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TRIP GENERATION OF ADULT WORKERS: A CASE OF GHANA

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ABSTRACT

Understanding the travel behaviour of road users is important in the development of transportation plans. In Ghana, most studies focus on mode choice modelling with truly little studies on trip generation. This paper examines the influence of household and individual characteristics together with other explanatory variables on trip generation using data from the 2012 Ghana Transport Indicator Database Survey which was conducted by the Ghana Statistical Service. Linear regression models were used to model the number of trips by car, bicycle, motorcycle, foot, taxi and bus for all working adults. The results from the study show that gender, age, education level and residential location all show a significant impact on the number of trips generated for the different trip modes. From the results, the cultural background of a worker also significantly affect bicycle trips a worker make. Also, adult household is that reside in the city center make fewer trips by car than similar adults that live outside the city center. The number of trips generated by an adult worker can also be used to explain the perception variables estimate. The model results can also be used to make trip generation prediction in developing transportation plans for Ghana.

1. INTRODUCTION

Travel demand forecasting plays a significant role in the development of transportation plans and evaluation of transportation infrastructure. The travel needs/demands keep on changing as such it is imperative to make plans that accounts for the possible future changes. In developing countries, especially Ghana, there is a growing need for a transportation system which captures the growing needs of its population. In Ghana, the vehicle population grows higher than the transportation network as such increasing pressure on the transportation infrastructure (The Report: Ghana 2018). Also, land use planning conflicts with transportation planning. For example, residential areas being used for commercial purposes. There is a critical need to understand the travel pattern of users to be able to make better prediction in meeting the transport needs of the country. Therefore, this study contributes towards developing a trip generation model which relates individual and household characteristics, residential location and other perception explanatory variables to the number of trips by mode.

Trip generation models is the first of the traditional four-step travel demand model which predicts the number of trips by purpose. The model determines the number of trips undertaken by a household or individual usual based on the characteristics at the person level and household level. Trip generation models employ the traditional linear regression model to determine its model estimates.

2. LITERATURE REVIEW

The trends of trip generation are common and well developed. In the United States, it is done by purpose as trip generation captures the reason behind a trip being made. An example of how trip generation by purpose is done in the US is reflected in the studies by Lim and Srinivasan (2011). Their study focused on comparing four different econometric structures (linear regression, log linear model, negative-binominal model, and ordered-probit model) for trip generation modelling for three trip purposes – home-based-work (HBW), home-based-other (HBO) and non-home-based (NHB). The data source for their study was from the 2001 and 2009 U.S. National Household Travel Surveys. The 2001 data was used to estimate the trip generation models and the 2009 data was used to validate the estimated model. Their findings recommend the use of ordered-probit models against the traditional regression models.

In Ghana and most developing countries, there appear to be few studies on trip generation, however there is a bunch of studies which have looked at mode choice. For example, Abane (2011) study the attitudes and travel behaviour of Ghanaians from four metropolitan areas – Accra, Tamale, Kumasi, Sekondi-Takoradi. Their study shows that mode choice is significantly impacted by the affordability and availability of those modes. This study is supported by the paper by Agyemang (2017) which identifies perceptions of convenience (that can be related to affordability and availability) as a strong predictor for choosing a 'trotro' (minibus) over a car. Additionally, older persons and persons with higher levels of education were less likely to travel by trotro than car and this result is consistent with the finding by Ye and Titheridge (2017). In comparing the mode choice of employees in the formal sector in the two largest cities in Ghana, that is Accra and Kumasi, Abane (1993) and Amoh-Gyimah and Nimako Aidoo (2013) found that high income workers are less likely to use public transport, Furthermore, findings from Amoh-Gyimah and Nimako Aidoo (2013) show that workers with households of family sizes greater than two are less likely to choose non-motorized transport. From their study, the distance from home significantly affects mode choice as workers are less likely to travel to work by public transport for distances greater than 5km.

In terms of trip generation by purpose, Takyi (1990) employed the cross-classification method to determine household characteristics and its influence in trip making. Results from the study significantly show that an increase in the household size will increase the trotro and walking trip rate for work, shopping and school trips. Also, Afolabi et al. (2017) shows a relationship between commuter's frequency of travel by their level of income.

Overall, there has been appreciable study on mode choice in developing countries but very few on trip generation. Therefore, this paper aims to study the trip generation by mode of working adults in Ghana.

2.1 Data

This study was performed using data from the 2012 Ghana Transport Indicator Database Survey which was conducted by the Ghana Statistical Service. This data which represents the second phase of the first ever nationwide household-based transport survey was conducted over a 3-month period between September 2012 and December 2012. The survey was administered to 6000 households which represent all the households in Ghana from all the ten regions. However, this analysis focuses only on all adult workers. The data includes some basic socio-economic characteristics of the individuals of a household (such as age, gender, ethnic group) in addition to variables that show the detailed characteristics of the individual's educational background (such as highest educational level, current grade, means of transport to and from school). Also, the data provides some socio-economic characteristics of the household characteristics such as size and income, and some location variables such region and district where household lives.

The survey also collected data on the various transport activities of individuals in the household with respect to health, economic activities, market activities and other household activities. The detail characteristics of the individual and households' characteristics makes the data viable in understanding the travel behaviors of households in respect to mode choice by purpose (work, school, health facility, market) and help generate a travel behavior model for the nation.

The data contains individual and household variables for 23238 individuals from 6000 households' selection from a total of 400 Enumeration Areas (EA). However, the data does not explicitly provide any variable that identifies each household member belonging to the same household. Therefore, with supplemental information on the enumeration areas listing that was used for the survey, which was provided by the Ghana Statistical services, a unique Household ID code was generated to match the household members with their respective households. The data provides a variable as household number (HHID) however, a frequency distribution of this variable showed that there were 20 household number with 15 of them each having more than 1450 households. From a further probe into this variable, we were able to identify that the household numbers referred to the number (staring from 1) assigned to each household that was randomly selected in each enumeration area for the interview. Therefore, a unique code combining each HHID in their respective EA was generated. For example, a code of 2312 refers to an EA of 231 and a HHID of 2). With this code generated, household members were linked to their respective households and we were able to generate some household characteristics such as household size, and total number of adults, children, workers and students in a household.

Out of the national sample of 23,238, 58.4% of them representing 12734 were adults (that is 18 years or older) from which 9836 are engaged in some sort of employment activity. Further basic statistics of this study is based on the sample size from adult workers.

In preparing the data for analysis, the data was subject to thorough cleaning and some data variables were reclassified and adjusted for clarity. There were some inconsistencies in the data sample, therefore some cases were filtered out to help clean the data. Some data cases showed a value of zero for the average travel time to/from school, work, health facility, and market, therefore careful check was done before filtering out the zero values in this variable. For school-related purpose, the average travel time of zero was filtered off for every transport means except boarding school. It is assumed that there is no major travel activity from residence or any origin to a school if it is a boarding school. For health and market, the average travel time of zero for every transport mode was filtered off. In terms of work, 1863 of the cases had an average travel time of zero. However, a crosstabs of average travel time to/from work with the variable: "does work require travel from residence", revealed that the time of zero was stemming from households that required travel from residence to work. A cross tabulation of the average travel time with the variable: "means of travel to work" shows that the average travel time of zero is predominantly by traveling by foot thus making it difficult to explain. Therefore, the 1863 cases were kept for this analysis purpose.

The different modes of transport for each purpose were also reclassified. All trips done by a shared public taxi or individual taxi was reclassified as taxi based on purpose. All means of transport by bus or 'trotro', a public minibus, were classified as bus, and the 'other' variable represented all other means of transport including boat/canoe/ferry and train. Therefore, the main means of transport identified in this data are taxi, bus, private cars, motorcycles, bicycles, foot and others.

Due to the constant evolution of the education system in Ghana, the highest-grade variable of the individuals in the household were reclassified into a standard educational system for easy comprehension.

Data Descriptive

Thorough cleaning and consistency checks generated a clean sample of 9833 cases with Table 1 showing a brief description of the key variables considered in this analysis describing the travel behavior of the various household workers. Table 1 presents descriptive for all workers, workers in households that own car, own bicycle or motorcycle. The full sample shows a gender distribution of 53% female and 47% male with an average age of 38.16. On average, there are about 4.86 persons per household, 2.15 children and 2.72 adults per household. In terms of culture, 46.8% of the households are from the Akan ethic group, 19.7% are Mole Dagbanis, 13.1% are Ewes, 6.7% are Ga/Dangmes with the remaining 12.8% belonging to the other ethnic groups. The highest education level of all persons in the household were also considered with only 1.4% of the workers having a bachelor's degree. Table 1 also presents the monthly income each household. Residential location of household, marital status of household person, religion and some perception variables. Descriptive of the households' vehicle ownership – 28.4% of the households' own bicycles, 8.75% own motorcycles, 4.8% own cars and 0.4% each own busses and trucks.

Figure 1 shows the frequency distribution of the total number of trips by car, bus, taxi, motorcycle and bicycle made by workers in the last seven days from the day the respondent completed the survey. For trips on foot, the number of trips the worker makes on a normal day was recorded as such Figure 2 shows the frequency distribution for that. In both figures, the number of trips after the 40th trip (which represents 0.1% of the sample) was aggregated with the 40th trip.

Table 1: Connected components and average clustering coefficient

Variable	Proportion of households by trip mode			
	All modes	Car	Bicycle	Motorcycle
Gender				
Male	47.00	51.40	51.10	53.50
Female	53.00	48.60	48.90	46.50
Age Categories				
18-24	14.00	14.40	14.60	13.60
25-44	56.20	60.50	56.00	62.70
45-64	24.80	23.70	24.50	20.80
>=65	5.00	1.50	4.90	2.90
Highest Education Level				
Less than middle school	19.10	8.20	15.40	13.60
Middle school graduate/ BECE	25.90	23.00	15.70	19.00
Some High School	2.00	2.70	1.40	2.00
Vocational Training	2.00	3.60	1.20	1.60
SSCE certificate/ A level certificate	8.50	14.60	6.50	10.20
Training College/Polytechnic	2.70	7.80	1.70	4.20
Bachelors	2.40	18.40	1.30	4.10
Other	0.70	2.70	0.50	1.00
HH member currently in school	5.70	14.40	6.20	6.60
Total number of students in household				
Household monthly Income				
Monthly income less than 200.01 ghc	38.10	5.30	43.40	32.30
Monthly income between 200.01 ghc and 600 ghc	34.40	26.60	34.00	36.50
Monthly income between 600.01 ghc and 1000 ghc	12.30	19.70	10.20	15.20
Monthly income between 1000.01 ghc and 1200 ghc	3.50	10.60	3.30	6.20
Monthly income greater than 1200 ghc	6.00	32.30	6.40	7.20
Marital Status				
Married	68.30	67.40	76.60	80.70
Divorced/Separated	5.90	3.20	2.70	2.00

Widowed	5.20	2.30	3.40	1.60
Never married	20.60	27.10	17.20	15.70
Ethnicity				
Akan	46.80	67.20	23.00	25.90
Ga/Dangme	6.70	0.40	2.60	2.20
Ewe	13.10	12.50	9.00	8.00
Mole Dagbani	19.70	8.70	39.00	36.60
Other ethnicity	12.80	3.00	25.70	26.10
Religion				
Christian	72.20	88.60	52.00	53.40
Islam	17.60	8.00	32.90	37.40
Traditional	5.10	0.20	11.00	5.80
Other religion	5.10	3.20	4.00	3.40
Residential location				
Houselhold member in urban area	41.30	77.00	30.20	47.90
Houselhold member in rural area	58.70	23.00	69.80	52.10
Household lives in city center	4.70	8.20	2.30	1.90
Household lives in town	35.80	27.90	27.60	35.70
Household lives in a suburban area	32.40	53.70	26.30	28.20
Household lives along a major road	8.50	6.30	13.20	10.90
Household lives on the farm	8.50	1.30	15.10	9.80
Household lives near transport terminal	0.20	0.00	0.00	0.00
Other household location	8.70	1.90	14.80	12.90
Regional census				
Western	9.80	4.20	3.70	3.70
Central	6.30	4.20	1.20	1.40
Greater Accra	12.90	32.60	6.20	6.00
Volta	8.00	2.10	8.40	8.90
Eastern	11.60	13.70	4.30	3.40
Ashanti	19.80	28.80	9.60	10.80
Brong Ahafo	10.80	7.20	16.30	13.10
Northern	11.20	5.20	27.20	31.40
Upper east	6.50	0.60	15.70	12.00
Upper west	3.10	0.80	7.40	9.30
Sekondi Takoradi	1.40	1.10	0.10	0.20
Gomoa East (Central)	0.60	1.30	0.00	0.00
Accra Metropolitan Area	4.80	13.70	1.60	2.40
Ho Municipal	0.20	0.00	0.20	0.20
Kwaku North (Eastern Region)	0.70	0.40	1.30	1.50
Kumasi Metropolitan Area (Ashanti Region)	6.90	20.70	1.50	5.00
Techiman (Brong Ahafo Region)	0.90	0.80	1.20	1.40
Tamale Metro	1.70	4.40	3.90	9.50
Bolgatanga Municipal (Upper East Region)	0.90	0.20	1.80	1.70
Wa Municipal (Upper West Region)	0.30	0.80	0.50	1.40
Vehicle Ownership				
Bicycle	28.40	17.12	100.00	57.30
Motorcycle	8.75	10.57	17.70	100.00
Car	4.80	100.00	2.90	5.81
Bus	0.40	3.00	0.20	0.80
Truck	0.40	1.90	0.54	1.50
Perception Variables				
Bus route convenient				
Yes	47.10	46.10	44.60	48.10

No	39.40	43.30	42.90	42.60
Satisfied with bus condition				
Yes	70.30	75.30	63.60	66.60
No	16.10	14.20	23.90	24.30
Satisfied with bus frequencies schedule				
Yes	52.60	67.00	46.40	56.00
No	32.70	22.20	39.90	33.10
First important transport problems				
Transport fares too high	19.40	11.00	26.40	22.50
Long delays at transport station	22.00	14.40	20.10	18.60
Bad roads	39.00	34.90	39.10	39.10
Traffic jam	11.00	30.00	5.10	7.90
Other transport problems	3.00	4.90	4.20	5.70

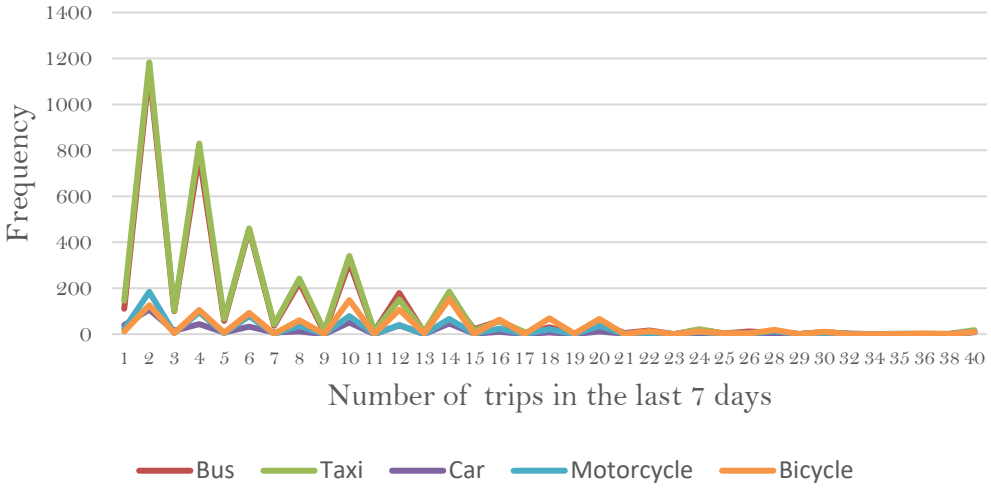

Figure 1. Frequency Distribution of the Total Number of Trips Per Mode

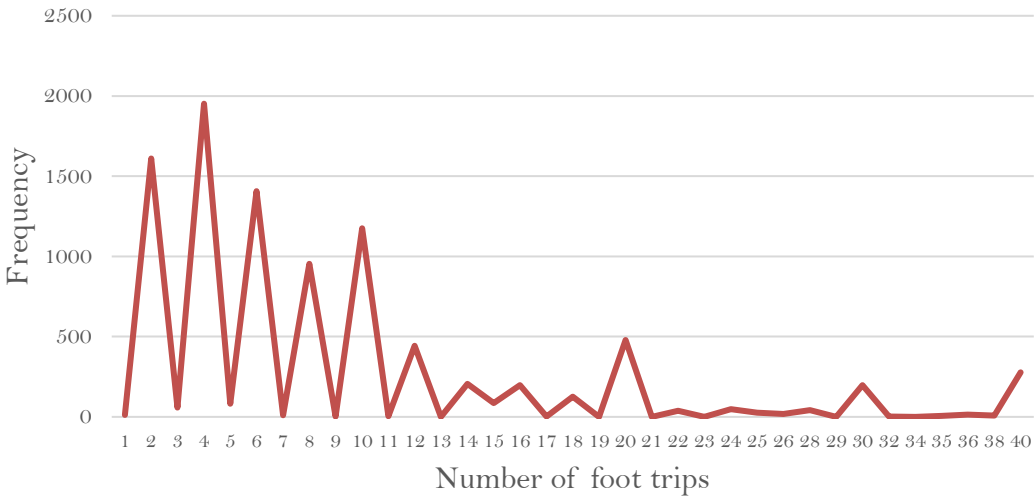

Figure 2. Frequency Distribution of the Total Number of Foot Trips on a Normal Day

3. METHODOLOGY AND ANALYSIS

This section of the paper discusses the modeling methodology used for analysis. In understanding how household characteristics, person characteristics, residential location, and vehicle ownership impact the frequency of trips made by a working adult, the conventional linear regression model (give reference) was employed. The Linear regression model is used extensively for trip generation models. The model developed examines the relationship between the number of trips a working adult makes for all trip purposes based on a set of explanatory variables. The general form of this model is given by:

$$Y_i=\beta_0+\beta_1 X_1+\beta_2 X_{(2)}+\cdots+\beta_i X_i+\xi_i$$

where

i= index for households

Y_i= number of trips made by household i for a given purpose

β_0= constant term which captures the mean effect of excluded factors

X_i= explanatory variable

β_i= coefficient of explanatory variable to be estimated

ξ_i= random error term which captures the impact of unobserved characteristics

4. FINDINGS

In this section, we present the results of the linear regression model with the coefficients of the estimate and their t-statistics as shown in Table 2. All the explanatory variables explain their impact on the number of trips made except for the perception variables which may not explain the number of trips; as their perception is controlled by all the other explanatory available such as education level, income, and residential location. The number of trips rather explain these perception variables.

The negative coefficients of the household size on trips made by car and bus show that the number of trips decreases with increasing household size for car and bus trips. From the results, workers in households with more adults make fewer trips by bicycle. The gender composition of a household also plays a significant role in the trip generation by car, bicycle and motorcycle. Male adult workers make fewer trips by these modes than female adult workers. The large negative coefficient with high t-stats values on the gender variable for bicycle and motorcycle show its strong determinant in the trip generation by bicycle or motorcycle. The age of an adult worker has a significant impact on trip generation by car and foot - older workers make more trips by car and fewer trips by foot. This is consistent with the findings from Agyemang (2017) on older person traveling more by car.

Education level plays a significant role in trip generation and mode choice in general. Workers with a bachelor's degree make most trips by car than workers with lower educational levels. Findings by Amoh-Gyimah and Nimako Aidoo (2013) also identified that households with a diploma, degree or higher to make car trips compared to households of lower educational status. Furthermore, trip generation decreases with workers who have a middle school certificate, training college degree or bachelors. However, the workers with a bachelor's degree make fewer trips than those with a middle school certificate or training college degree. Interestingly, the results suggest that all workers with a middle school certificate or higher make more trips by taxi although adults with bachelor's degree would make more taxi trips.

Similarly, workers with a household income greater than 200ghc ($104 per 2012 cedi to dollar conversion rate) make more taxi trips. According to the data, about 85% of the taxi trips are shared and the remaining 15% are individual trips. This could be a possible explanation of why trip generation increases irrespective of worker's educational level or household income. Household income, which also shows a positive association with level of education significantly impacts trips generation. The highly positive significant variable of

an adult with a household income greater than 1200ghc ($624) indicate that trip generation by car increases with high income. Workers with a household income between 1000.01 ghc and 1200ghc make fewer foot trips than workers with a household income less than 200ghc.

Table 2. Model for Trip Generation

	Car		Bicycle		Motorcycle		Foot		Taxi		Bus	
Variables	*Coeff.*	*T-stat*	*Coeff.*	*T-stat*	*Coeff.*	*T-stat*	*Coeff.*	*T-stat*	*Coeff.*	*T-stat*	*Coeff.*	*T-stat*
Constant	-0.74	-0.32	12.39	10.98	13.36	11.37	4.88	1.01	2.01	9.71	4.19	12.72
Socio-Economic Variables												
Household (HH) size	-0.72	-4.16	-	-	-	-	-	-	-	-	-0.06	-2.63
Total number of adults in household	-	-	-0.70	-8.71	-	-	-	-	-	-	-	-
Total number of employees/workers in household					-0.98	-5.00	-	-	-0.21	-4.25	-	-
Male	-2.63	-3.43	-5.43	-22.14	-6.08	-11.08	-	-	-	-	-	-
Age in years	0.18	5.40	-	-	-	-	-0.04	-5.44	-	-	-	-
Highest Education Level												
Less than middle school graduate	-	-	-	-	1.83	2.26	-	-	-	-	-	-
Middle school graduate/BECE	-	-	-1.20	-3.31	-	-	-	-	0.73	4.72	0.60	4.41
Vocational Training	-	-	-	-	-	-	-	-	2.39	5.31		
SSCE certificate/A level certificate	-	-	-	-	2.21	2.41	-	-	0.85	3.54	1.28	6.09
Training College/Polytechnic	-	-	-2.60	-2.69	6.51	4.69	-	-	1.35	3.31	1.14	3.19
Bachelors Degree	2.70	2.52	-3.27	-2.92	-	-	-	-	3.54	8.22	-	-
Household member currently attending school	-	-	1.81	3.49	-	-	1.05	2.21	-	-	-	-
Total number of students in household	-	-	-	-	-	-	-0.23	-3.93	-	-	-	-
Household Monthly Income												
HH with monthly income less than 200.01 ghc	-	-	-	-	1.71	2.47	0.97	4.41	-	-	-0.41	-3.11
HH with monthly income between 200.01 ghc and 600 ghc	-	-	-	-	1.80	2.69	-	-	0.44	3.02		
HH with monthly income between 600.01 ghc and 1000 ghc	-	-	-	-	-	-	-	-	0.80	3.80		
HH with monthly income between 1000.01 ghc and 1200 ghc	-	-	-	-	-	-	-1.27	-2.29	1.77	5.06	-0.78	-2.61
HH with monthly income greater than 1200 ghc	3.49	4.19	1.09	2.14	-	-	-	-	1.07	3.65	-0.61	-2.60
Marital status												
Never married	-	-	-	-	-	-	-	-	-0.39	-2.44	-	-
Ethnicity												
Akan	-	-	-2.01	-5.45	-	-	-	-	1.06	7.58	-	-
Ga/Dangme	-	-	-2.33	-2.85	-	-	-	-	-	-	-	-
Ewe	-	-	-2.66	-5.51	-	-	-	-	-	-	-	-
Mole Dagbani	-	-	1.22	3.96	-	-	-	-	-	-	-	-
Residential Location	-	-	-	-	-	-	-	-	-	-	-	-
Household lives in city center	-	-	-1.74	-2.12		-	6.50	11.37				
Household lives in town	4.83	3.36	-	-	1.32	2.19	0.75	2.28				
Household lives in a suburban area	5.60	4.25	-	-			3.27	9.71	0.83	5.69	0.75	5.49
Household lives along a major road	6.41	3.38	-	-	2.14	2.35	2.01	4.65				
Regional Census												
Sekondi-Takoradi (Western Region)	-	-	-	-	-	-	-	-	-	-	1.18	2.52
Accra Metropolitan Area (Greater Accra Region)	6.51	5.22	-	-	3.81	2.15	4.08	7.40	-	-	3.08	10.13
Kwahu North (Eastern Region)	-	-	-	-	-	-	-4.51	-3.90	-	-	-	-
Gomoa East (Central Region)	-	-	-	-	-	-	-	-	1.77	2.01	-	-
Kumasi Metropolitan Area (Ashanti Region)	-	-	-	-	-	-	-	-	0.77	2.84	2.69	11.62
Techiman (Brong Ahafo Region)	-	-	-	-	-	-	-	-	-	-	-1.22	-2.10
Tamale Metro (Northern Region)	-	-	-	-	3.64	3.81	-	-	2.91	6.05	-1.30	-3.18
Wa Municipal (Upper West Region)	-	-	-5.32	-2.98	6.50	2.82	-4.54	-2.26			7.91	3.61
Vehicle Ownership												
Car owned by household	-	-	-	-	-	-	-	-	-0.43	-2.37	-	-
Motorcycles owned by household	-	-	-	-	-	-	0..513	2.27	-	-	-0.27	-2.22
Bicycles Owned by household	1.12	2.19	-	-	-	-			-	-		
Bus owned by household	-	-	-	-	-	-	-2.17	-2.71	-	-	-1.29	-3.06
Perception Variables												
Bus route convenient	-2.70	-3.37	-	-	-	-	-	-	-	-	-0.54	-4.16
Satisfied with bus frequency	-	-	-	-	-	-	-	-	-	-	-0.32	-2.38
Fares too high	-	-	-	-	-	-	2.64	7.76	-	-	-	-
Long delays at transport stations	-	-	-	-	-	-	2.53	7.74	-	-	0.37	2.44
Traffic Jam	2.98	3.45	-1.80	-3.12	-	-			1.89	8.79	0.60	3.07
Bad Roads	-	-	-0.94	-3.65	-	-	1.27	4.26				
Other Explanatory Variables												
Time to walk to the nearest taxi rank (min)	-	-	-	-	-	-	0.16	3.67	-0.20	-7.86	-0.06	-2.44
Time to walk to the nearest bus stop (min)	-	-	-	-	-	-	-	-	-	-	-0.14	-5.14
Time to walk to the nearest train station (min)	-	-	-	-	-	-	-	-	-	-	-0.11	-3.43
Distance from residence to station /boarding point (km)	-	-	-	-	-	-	0.05	2.17	-	-	-	-
Time to walk to the nearest station/boarding point (min)	-	-	-0.03	-3.01	-	-	-	-	-	-	-	-
Number of observations	473		2791		861		9983		9983		9983	
R Square	0.336		0.232		0.239		0.060		0.089		0.109	
Adjusted R Square	0.316		0.227		0.228		0.058		0.087		0.106	

Adults with more children in the household tend to make fewer trips by foot. A possible explanation to this is that such adults who are more likely to be the parents of the children may find it difficult walking together with many children whiles ensuring their safety and not losing sight of any of them. Across all trip modes except taxi trips, the marital status of a worker shows no significant impact on trip generation. It was interesting to find out that single working adults generate fewer trips that married workers.

The cultural background of a worker also significantly affect bicycle trips a worker make. The coefficients of the ethnicity variables for bicycle trips establishes a significant relationship with trip generation. The Mole Dagbani adult workers generate more bicycle trips than workers of other ethnicities. As seen in the descriptive statistics, the Mole-Dagbanis' (located largely in the northern part of the country) major mode of travel is by bicycle and motorcycles with a higher mode share by bicycles. Therefore, a plausible explanation for the significance in generating more trips.

In terms of residential location, adult household is that reside in the city center make fewer trips by car than similar adults that live outside the city center. Similarly, such adults create fewer trips by bicycle. In contrast, such adults living in the city center generate more foot trips although the number of foot trips generally increases across all the residential location variables. A conceivable reason for this is that the travel activity of such workers can be located within the city center. This result can also be linked with the finding by Haybatollahi, et al., (2015) that people in highly dense areas of the city center often walk or bike. Working adults in the Accra Metropolitan Area (AMA) create more trips than workers in all the other major metropolitan areas in the country. Also, the number of motorcycle and taxi trips increases whereas the number of bus trips decreases for adults in the Tamale Metro area. This result is also consistent with the findings from Abane (2011) which did not identify any trip by "trotro"- the most popular form of bus trips, in his study.

The number of trips generated by an adult worker can be used to explain the perception variables estimate. Workers who make foot trips complain about high fare price, long delays at transport terminals and the bad conditions of the road. Also, adults who make car trips, taxi trips and bus trips would generally complain traffic jam on the roads. Some of the explanatory variables also show some significance in the trip generation for all modes except car and motorcycle.

5. CONCLUSION AND SUMMARY

Although understanding the travel behavior of road users is key in travel demand forecasting, there has been little contribution in the modeling of trip generation by purpose. This study, however, presents a trip generation model by mode for adult workers using the 2012 Ghana Transport Indicator Database Survey. Apart from the Ghana Statistical Services which developed a report based on this survey, the data has not been used for any research relating to transportation or trip generation as such. Therefore, results from this data serve as a useful contribution to the Ghana Statistical Services and other governmental transportation agencies in developing national policies. Of the national sample of 23,238, 58.4% of them represent 9833 were adults (that is 18 years or older) who are engaged in some sort of employment activity. A linear regression model was used to model the trip generation by car, bicycle, motorcycle, foot, taxi and bus for these working adults. The results from the study show that gender, age, education level and residential location all show a significant impact on the number of trips generated for the different trip modes. Also, workers with a household income greater than 200ghc ($104) make more taxi trips. Meanwhile, from the data, about 85% of the taxi trips are shared and the remaining 15% are individual trips. Therefore, a better understanding of this finding will be to separate induvial taxi trips from shared taxi trips and develop trip generation models based on these modes. In terms of location, AMA, Tamale Metro and Wa Municipal show a strong positive relation

with motorcycle trip generation. The main mode for travel in the northern part of the country which is captured by the Tamale Metro area and Wa Municipal is the motorcycle. However, over the past few years, there has been an increase in motorcycle trips in the AMA because of the vehicle population growing higher than the transportation network and the heavy vehicular traffic.

The linear regression model gives a baseline explanatory model across all modes therefore the need to employ other econometrics modelling structures like poisson regression to generate the trip generation trips. There may not be much difference between the linear regression and poisson regression if we only want to other stand the relation between trip generation and the explanatory variables. However, there may be some differences in replicating the trip generation patterns in making prediction.

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