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CONTENTS

SOCIO-ECONOMIC FACTORS' EFFECTIVENESS IN ESTIMATING TRIP GENERATION AND ATTRACTION OF AN EDUCATIONAL LANDUSE

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Abstract
The traditional approach used by transport planners in developed countries to estimate and forecast trip generated and attracted by residential land uses has been largely based on the socio-economic characteristics of the urban trip makers. This is due to the assumption that socio-economic characteristics of the urban travelers significantly affect the level and pattern of trips they generate. This paper therefore attempts to use socio-economic characteristics to estimate trip generated and attracted by commuters of an educational land use within an urban centre of a developing environment; this was done by using multiple linear regression models. The purpose is to determine how effective are these variables in estimating and forecasting trips generated and attracted by educational land use. The results clearly show that socio-economic factors are too weak for modeling trip generation and attraction of an educational land use in a developing environment like Nigeria. The paper therefore raised some issues and questions, in which answers and solutions to them require further research.

Introduction

The volume and pattern of trip generated and attracted in urban centres is mainly a function of landuse (i.e. type and intensity) and efficiency of the city's transport system. Different land uses in urban centres generate and attract different volumes and patterns of trips. Therefore, the need to estimate or forecast trip generation and attraction by various landuses in urban centres become very crucial considering the fact that the planning and design of any urban transport system requires some anticipated level of traffic flow for a design year (Ogunsanya 1983).

In recognition of this, scholars over the years have focused attention in developing appropriate models for estimating trip generation and attraction for different landuse types in urban centres. Starkie (1967) for example, focused mainly on the industrial landuse and its traffic generation characteristics in his study of Meadway town in Britain. He discovered that the types and sizes of manufacturing plans are major determinants of the volume of trips generated by the industries. Daniel and Warnes (1983) also emphasized the influence of residential and work place locations on the pattern of travel. Wooton and Pick (1967) identified the factors that affect trip generation and they are classified into two groups, namely:- internal and external factors. The internal factors include, income, car ownership, family structure (particularly number in employment). The external factors include rail and bus accessibility. According to them, the rail is primary factor that affects work trip generation especially in places where there is heavy dependence on the rail system.

Malthy (1970) Hurst (1970), and Lawton (1963) also worked on trips generated by industrial plants and discovered that employment size and

structure as well as size of industrial plants are major factors that determine the number of trips generated and attracted by industrial plants. Chisholm and O'Sullivan (1973) also used total population of an area, total retail turnover in pounds sterling and total employment by Standard Industrial Classification (S.I.C) order to estimate the volume of national road freight transport in Britain.

It is very evident from the available literature that, the factors that affect the volume of trips (or traffic) generated in urban centres are numerous and vary from one particular landuse to another. It is also discovered that many of the studies done both in developed and developing countries focused mainly on residential, industrial and commercial landuse, very little attention if any at all examined the factors that affect the trip generation and attraction of an educational landuse. Thus, information on the factors that affect the trip generation and attraction of an education landuse is not available or at best scanty.

On the other hand, educational landuse is widely spread all over the urban centres in Nigeria. It has occupied a very large proportion of urban landuse, and there is a high rate of students' enrolment in all educational centres. All these have combined and made educational landuse to contribute significantly to the overall volume and pattern of intra-urban travel in Nigeria cities. In the light of the above reasons, the paper attempts the use of socio-economic factors to estimate the volume of trip generation and attraction by an education landuse, as a case of University of Ilorin main campus. This is to provide useful information on how best socio-economic factors, such as, age, sex, marital status, occupation, education, car ownership family size and income can estimate trips generated and attracted by an educational landuse. This is to serve as a basis for generalization as well as filling the gap created in the literature.

The Study Area

The study area is the University of Ilorin, is located in the city if Ilorin, the capital of Kwara state of Nigeria, and situated at the northeastern, part of the city. The main campus has various functional and interacting land uses. It has three broad categories of landuse; the student's village, the staff quarters; and the academic areas. With a resident student's population of over 6000 (excluding the squatting students) and over 700 resident staff, an interaction between the campus and the town is very high. In addition to this, there is high level of interaction between the University mini campus and main-campus which are located in different parts of the city. The location of other public utilities, such as Unilorin staff school and secondary school has contributed greatly to the level of interaction between the University and the city. This increased interaction between the city and campus all make a strong justification for the study of the educational landuse as a traffic generator and attractor in the city's space.

Methodology

The data used in this study were part of a larger study carried out by he author. Questionnaires were used to collect specific information on the socio-economic characteristics of campus residents; staff and students as well a commuters to the campus. The information includes, sex, age, marital status, income, car ownership, family size, occupation and education. Others include trip purpose, frequency of trips, origin and destination of trips. Only the trips made from the city to campus and /or made from the campus to city were considered in the field survey.

The systematic random sampling technique of one out of every ten commuters

to the campus or out of the campus was selected for interview at the University main gate. The same sampling technique was adopted for both resident and staff on campus. A total of 400 questionnaires were administered, but only 365 questionnaires were returned and after removing the defective ones only 350 were considered for the analysis. However, out of the 350 questionnaires, 150 were applicable for trip generation analysis while remaining 200 is for trip attraction. In measuring the income of students, their monthly pocket-money was regarded as their income while each student interviewed was regarded as a unit of family of one person. The socio-economic variables (as independent variables) were subjected to step-wise and multiple regression model with number of trip made weekly by commuters as dependent variable.

Estimating Trip Generation

The trip generation model attempts to predict or estimate the amount of movement or trip leaving a particular zone based on the attributes of that zone. We refer to the variable to the predicted as the dependent variable, measured as the number of trips leaving a given zone during a fixed period of time. The attributes of a zone that are used to predict this are called explanatory variables. The explanatory variables used will differ depending on the types of trip being modeled. In estimating trip generation of landuse, various methods could be used; these include, category analysis, and regression model. However, in this study the author made use of regression model which can be conceptualized as:

$$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, \ldots) \quad (1)$$

where Y represents the number of trips made by respondents

X_1 = Income
X_2 = Car Ownership
X_3 = Family Size
X_4 = Educational level
X_5 = Occupational types
X_6 = Marital types
X_7 = Sex
X_8 = Age

Equation (1) above is now made operational in the form of a regressions

$$Y = b_0 + b_{1x1} + b_{2x2} + b_{3x3} \ldots b_{8x8} \quad \ldots\ldots\ldots\ldots (2)$$

Where X_1 .....X_8 represent independent variables and b0, b_1, b_2. b_8 represent the regression constants.

Using the equation (2 above, the data were subjected to the step-wise multiple regression analysis. Table 1 below shows the correlation matrix for dependent and independent variables.

Table 1: **Correlation matrix of the Dependent and Independent Variables of Trip Generation**

	X1	X2	X3	X4	X5	X6	X7	X8	Y
X1	1.0000								
X2	0.7721	1.0000							
X3	0.9747	0.7597	1.0000						
X4	0.4772	0.5419	0.4695	1.0000					
X5	0.7889	0.6722	0.7743	0.6706	1.0000				
X6	0.8700	0.6522	0.8410	0.4706	0.8525	1.0000			
X7	0.0269	0.316	0.0355	0.1529	-0.0752	-0.0761	1.0000		
X8	0.6833	0.6288	0.7182	0.6511	0.7813	0.7317	-0.1065	1.0000	
Y	0.1179	0.0100	0.0762	-0.1112	0.1660	0.1660	0.0034	0.0371	1.0000

SOURCE: Computer Output

An examination of the table above reveals some relationship; outstanding among them is that most of the variables are positively related. This means that there is a general tendency for the variables to rise and fall together. For example, variable X_1 has a high correlation coefficient of 0.97, 0.87, 0.79, 0.77 and 0.68 with X_3, X_6, X_5, X_2, and X_8 respectively. The same pattern of high correlation coefficient is observed in all the variables with the only exception of variable X_7, and X_4. This is a problem of multi collinearity, however, multicollinearity may not be a problem if this trend continues into the future (Ogunsanya 1993). Another observation in the table is that all the dependent variables have very poor correlation coefficient with dependent variable "Y". In the table, X_5 has the highest correlation coefficient with dependent variable and this is as low as 0.166m this is followed by X_6, with 0.16, while the least coefficient correlation is recorded for X_7, with 0.003. This poor correlation is quite contrary to some studies previously conducted on the same in both the developed and the developing countries (see Whilte and Senior, 1984 and Hurst 1974)

However, the analysis above merely explains the strength and direction of the relationship between the trips and socio-economic variables. It is also useful to know the explanatory strength of these variables. To do this, a stepwise regression procedure was employed. This is because; the method is very useful in identified and retaining independent variables that are significant in estimating the dependent variable. However, none of the eight variables is significant enough to enter the stepwise regression model at 0.05 levels and 0.15 levels.

Therefore, the entire eight variables were then subjected to multiple linear regressions. The details of the analysis are presented in table 2.

Table 2: **Regression summary for Dependent and Independent Variable for the Trip Generation**

Dependent Variables	Independent Variables	Regression Estimate	Standard Errors
Y:	X1	0.000132	0.00010512
	X2	-0.119797	0.22344513
	X3	-0.188472	0.13763673
	X4	-0.195827	0.09166491
	X5	0.248663	0.13295482
	X6	-0.167509	0.44342519
	X7	-0.012710	0.14627946
	X8	0.027272	0.13581732
Coefficient of determination	R^2% = 15.85%		

Source: Computer Output based on field work survey

B0 = regression constant = 0.574218
Coefficient of determination (%) i.e R = 15.85%
Number of observation = 150
Number of variables (including dependent) = 9

Standard error of estimate = 0.60960067
Multiple regression equation is $Y = 0.574218 + 0.000132X_1 - 0011979X_7 - 0.188472X_3 - 0.195827X_4 + 0.248663x5 - 0.167509X_6\ 0.012710X_7 + 0.027272X_8$
Y = number of average weekly trips made by individual respondents.
X_1 to X_8..... represents the socio-economic variables mentioned earlier.

The analysis of both correlation coefficient and multiple regression shows that socio-economic variables are too weak and quite inadequate to estimate the pattern and level of trips generated by the educational land use. The whole 9 variables explain a total variation of 15.85%. This cannot adequately explain the number of trips generated by the land use under study.

Estimating Trip Attraction

Trip attraction is concerned with the prediction of where the trips go. The model tries to link the origin and destination end of trip generated. For the estimation of trip attraction, independent variables were regressed against the number of trips attracted by the University. Table 3 shows the correlation matrix, which indicates the strength and direction of the relationship between these variables.

Table 3: **Correlation Coefficient of the Dependent and Independent Variables of Trip Generation**

	X1	X2	X3	X4	X5	X6	X7	X8	Y
X1	1.0000								
X2	0.2682	1.0000							
X3	0.3979	0.3353	1.0000						
X4	0.0808	0.1691	0.1055	1.0000					
X5	0.1716	-0.0556	0.1777	0.1902	1.0000				
X6	0.2131	0.0580	-0.0107	0.1276	0.1859	1.0000			
X7	-0.1319	-0.1142	-0.0914	0.0136	-0.0191	-0.0558	1.0000		
X8	0.1270	-0.0275	0.0272	0.0810	0.0318	0.4369	-0.1637	1.0000	
Y	0.0946	-0.0771	-0.0077	-0.1001	0.0681	-0.0449	0.0730	-0.0340	1.0000

SOURCE: Computer Output based on fieldwork survey.

An observation of the correlation matrix reveals that some of the correlations are positive while some are negative. This implies hat some of the variables rise or and fall together while some rise while the others fall. Another very important thing to note here is that the correlation among the variables is very weak. For example, X_1 that has the highest correlation with dependent variable has 0.27, 0.04 -0.08, 0.17, 0.21, -0.13 and 0.095 with X_2, X_3, X_4, X_5, X_6, X_7, and X_8 respectively.

Not only is that, the relationships between the dependent and independent variables are also weak. The highest correlation coefficient between dependent variable "Y" is recorded by X_4 which is -0.1001 while the least correlation coefficient is by X_3 with -0.007. This result is similar to what was obtained in the analysis of trip generation. Therefore, one can conclude that these independent variables are not sufficient to explain the pattern and level of trips attracted by the educational land use under this study.

Table 4 **Regression Summary for Dependent and Independent Variable for the Trip Attraction**

Dependent Variables	Independent Variables	Regression Estimate	Standard Errors
Y	X1	0.000025	0.000025s
	X2	-0.051050	0.12021494
	X3	-0.013844	0.3149766
	X4	-0.044324	0.06122931
	X5	0.031943	0.06122931
	X6	-0.076750	0.04923927
	X7	0.099818	0.15362086
	X8	-0.002284	0.08119583
Coefficient of determination	R^2% = 4.1%		

Source: Computer Output based on field work survey.

Regression constant = 0.701969
Standard error of estimate = 0.43600176
Coefficient of Determination % i.e. $R^2 = 4.1\%$
Number of observation = 200
Number of variables (including) dependent) = 9
Multiples regression equation is $Y = 0.701969 + 0.000025X_1 - 0.051050X_2 - 0.013844X_3 - 0.044324X_4 + 0.031943X_5 - 0.076750X_6 + 0.099818X_7 - 0.00228448X_8$
X_1 to X_8 represent the eight socio-economic variables mentioned earlier.

The result indicates a poor level of explanation as the coefficient of determination is only 4.1%. This is ridiculously low and therefore cannot adequately explain the pattern of trip attraction by the educational land use. Therefore, it is evident in the analysis of estimation of trip generation and attraction that, socio-economic variables cannot predict accurately the pattern and level of trip generated and attracted by the an educational land use. Many reasons can be attributed for this.

- Many previous studies that show the relevance of socio-economic variables in estimating trip generation and attraction were mostly done on macro intra-urban level. Perhaps, socio-economic variables are not relevant at the micro level of analysis for educational land use.
- Some studies in developing countries have questioned the reliance on the socio-economic variables as the major or only factor that explains the pattern of trip generation and attraction. Other variables such as attitudinal and behavioural factors have been discovered as determinant factors of trip making in developing countries (see Ogunsanya 1988). Could it then be that attitudinal factors such as convenience, comfort, taste, personal values and attachment are additional factors for trip generation and attraction in the study area?
- The study did not also consider the accessibility factor, which may also be a contributing factor to the volume and pattern of trips generated in the study area.

- The data used in this study were collected at disaggregate level while most past studies used data collected at aggregate level. Could it therefore be that the method used here is not quite relevant? Educational land use has a unique character, in that, it has a mixture of both public and private residential uses, socio-economic variables do not seem to be good determinants of its traffic volume.

Conclusion

These are questions that arise and their detailed answers require a further search. However, the objective of this study has been achieved, this is because, we have been able to find out that conventional socio-economic variables are not sufficient for estimating trip generation and trip attraction at least at micro level of trip analysis particularly for educational land use. A further search is therefore required to determine the appropriate variables needed for estimating traffic generated and attracted by an education land use.

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