilities (0.851) and tertiary institutions (0.817). Also, strong correlation in excess of 0.80 exists between hotel and each of the following: primary schools (0.933), private health centers (0.914), secondary schools (0.93), postal agencies (0.852) sport facilities (0.836), telephone facilities (0.898) and traditional markets (0.828). All these are indications of serious collinearity problems among the variables. In order to overcome these problems, the principal component analysis is employed. The principal component analysis technique is also relevant in a situation where the number of explanatory variables that are theoretically relevant in a regression model is very large relative to or more than the cases (observations) [35; 30]. This is the case of the data being used for the regression analysis in this study. There are fourteen urban centers (cases) as against sixteen explanatory variables.

4.2. Principal Component Analysis

In the application of this technique a major issue is how to determine the number of components that the researcher needs to represent the data. The eigen-value, greater than one criterion has been given wider applications in research [8; 22; 35; 40; 37] and therefore used in this study.

The results of the principal component analysis on sixteen socio-economic variables of the urban centers are shown in tables 4 and 5. Table 4 shows that there are two components that explain the underlying similarities of the sixteen variables. Table 5 further reveals that these two principal components accounted for about 88% of the variation in the original data. On the basis of the high percentage of the total variance explained by these components, they can be de-scribed to have adequately represented the original data.

Table 3. Inter-Relationships between Socio-Economic Variables of Urban Centers

	HTL	IND	MDM	NPS	POP	POA	POA	POF	PRH	PUH	RHD	SES	STD	TEL	TER	TRM
HTL	1.000															
IND	.395	1.000														
MDM	.373	.015	1.000													
NPS	.933**	.470	.478	1.000												
POP	.928**	.342	.494	.979**	1.000											
POA	.852**	.167	.489	.929**.	.968**	1.000										
POF	.672**	.142	.593*	813**	.818**	.864**	1.000									
PRH	.914**	.478	.456	.931**	.944**	.883**	.683**	1.000								
PUH	.819**	.111	.557*	.864**	.937**	.950**	.820**	.872**	1.000							
RHD	.883**	.156	.479	.936**	.975**	.985**	.856**	.873**	.966**	1.000						
SES	.913**	.334	.509	.970**	.990**	.961**	.834**	.938**	.954**	.944**	1.000					
STD	.836**	.362	.379	.850**	.851**	.809**	.749**	.810**	.814**	.843**	.872**	1.000				
TEL	.989**	.537*	.466	953**	.951**	.887**	.758**	.966**	.881**	.882**	.956**	.893**	1.000			
TER	.644*	.051	.633*	.772**	.817**	.856**	.870**	.661**	.860**	.851**	.835**	.800**	.756**	1.000		
TOU	.766**	.139	.713**	.711**	.769**	.709**	.659*	.745**	.826**	.737**	.783**	.764**	.762**	.768**	1.000	
TRM	.828**	.190	.518	.904**	.955**	.969**	.842**	.876**	.982**	.957**	.970**	.856**	.907**	.902**	.789**	1.000

**Correlation is significant at the level 0.01 level

**Correlation is significant at the 0.05 level

Note:

HTL -	Hotel	RHD -	Rateable Hereditaments	IND -	Industry
MDM -	Modern Market	NPS -	Number of Primary School	POP -	Population
POA -	Postal agency	POF -	Post Offices	PRH -	Private health centers
PUH -	Public health centers	SES -	Secondary Schools	STD -	Sport Centers
TEL -	Telephone lines	TER -	Tertiary institutions	TOU -	Tourist Centers
TRM -	Traditional markets				

The first component has Eigen values of 12.620 and accounted for about 79% of the variance in the original data. All these variables, except, industrial establishments loaded highly on this component. All these variables also have positive signs. Component I is named social and commercial factor. The second component has Eigen value of 1.436. Only one variable (industrial establishments) loaded highly on this component and accounted for about 9% of the variance in the original data. Component II is therefore named industrial development factor.

DOI: 10.26552/tac.C.2021.1.4

Table 4. Rotated Component Matrix of the Sixteen Socio-Economic Variables of the Urban Centers

Socio-economic variable	Principal Components	
	I	II
Hotel	0.908*	0.230
Industry	0.315	0.844
Modern market	0.570*	-0.468
Primary schools	0.964*	0.194
Population	0.986*	0.07681
Postal agency	0.962*	-0.084
Post office	0.861*	-0.229
Primary health	0.930*	0.251
Public health	0.955*	-0.171
Reteable hereditament	0.86*	-0.081
Secondary school	0.991*	0.05325
Stadia	0.895*	0.114
Telephone	0.957*	0.249
Tertiary institution	0.871*	-0.341
Tourist centers	0.831*	-0.241
Traditional market	0.972*	-0.104

*Socio-economic variables that loaded highly on the components

Table 5. Eigen-values and the total variance percentage explained by each component

Principal component	Eigen value	% Total Variance	Cumulative variance
I	12.620	78.874	78.874
II	1.436	8.978	87.852

4.3. Application of Multiple Regression Model

The regression model is now applied to relate the two derived independent factors to the trip generated (dependent variable). The result is presented in table 6. The two components jointly explain 58.68 of the variation in the average intra-city trips generated in the study area. With F ratio of 7.830, this result is significant at 95% confidence level. The signs of the coefficient of the two components show that they are both positively related to the mean trip generated. This shows that the higher the level of these facilities, the higher the trip generated by the urban centers in the study area.

Table 6. Summary of the regression result between the trip generated and two socio-economic components

Socio-economic component	Social/ commercial	Industrial development
B coeff	4.755	1.439
Standard error	1.272	1.255
Multiple R	0.734	0.766
Level of explanation (%)	53.80	4.88
Cumulative level of explanation (%)	53.80	58.68
F value	13.982*	7.830*
T value	3.739*	1.146

*Significant at 95% confidence level.

Of the two components the social/commercial component alone explains 53.80% of the total variation in the mean trip generated. This is also significant at 95% confidence level. The industrial development component accounts for only 5% of the variation. Although F value is significant at 95% level, the t value for this component is not significant at 95% confidence level. This shows that the industrial development component does not provide a significant explanation towards the variation in intra-city trip generated in urban centers of Ogun State.

Based on the above explanation, the regression model for the relationship between mean trip generated by urban centers and socio/commercial components in this study is as follows:

METG = 37.14 + 4.755X;

where

METG = mean trip generated

X = social/commercial component

Intra-city trip generation in the study area is thus, a direct function of the level of social/commercial component. This finding is in agreement with earlier finding of [13; 22] (both in industrialized society) and [35] (in developing country) that population and other socio-economic factors are important factors, positively predicting trips generated by the urban centers at the intra city level. With the above result, it is plausible to state that just as socio-economic variable are important as predictors of inter-city trip, they are equally important in the prediction of intra-city trips. In other words, the findings of scholars like [13; 22; and 35] a travel behavior at intercity level is applicable to intra-city level.

4.4. Socio-economic characteristics of residents and intra-city trip generation

The Regression analysis is also used to examine the influence of socio-economic characteristics of urban residents on intra-city travel.

Table 7 shows the matrix of zero-order correlation coefficient between the socio-economic characteristics of residents and intra city trips generated. Generally, the correlation coefficient are not very high, the highest being 0.546 between

auto-ownership and mode of travel. On the basis of these low relationships among these data set, the independent variables are considered truly independent. In other words, there is no multi collinearity problem that can adversely affect interpretation of the regression analysis in this respect.

Table 7. Intercorrelations between socio-economic variables and trip generated

	Resex	Reage	Reedu	Reoccup	Reoccupe	Rems	Reincome	Relostay	Reautown	Remotrav	Noworker	Rent	Totrip
Resex	1	-0.002	.114**	0.028	0.022	.145**	.306**	.057*	.237**	.186**	.325**	.195**	.291**
Reage		1	-.086**	-.005	-.020	.250**	.175**	.317**	.176**	.081**	.284**	.094**	.400**
Reedu			1	.013	.175**	-.082**	.180**	-.176**	.175**	.219**	-.091**	.320**	-.017
Reoccup				1	-.121**	.243**	.057*	.062*	.017	-.050	.056*	.046	-.054
Reoccupe					1	-.161**	-.069**	-.095**	.019	.046	-.184**	.088**	-.079**
Rems						1	.196**	.277**	.134**	.021	.272**	.089**	.221**
Reincome							1	.049	.276**	.245**	.387**	.253**	.328**
Relostay								1	.128**	-.039	.187**	.037	.226**
Reautown									1	.546**	.205**	.361**	.226**
Remotrav										1	.185**	.321**	.245**
Noworker											1	.151**	.603**
Rent												1	.206**
Totrip													1

** Correlation is significant at the 0.01 Level * Correlation is significant at the 0.05 Level

The multiple regression analysis of socio-economic characteristics of residents and trips generated is presented in table 8. A fairly high multiple correlation co-efficient (R) of 0.680 is found to be highly significant at 99% confidence level, implying that the relationship between the criterion and predictors is worthy of note. With F value of 91.869, regression equation provides an explanatory model of some determinants of the propensity to interact in the study area.

The twelve socio-economic characteristics of residents account for 46.20% of the total variation in the criterion, while eight of them are significant at 95% confidence level and above. The significant predictors jointly account for 46.10% of the level of variation in trips generated. These variables in order of importance as revealed by table 8 are: number of workers, age, mode of travel, sex, occupation, Length of stay, rent and income. On the basis of the significant variables, the regression model of socio-economic characteristics of urban residents and intra-city trip generation is of the form:

$$TOTRIP = 14.529 + 8.984xNOWORKER + 6.957xAGE + 3.641xMOTRAVEL + 4.235xSEX - 3.432xOCCUP + 1.840xLOSTAY + 0.050xRENT + 1.320xINCOME$$

where all the variables are as earlier defined.

The outcome of this analysis confirms most of the findings of [6] for Jos, [43] for Oyo, [28] for Ile-Ife, [31] for Lagos, [29] for Ibadan among others that number of workers, age, income, mode of travel, rent and length of stay in city etc are significant factors of urban travel behavior.

A comparison of the proportion of variation in the criterion provided by socio-economic characteristics of urban centres and socio-economic characteristics of urban residents shows that the former provides a greater explanation (56%) than the latter (46%). This confirms the hypothesis of this study that the propensity to generate intra-city trips in the study area depends more on socio-economic function of urban centres than the socio-economic status of the individuals.

With this result, it is plausible to state that just as socio-economic characteristics of residents are important as predictors of intra-urban travel, the socio-economic characteristic of urban centres are more fundamental.

DOI: 10.26552/tac.C.2021.1.4

Table 8. Summary of Multiple Regression Results: Socio-economic characteristics of Residents and intra-city trips generated

Variables	b Coefficient	STD Error of b Coefficient	Multiple R	Level of Explanation (%)	Cumulative Level of Explanation (%)	F Value of the Equation	Beta for Variables	T Value for Variables
No of Worker	8.984	0.333	0.6000	36.00	36.00	729.635**	0.600	27.012**
Age	6.957	0.617	0.646	5.70	41.70	463.842**	0.249	11.273**
Mode of Travel	3.641	0.591	0.659	1.70	43.40	330.735**	0.131	6.165**
Sex	4.235	0.803	0.668	1.20	44.60	260.157**	0.131	6.165**
Occupation	-3.432	0.915	0.672	0.60	45.20	213.042**	-0.078	3.750**
Length of Stay	1.840	0.607	0.675	0.40	45.60	180.192**	0.066	3.031**
Rent	0.050	0.018	0.677	0.30	45.90	156.356**	0.061	2.778**
Income	1.320	0.649	0.679	0.20	46.10	137.662**	0.048	2.035*
Car Ownership	-0.974	0.719	0.679	0.10	46.20	122.650**	-0.035	1.356
Marital Status	0.673	0.887	0.680	0.00	46.20	110.406**	0.017	0.759
Occupation Category	-0.092	0.634	0.680	0.00	46.20	100.295**	-0.003	0.145
Education	0.099	0.666	0.680	0.00	46.20	91.869**	0.003	0.150

No of Cases: 1,300 **Significant at the 0.01 Level STD - Standard
Constant: 14.529 * Significant at the 0.05 Level

5. Summary and Conclusion

This study is on the factors of intra-urban trip generation in relation to the socio-economic characteristics of urban centres as well as the socio-economic characteristics of their residents.

The study is based on both secondary and primary data. The secondary data are the socio-economic variable/development indicators of the urban centres. Sixteen socio-economic characteristics of urban centres considered paramount and relevant as potentials of urban trip generation were collected. The primary source of data is questionnaire survey for urban residents on household basis. Twelve measures of socio-economic characteristics of the residents were employed as indicators of status of residents.

The simple bivariate correlation was used to examine relationships between socio-economic characteristics of urban centres and trips generated on one hand as well socio-economic characteristics of residents and trips generated on the other hand. Multiple regression analysis was used to examine contributions of predictors to the criterion on both sides. The principal components analysis was used to resolve some of the problems met in order to satisfy the assumption of the multiple regression analysis as well as for data parsimony.

The study reveals that socio-economic characteristics or urban centres contributed 53.68% of explanation of intra-urban trip generation while socio-economic characteristics of residents provided 46.20%.

The findings of this study pose considerable challenges to previous research in transport studies. Hitherto, in the ex-planation of intra-city travel, researchers have focused attention on the relationship of observed trip generation and socio-economic characteristics of trip makers. The findings of this study have shown that the socio-economic characteristic of urban centres is a more powerful factor than socio-economic characteristics of urban residents on the explanation of regularities that characterized trip generation in our cities. In conclusion therefore, Researchers need to be critical in using socio-economic characteristics of residents alone as measures of determinants of household travel behavior especially in the developing nations. This shows that while socio-economic developments of urban centres as well as socio-economic characteristics of urban residents contribute to trip generation in urban centres the former provides more explanation than the latter.

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DOI: 10.26552/tac.C.2021.1.4

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Journal is excerpted in **Index Copernicus** database (ICV 2019 91.48).

Frequency of publishing: Twice per year.

Publishing language: English

Publisher: The Faculty of Operation and Economics of Transport and Communications, University of Žilina, Univerzitná 1, 010 26 Žilina, Slovakia

Printed: EDIS – Printing House of the University of Žilina, Univerzitná 1, 010 26 Žilina, Slovakia

IČO 00 397 563

Edition: 20 pc

Registered No: EV 4902/13

Tel: ++421/41/5133051

Email: tac@fpedas.uniza.sk

Web: http://tac.uniza.sk

Máj 2021

DOI: 10.26552/tac.J.2021.1

ISSN 1339-5130

ISSN 1339-5130

DOI: 10.26552/tac.J.2021.1