Choice of Transport Mode by Non-Resident University Students in Ghana

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Abstract

Most tertiary educational institutions in Africa and Ghana practice non-residential housing system for their students in a bit to reduce the cost of tertiary education to government. This requires that students shop for accommodation outside the school premises and commute for academic activities. This study employs the multinomial logit regression to study the choice of transport mode among 384 non-residential university students in Ghana. The results show that distance of stay, travel time to campus, amount earned by mother, mother's level of education and amount remitted to student statistically affect the probability that a student walks, uses a motorbike or takes a bus to campus. The study thus recommends that alternative public transport services be extended to the campus and that the private sector should be encouraged to provide students accommodation on campus.

Keywords: Choice; Transport Mode; Multi-campus System; Multinomial Logit; Ghana

1. Introduction

Transportation is a part of any human activity and defines to a large extent, the range and location of these activities, as well as the goods and services which will be available for consumption. Indeed, a study Han and Fang (2000) has identified that even though the supply and demand sides of transportation overlap, consumers provide a significant amount of transportation for their own use.

According to Starkey (2000), walking represents the most basic and efficient form of transportation especially for short distances involving small loads, and that modern means of transport such as cars, buses, aeroplanes and ships are generally designed for moving long distances with full load, while intermediate means of transport such as bicycles and motorcycles which fill the gap between human walking and large-scale transport, are designed to increase transport capacity and reduce drudgery at a relatively low cost.

Many researchers (see, for example, Vuchic, 2005; Sperling, 1997) have studied the roles and adverse effects of transportation on cities. In particular, Blonk (1979) has stated, and arguably so, that transport is a catalyst, both as an agent vital for economic growth and as an agent for economic decline where economic resources and conditions, as well as human endeavour, are insufficient.

One area of considerable neglect by researchers however is relating the subject matter to students' life, especially in tertiary institutions. A possible reason for this neglect is related to historical educational funding in general and student housing in particular. Higher education in Ghana, for example,was traditionally not only free of charge, butqualified students were also entitled to free boarding and lodging. The scenario today is considerably different as funding has become one of the most serious challenges faced by higher education the world over, and Ghana in particular.

In order to solve the financial crisis in higher education, and as part of the second phase of its Economic Recovery Program (1987-89), the government of Ghana considered several steps towards adjusting the financial structure of higher education.

These adjustments included increasing the role of private higher education institutions, increasing the number of public universities, and introducing cost sharing. Cost sharing was eventually introduced in 1997 and student academic and residential facility user fees were introduced in 1998. This means that students who live in university housing pay both residential facility user fees and academic facility user fees, while students off campus pay the non-residential academic facility user fee and a small non-residential facility user fee. The implication is that non-residential students usually have to source for their accommodation while dual residential and residential students are housed by the university (Yussuf, 2011). This kind of arrangement places an extra burden on non-residential students as regards finding means of transport to lecture centres for studies. This means that the successful implementation of non-residential policy as a means of containing cost of tertiary education hinges to a large extent on students' ability to access means of transport to and from the learning centers.

Studies (see, for example, Starkey, 2000; Porter, 2002) in Africa and in Ghana in relation to transport mode suggest that most village transport still involves people walking and head loading and that distribution of adoption of transport technologies is partly explained by differences in population density, incomes and transport needs among others. Also, Atasoy et al.(2010) conclude that, in Switzerland, walking and cycling are active modes of transportation that are convenient for relatively short trips, and that choice of walking/cycling mode is influenced by age, ability, income, concern for the environment and recreational preferences but are constrained by weather and distance travel, access to alternative transportation services for longer trips.

Unfortunately, these studies did not concern themselves with the specific subject matter of transport mode by students. This study departs from these previous studies and investigates the choice of transport mode by non-residential students on one of the four campuses (the Wa Campus) of the University for Development Studies in Ghana. The rest of the paper is organised as follows.Section 2 discusses methodology, section 3 covers analysis and discussion of results and the final section concludesthe study and makes recommendations.

2. Methodology

2.1. Study design

The study employs the multi-stage sampling technique to draw 384 students of the Wa Campus of the University for Development Studies.The choice of the University for Development Studies out of the eight (8) public universities in Ghana is motivated by the fact it is a relatively young university and the firstto operate a multi-campus system in Ghana. Established in 1992, the University currently operates four campuses in northern Ghana, *viz*.Nyankpala, Tamale, Navrongo and Wa. Though a noble system since it brings university education closer to the door-step of populace, themulti-campussystem exposes the university to serious infrastructural challenges especially in the area of providing adequate housing for its students. As such, it is likely that the proportion of non-residential students in the university will be high as compared to that in the other public universities not running the multi-campus system, some which were established in the 1940s and 1960s.

The Wa Campus, which houses three faculties, was chosen through a simple random procedure out of the four campuses. According to University sources, there are currently four hostels on this campus, each with a bed capacity of less than 250 students. This means that a maximum of 1,000 students can be accommodated in any given period compared to an estimated total student population of 11,346 for the 2011/2012 academic year. In effect, over 10,000 students have non-residential status and stay outside campus. To draw a representative sample, the stratified random sampling procedure was used to select one faculty (Faculty of Integrated Development Studies) out of the three faculties on the Wa Campus.Students in the Faculty were further stratified based on year of enrolment and then a sample proportional to the population of each year group (as represented in Table 1) was selected.

Table 1: Selection of final sample

Year (Level)	Population	Proportion	Sample
100	258	6.57	25
200	1044	26.60	102
300	1262	32.16	123
400	1360	34.66	134
Total	3,924	100	384

Source: Examinations Unit, FIDS, UDS-Wa Campus

A listing of students from each year group was obtained from which the simple random procedure was used to select the final sample. Data collection was done using a questionnaire administered over a period of two weeks.

2.2. Data analysis

Transport choice modelling has undergone significant changes, from mostly qualitative perspective, to more quantitative approaches as a result of the desire for better results (Atasoy et al., 2010). This study employs a quantitative approach for the purpose of examining magnitudes of the effects of various factors.

The variable of interest, choice of transport, is categorical. Such variables are usually analysed in the framework of discrete choice models. Given that the choice set- walking, bicycle, motorbike and bus - exhibits the relevant characteristics of mutual exclusiveness, are exhaustive and finite, Train (2002) posits that choice probabilities can be derived under the Random Utility Models (RUMs) framework. The RUMs framework assumes that a decision maker, in this case the student, faces a choice among a number of alternatives (walking, bicycle, motorbike and bus) and that the alternative that provides the greatest utility will be chosen since the utility obtainable from any particular alternative is known.

Unfortunately, the researcher is unable to observe the decision maker's utility. In place, the researcher observes some attributes of the alternatives faced by the decision maker and some attributes of the decision maker (*ibid.*). Since the students' choice of transport depends on many factors, some observable and some unobservable, the utility a student obtains from using a particular transport mode is stated as:

$$U_{ij} = \beta_j^{'} X_{ij} + \varepsilon_{ij} \qquad (1)$$

where $X_{ij} = X(Z_{ij}, S_j)$, such that $Z_{ij}$and S_j are the observable characteristics of the chosen alternative and the decision maker respectively, β_j is the corresponding vector of coefficients of the observed variable and ε_{ij} captures the impact of all unobserved factors that affect the person's choice.

Given that the choice set has more than two alternatives, if we assume a cumulative distribution function (cdf) of ε_{ij} then the appropriate model to use is the multinomial logit model (Cameroon andTrivedi, 2009), in which case the probabilities from the four different outcomes can be derived in such a way that they sum up to unity. The multinomial logit model is thus specified as:

$$P(Y_i = j) = P_{ij} = F_j\left(\beta_j^{'} X_{ij}\right) = \frac{\exp(\beta_j^{'} X_{ij})}{\sum \exp(\beta_j^{'} X_{ij})} \qquad (j = 1, \dots, m) \qquad (2)$$

whereY_i is the probability that a student choses a particular means of transport,X_{ij} is a vector of explanatory variables and includes distance in kilometres, travel time in minutes, father's income, mother's income, student's income, all in Ghana cedis[1], father's education, mother's education, guardian's occupation, remittances and number of siblings.

Usually the coefficients obtained from the specification in equation (2)indicate the direction of the effect of the explanatory variables on the preference of each alternative, compared to a chosen base choice. As such these preferences change as soon as there is a change in the base choice. Even though the coefficients are useful in giving the direction of the various explanatory variables on the preference for each alternative, they are deficient in communicating the actual size effect on these preferences, say by how much preference for an alternative changes if income changes.

To come around this, the marginal effects are usually computed from the coefficients obtained. Theoretically, the marginal effects are obtained by taking the first order derivative of the specification in equation(2) (see, Cameroon andTrivedi, 2009; Greene, 2008) given as:

$$\frac{\partial P_{ij}}{\partial X_i} = P_{ij}(\beta_j - \bar{\beta}) \qquad (3)$$

where$\bar{\beta} = \sum_j P_j \beta_j$ is a probability weighted average of the β_j, implying that the sign of the marginal effect is not necessarily determined by that of the β_j.

[1]GH¢1 = US$0.5150 as at 20/08/12 accessed from www.xe.com.

3. Discussion of results

3.1. Descriptive statistics

The study found that the most preferred mode of transport by students is the bus. There are currently two types of bus services operating; one operated by the students through the Students' Representative Council (SRC) and another by private individuals, usually referred to as *tro-tro.* The least preferred mode is the bicycle.

On average, students stay about 4.362 kilometres from campus, spend about 2.695 minutes using various means to travel to campus and expend about GH¢6.479 every week and GH¢25.916 a month on transportation. Given that these students receive a monthly average remittance of GH¢150.724, it means that about 17.277 percent of their income goes into transportation every month if they do not earn income on their own. Similarly, given that students earn on average GH¢64.369, about 40.262 percent of their earning is used for transportation purposes every month if they do not receive any remittance from home. For this group of students, it will be difficult to cope since less than 60 percent of their income will be used for other expenditure lines like feeding, accommodation and study materials. For those students who receive remittances in addition to their earning, they will usually part with about 11.88 percent of their monthly income for the purpose of transportation. The summary statistics of student choice of transport, transport characteristics and socio-economic characteristics of students are presented in Table 2.

Table 2: Summary statistics

Variable	Statistics	
Choice of transport	*Freq.*	*Percent*
Walking	43	11.20
Bicycle	7	1.82
Motorbike	106	27.60
Bus	228	59.38
Transport characteristics	*Mean*	*Stand. Dev.*
Distance to campus (km)	4.362	2.355
Travel time (minutes)	2.695	0.974
Weekly expenditure on transport (GH¢)	6.479	3.4016
Socio-economic status	*Mean*	*Stan.Dev.*
Father's income (GH¢)	592.435	777.355
Mother's income (GH¢)	317.528	318.605
Student's income (GH¢)	64.369	174.655
Remittance (GH¢)	150.724	132.844
Number of siblings	3.630	2.060

3.2. Determinants of choice of transport mode

In doing the analysis, the bus was used as the base alternative so that all other possible choices such as walking, bicycle and motorbike was compared to this base alternative (choice). The model summary as presented in Table 3 shows a Likelihood Ratio value of 303.895 which is significant at the 0.01 level. The Nagelkerke Pseudo R-squared value of 0.637 reveals the model is useful in predicting students' transport choice.

In addition, the classification of means of transport was predicted and the results show that 36 out of 43 students who chose walking were correctly classified representing 83.7%; 5 out of 7 students who chose bicycle were correctly classified representing 71.4%; 45 out of 106 students who chose motorbike were correctly classified (42.5%) and 197 out of 227 students who chose bus were correctly classified(86.8%). Overall, 73.9% of the means of transport were classified correctly, which suggests that the predicted ability of the model is good.

Table 3: Model summary

Model	Fitting criteria	Likelihood Ratio Tests		
	-2log likelihood	Chi-square	Df	Significance
Intercept only	753.912			
Final	450.017	303.895	123	0.0001
The Goodness-of -Fit				
Pearson		557.210	1023	1.00
Deviance		450.017	1023	1.00
Pseudo R-squared		Cox and Snell	Nagelkerke	McFadden
		0.548	0.637	0.403
Classification of means of transport predicted				
Observed	Walk	Bicycle	Motorbike	Bus	% correct
Walk	36	0	2	5	83.7%
Bicycle	0	5	0	2	71.4%
Motorbike	2	0	45	59	42.5%
Bus	9	1	20	197	86.8%
Overall	12.3%	1.6%	17.5%	68.7%	73.9%

The regression results as presented in Table 4 show the distance of stay, travel time to campus, amount earned by mother, mother's level of education and amount remitted to student statistically affect the probability that a student walks, uses a motorbike or takes a bus to campus. For example, the farther a student stays from campus the more likely the student would take a bus to campus ($\beta = 0.054$) compared to walking and using a bicycle. The bus and motorbike were found to be close substitutes when a student takes the distance from campus to where he/she stays into account. This is because the farther the distance of stay from campus the more likely a student will choose a bus or a motorbike. These findings are consistent with findings by Black et al. (2004) that significant relationship between mode choice and perceived distance from house to school.

Travel time significantly affects the probability of choosing a bus ($\beta = 0.063$) and walking ($\beta = 0.032$) positively but negatively affects the probability of using the motorbike ($\beta = -0.102$). Similarly, studies (such as McMillan et al., 2002) found that walking and biking to school were more likely when a household lived within a mile to school.

Mother's income and the value of remittances were found to positively affect the probability of using a motorbike compared to bus. This means that the higher the income available to a student the likely that the student will use a motorbike to campus. This could be explained by the fact that there are no motorbikes operating on commercial basis in the study area. Thus to use a motorbike, a student must buy one or given a lift by a friend who owns one. Meanwhile given the price range of GH¢1,200 to GH¢1,500 the amount of income available to a student importantly affects the ability to own one.

Interestingly, mother's level of education significantly affects the probability of choosing a motorbike negatively but positively affects the student's choice for a bus. This is likely due to the level of risk awareness associated with the use of motorbike by more educated mothers who will more likely advise their wards against it. Indeed, a study by Kudebong et al. (2011) reveals that the economic burden of motorcycle accidents in northern Ghana was estimated to be about US$1.2 million, and that most motorcycle accident victims were in their productive ages and were males. More educated mothers are more likely to be in knowledge of such evidence and be in the position to advise their wards against the dangers associated with the use of motorbikes.

Table 4: Multinomial logit regression results

*, **, *** denote statistical significance at the 0.1, 0.05 and 0.001 levels, respectively; *j=0* is the base choice (bus), *j=1* is walking, *j=2* is bicycle and *j=3* is motorbike; figures in parentheses are standard errors.

Variable	***j* = 0**	***j* = 1**		***j* = 2**		***j* = 3**	
	Marginal Eff.	Coefficient	Marginal Eff.	Coefficient	Marginal Eff.	Coefficient	Marginal Eff.
Constant		1.1713		-2.8070*		-0.5683	
		(0.9817)		(1.6958)		(0.5623)	
Distance	0.0543***	-2.0532***	-0.1021***	-0.3526*	-0.0001	0.1330	0.0479***
	(0.0161)	(0.5157)	(0.0187)	(0.1985)	(0.0021)	(0.0826)	(0.0111)
Travel time	0.0630**	0.5408**	0.0324***	0.3296	0.0061	-0.5633***	-0.1015***
	(0.0282)	(0.2634)	(0.0114)	(0.4740)	(0.0081)	(0.1740)	(0.0273)
Father's income	-0.327e-04	0.0003	0.126e-04	0.0003	0.318e-05	0.0001	0.169e-04
	(0.347e-04)	(0.0005)	(0.227e-04)	(0.0005)	(0.819e-05)	(0.0002)	(0.303e-04)
Mother's income	-0.0001	0.0001	0.638e-05	-0.0032	-0.594e-04	0.0009*	0.0002*
	(0.0001)	(0.0010)	(0.494e-04)	(.0021)	(0.414e-04)	(0.0005)	(0.0001)
Student's income	-0.0001	0.0001	-0.750e-05	0.0034	0.0001	0.0002	0.198e-04
	(0.0002)	(0.0028)	(0.0001)	(0.0034)	(0.0001)	(0.0012)	(0.0002)
Father's education	0.0141	-0.1339	-0.0054	-0.2108	-0.0031	-0.0476	-0.0056
	(0.0174)	(0.2102)	(0.0102)	(0.3214)	(0.0057)	(0.0933)	(0.0154)
Mother's education	0.0475**	-0.1008	-0.0027	0.5022	0.0103	-0.3266***	-0.0551***
	(0.0213)	(0.2115)	(.0102)	(0.3895)	(0.0076)	(0.1217)	(0.0193)
Guardian's occupation	-0.0045	-0.0285	-0.0020	0.0673	0.0012	0.0316	0.0054
	(0.0074)	(0.0876)	(0.0042)	(0.1301)	(0.0023)	(0.0394)	(0.0064)
Remittance	-0.0004	-0.0034	-0.0002	-0.0037	-0.0001	0.0036**	0.0007**
	(0.0003)	(0.0046)	(0.0002)	(.0056)	(0.0001)	(0.0016)	(0.0003)
Siblings	-0.0058	-0.0546	-0.0035	0.0802	0.0014	0.0450	0.0079
	(0.0112)	(0.1393)	(0.0068)	(0.1922)	(0.0033)	(0.0606)	(0.0100)

4. Conclusions and recommendations

From the findings, the study concludes that the most patronised means of transport by students is the bus, followed by the motorbike. Students who stay close to campus however prefer to walk, while the transport mode which is least used is the bicycle.

Also, students spend up to GH¢6.00 every week or up to GH¢25.00 every month on transport. Indeed, for students who do not receive remittances and depend only on their earnings, this figure represents up to 40.00 percent of their monthly earnings on transportation. This obviously is high and can have implications for other expenditure items like feeding and academic materials.

Distance of stay, travel time, mother's income and education as well as level of remittance received significantly influence students' choice of transport mode. For example, students who stay farther away from campus resort to the use of bus or motorbike as their main mode of transport to campus. Mother's income and remittance received positively affect students' choice of a motorbike compared to bus.

From these conclusions, it is recommended that alternative public transport services be extended to the campus to help students reduce their expenditure on transport since public transport services like the Metro Mass Transport currently running in the country charges lower rates than the private transport services.

In addition, University authorities should liaise with the private sector to provide students accommodation on campus, since this will encourage students to walk instead of spending money on other modes. This will also reduce the risk involved in using motorbikes especially by those students who stay farther away from campus and see the use of motorbike as an alternative to the use of bus.

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