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

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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.

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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 1,200km² of the state is of sedimentary formation while about 400km² 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-

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

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.

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.

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 \quad **Significant at the 0.01 Level STD - Standard
Constant: 14.529 \quad * 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 explanation 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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