The Determinants of Choice of Transportation Mode in Addis Ababa, Ethiopia

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Abstract

This study is designed to investigate the determinants of choice of transport mode in Addis Ababa. It adopted a cross-sectional research design and collected quantitative data from 141 respondents that used different transport modes. A multinomial logit model was adopted to identify the determinants of choice of transport modes. About 54% of the city's dwellers used taxi (popularly known as ''Blue minibus taxi''), and 25% of them used buses. The proportion of dwellers who chose to use train transport method and private cars are equal (10.5% each). Blue minibus taxi are the dominant mode of transport used in the city of Addis Ababa. The results of the multinomial logit model revealed that traveler's characteristics (age, family size, income, occupation, and educational level) and mode of transport characteristics (travel time, travel cost, travel distance, comfort, accessibility, safety, and security) were found to be statistically significant in determining choice of a transport mode. The city government of Addis Ababa should therefore take into account the significant correlates in deciding to improve the transportation system of the City..

***Keywords**: Transport mode, Multinomial logit, Minibus blue taxi, Buses, Private cars, Train transport, Addis Ababa, Ethiopia*

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1. INTRODUCTION

1.1 Background of the study

Transport plays a vital role in the development of the modern era as an integral part of the socioeconomic and political structure of the country. Transport infrastructure, and traffic management should involve the socioeconomic and physical integration of the city (Mulu, 2015). Transportation is one of the basic sectors supporting people's daily activities. People conduct activities in different places due to biological needs, social obligations, and personal desires (Vilhelmson, 2007; Eriksson, 2009). The urbanization process increase substantially the demand for urban transport also increases. Urban transport has a great role in the transformation of society and facilities modernization at large (Mulu, 2015). Urban transport is usually accepted that cities are the engines of economic growth in most developing as well as developed countries. Essentially, urban transport can be viewed as the oil that prevents this engine from seizing up (ORAAMP, 2010)

People's activities become more complex and also increase people's move from place to place. In this case, peoples tend to choose and determine which travel mode the most suitable and fair cost for them to fulfill their needs. A few decades ago, the travel modes existed only in the small shape and number of vehicles ware build to accommodate people's movement, but now the travel modes also become parts of people's movement. Nowadays the travel modes are available starting from the cheapest to the most expensive one and also from the availability of the common service standard until the exclusive quality (Utami, 2010).

People are highly concerned with the choice of travel modes that are convenient and suitable for their trips (Joe et al, 2015). There are different modes of transportation and people can choose the mode to accomplish their needs. Now

the travel modes are becoming various aspects from the conventional models and peoples tend to choose the mode with concerning the comfort, security, vehicle in time, trip distance, time reliability, cost of the travel mode, etc. with the different accessibility of travel modes since the people have various opportunities to choose the mode (Eriksson, 2008).

The dominant mode of public transport in developing countries in road-based transport is the use of the conventional bus. It has wider social, economic, and environmental benefits. It is the best affordable for urban poor people (Wright et al, 1987). It needs less investment and feasibility economically for all groups and environmentally friendly systems. In Indonesia, using privately owned cars and motorcycles becomes the dominant choice in supporting people's daily activities. One of the main reasons to choose this mode of transportation is its easiness such as the car price now is cheaper and also there is a belief in society that owning a private car will increase the prestige of the people (Utami, 2010). Hence, investigating the determinants for the choice of the transport system in day to day activities to fulfill their needs and it has a strong relationship to the transport policy that is essential to design workable policy and strategy for suitable urban transport. Therefore this study intends to examine determinants for the choice of transport services in Addis Ababa.

1.2 Statement of the problem

Due to the ever-increasing population in the country and also in urban areas in particular as a result of immigration and natural growth, there is an increased demand for transportation in the city. Effective and available transport facilities are common problems in any metropolis where the movement of millions of people makes it a daily reality of modern living in Addis Ababa. Rapid urbanization and population growth have led to a rise in poverty and social inequality. Therefore, the demand for transport has increased faster than the city

can provide it and is creating health and safety risks, impeding economic development, and producing more greenhouse gas emissions (Meron, 2011). Even if there is a high demand for transport in Addis Ababa, people had a choice of a different mode of transportation such as buses, higher buses, railways, minibusses taxi, Ladas, and other small taxis that serve the millions of residents on a daily origin. The federal government has also introduced a new public transport service the so-called blue buses to serve not only the civil servants but also other clients. The existing public transport is of low quality and a limited number of buses and taxis. The majority of people choose a taxi for availability which is better than buses even if the price of a taxi is expensive and the belief in society to use taxis has risen the status of the people (Mintesnot and Takano, 2007).

Accordingly to Mintesnot and Takano (2007), mode of choice is affected by people's perception because perception is a significant role in the mode of choice and there are only two modes of public transportation which are bus and taxi was addressed by the study. The Perception responses of people have a ranking nature and the methods of analysis are ordered logit models with four ordered levels of perception on the three mode related-aspects (fare, convenience, and frequency) have a statistically significant influence on public transport mode choice. The study didn't include different mode transportation like a private car, train, and different buses, and also it didn't include some important variables such as comfortably, accessibility, prestige, safety, and security that affects the mode of transport choice in Addis Ababa. Unlike the previous model choice, this study is trying to fill the research gap by providing a detailed analysis of factors affecting the mode of transportation choice depending on socioeconomic characteristics, and mode of transport characteristics. Since transportation mode is vital for our country researching

this theme provides economic as well as a social contribution. The economic aspect includes ease of people's movement from one place to the other in which anyone could work in offices further away from home, secondly, time consumption will be minimized in which one could use time spent outside work for office purposes. Social contribution includes it facilitates communication and discussion with the people who use the same model.

In addition to the above mentioned, the study gives a contribution by identifying the potential determinants of household choice for the transportation system in Addis Ababa. It is important to identify the most commonly chosen transport mode in the city for a different activity. This finding may be quite useful for policymakers to better challenge commuters' choices and to define the appropriate urban mobility management actions and policies. Further, this research can serve as a reference material either to students or researchers who want to undertake further researches on the same or related topics in the future. Specifically, the study efforts to answer the following research questions:

1) Which transport mode is chosen by the majority of people in Addis Ababa?
2) What are the traveler's characteristics related factors determine the mode of transport choice in Addis Ababa?
3) What are the transport modes characteristics related factors determine the mode of transport choice in Addis Ababa?

This study examines the determinants of household choice for transportation services in Addis Ababa and the findings cannot be generalized to other cities and towns across the country even though they might experience similar challenges as Addis Ababa. The mode of choice in Addis Ababa for this study was based on the fact that it is the capital city of Ethiopia and one of the fastest-

growing cities. This research was observed the factors affecting people in choosing transportation means for a different activity and involves only land transportation modes which are a private car, bus, train, and minibus taxi. This research is limited to the head of the household because of time and financial constraints, it was impossible to research all family members. Another limitation of this study is the lack of local literature particularly on the mode of transportation choice in the Addis Ababa context.

2. Research Methodology

2.1 Research Approach and Design

For this study, a descriptive and causal research design was applied. In ordered to accomplish the proposed research concerning the objective and the nature of research questions of the study, quantitative data collection, and analytical techniques were employed. Therefore, the overall congregation of the study consists of quantitative. Quantitative data analysis is all about quantifying the relationship between the dependent and independent variables.

2.2 Population and Sampling

According to CSA (2007) report, the total population of Addis Ababa was 2,738,551 in 2007, out of which 1, 305,387 are males and 1, 434, 164 are females. People are live in 10 sub-cities. Kolfe Keraniyo has the largest number of people with 428, 895, followed by Yeka sub-city with 346, 664, and Bole sub-city with 308, 995. Akaki Kality sub-city has the least number of people with 181, 280. About 662, 728 households are in the city, among these 655,118 are conventional households[1], and 7, 610 are unconventional households. Out

[1] Households that are classified as ‘’conventional’’ are those who have permanent addresses and can be traced easily. Those that are classified as ‘’unconventional’’ are without any permanent addresses to trace them in any survey.

of the total 655,118 conventional households, Kolfe Keraniyo has 97, 287 households, Yeka sub-city has 90, 195 households, and Addis Ketema sub-city have 52,063 households. Lideta sub-city has the least number of households which is 46, 206.

This study uses multiple-stage sampling to draw an appropriate sample household. In the first stage, due to the significant variation of owned private cars among the 10 sub-cities, the cities divide into two strata. The first group consists of Kolfie Keraniyo, Kirkos, Akaki Kality, Lideta, Arada, Addis Ketema, and Gulele and the second group consists of Yeka, Bole, and Nifaslk Lafto sub-cities. In the second stage, two sub-cities from group one and one sub cities from group two were selected randomly. Finally, from a total of 239,545 households, 156 samples were selected randomly. Yemane (1967) provides the following simplified formula. Accordingly, the required sample size at a 95 % confidence level with a degree of variability (the more homogenous a population the smallest sample size required to be, to obtain a given level of precision). Values are calculated according to Yamane's formula the uppermost pair is for 5%, middle one for 8% and the lower one for 10% level of significance. For this study the level of precision equal to 8% is used to obtain a required sample that represents a true population.

$$n = \frac{N}{1+N(e^2)}$$

Where n= Sample size

N= Population Size

e= Level of precision considered as (8%)

$$n = \frac{239{,}545}{1+239{,}545(0.08^2)} = 156$$

Table 1: Sample households by sub-cities

Sub City	Total Households	Sample Households
Kolfe Keraniyo Sub City	97, 287	63
Yeka Sub City	90, 195	59
Addis Ketema Sub City	52,063	34
Total	239,545	156

2.3 Conceptual Framework

The conceptual framework is the blueprint of the research work that guides the researcher to conceptually understand the research and outline and operationalized the dependent and the independent variables so that the measurement, processing, analysis of the data, and interpretation of the result being easy and meaningful.

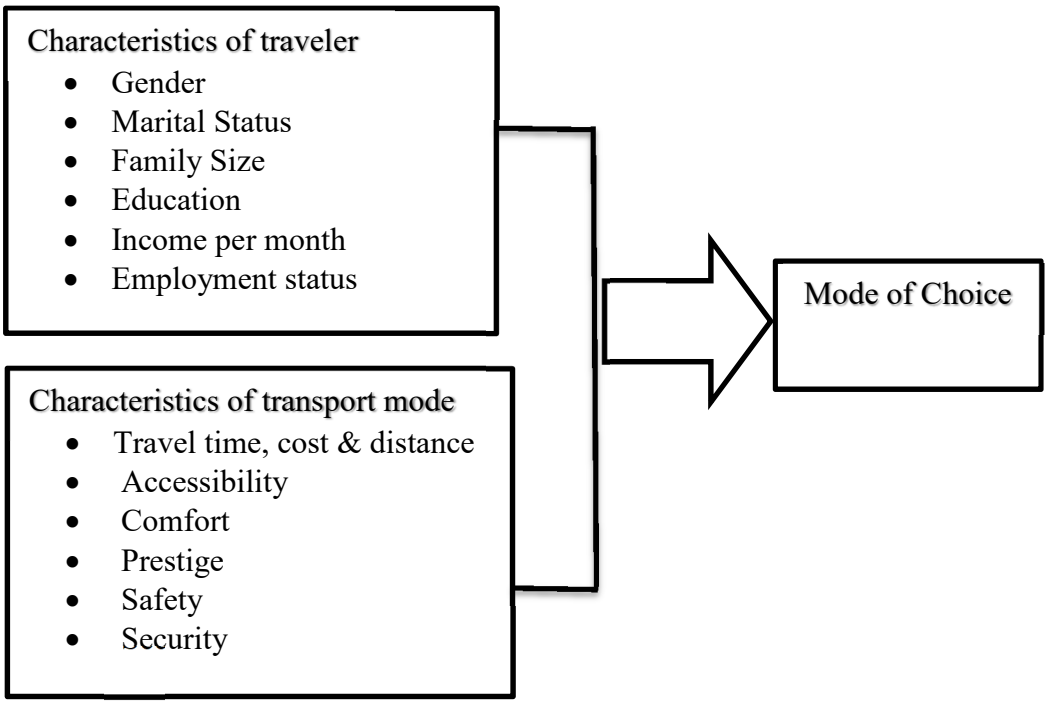

Figure 2.1: Conceptual framework for the study

Source: Author's construction based on literature (2020)

2.4 Method of Data Collection and Analysis

This research applies both primary and secondary data sources. The primary data needed to achieve the design object is obtained through structured questionnaires (both closed-ended and open-ended questions) and interviews with the participant are illustrates. A household survey is a typical method to collect primary data from the participant. A household survey was carried out through a face-to-face interview of the participant and enumerators. The secondary data source for this study is published and unpublished documents related to transport mode. Those are books, articles, journals, scientific reports; the minister of transport authority is considering being important to the study.

To achieve the objective of this study, both descriptive and econometric methods of data analysis were applied. Descriptive statistics such as frequency, percentage, and cross-tabulation were used to characterize the demographics of households in the study area. Econometric analyses were employed to identify factors that affect the mode of transportation choice at the household level by using a multinomial logit model.

According to Koppelman and Bhat (2006), the mathematical form of a discrete choice model is determined by the assumptions made regarding the error components of the utility function for each alternative. There are good theoretical and practical reasons for using the normal distribution for many modeling applications.

In this case, the MNP model may produce arbitrary parameter estimates within the tolerance of the estimation procedure (Keane, 1992; Alvarez and Nagler, 1998). A typical sample identification strategy is to include one alternative specific variable in each utility. While this often helps, this restriction does not guarantee convergence at a global optimum within the tolerance of the software.

However, in the case of choice models, the normal distribution assumption for error terms leads to the Multinomial Probit Model (MNP) which has some properties that make it difficult to use in choice analysis more than 2 alternatives. The mathematical structure of the Multinomial Logit Model (MNL) is given as choice probabilities of each alternative as a function of the systematic portion of the utility of all the alternatives. The general expression for the probability of choosing an alternative 'i' (i = 1, 2... J) From a set of J alternatives are:

$$\Pr(i) = \frac{\exp(Vi)}{\sum_{j=1}^{J} \exp(Vj)}$$

Where Pr (i) is the probability of the decision-maker choosing alternative i and

V_j is the systematic component of the utility of alternative j.

2.5 Variable Definition and Hypothesis

Accessibility: In metropolitan areas where mass transit is available, it offers an attractive alternative to other means of commuting. The accessibility of transport mode depends on the development of transport planning. Some of the areas are covered by public transport because they are high-density areas as a result of good planning. But for the low-density area, the availability of public transport is less and the only mode is private motorized transport (Koslowsky, 1995).

Income: Lower-income countries tend to have the highest vehicle ownership and mileage growth rates, higher-income countries are experiencing low or negative growth (Litman, 2006) country like Ethiopia, people who are high income tend to use a car with a driver and do not use public transport but the middle and lower-income people, the only choice is public transportation such as bus, taxi, train, etc. as the main transport.

Travel time: According to Koslowsky (1995), direct negative effects of commuting are obvious and include hours lost from work and/or leisure activities. If the traveler can use other solutions to avoid congestion, they can reduce their hours lost from congestions.

Travel cost: Every single travel will need cost but the difference is the high cost or low cost and it depends on the type of travel and the distance of travel. Private driving will need more cost when comparing to public transport sharing. Normally, public transports are cheaper than a private car (Sherman, 2000).

Security: refers to measures taken by a mass transit system to keep its passengers and employees safe, to protect the carrier's equipment, and to make sure other violations do not occur. This includes the enforcement of various rules and regulations, human and video surveillance, the deployment of a transit police force, and other techniques.

Prestige: prestige-striving in the phylogenetic perspective suggests it to be essentially homologous with primate social dominance. In our species, however, selection for "cultural capacity" has transformed striving for social dominance into striving to evaluate the self as being higher in rank than others or, in other words, into striving for self-esteem (Barkow, 2014).

Comfort: Travel comfort plays a significant role in the choice of transportation mode. Because of the crowd level, variability in transportation time, ventilation problems, and similar problems, passengers may prefer to stick to their private vehicles despite the risk of wasting hours in congestion (Sukru and dilay, 2016).

The researchers developed research hypotheses based on what available in the literature. Accordingly, six variables that are related to the

characteristics of transport mode and seven independent variables that are related to the characteristics of the travelers were identified (Table 3).

Table 2: Measurement of Variables and Expected Signs

Variables	Measurement	Expected sign
Choice of transportation mode	1 = Private care, 2 = Blue minibus taxi, 3 = Bus, 4 = Train	Positive
Accessibility	1 = Very unimportant, 2 = Unimportant, 3 = Neutral, 4 = Important, 5 = Very important	Positive
Income	Ethiopian Birr/Month	Positive
Travel time	Hour/ minutes	Positive
Travel cost	Birr/Trip	Positive
Security	1 = Very unimportant, 2 = Unimportant, 3 = Neutral, 4 = Important, 5 = Very important	Positive
Prestige	1 = Very unimportant, 2 = Unimportant, 3 = Neutral, 4 = Important, 5 = Very important	Positive
Comfort	1 = Very unimportant, 2 = Unimportant, 3 = Neutral, 4 = Important, 5 = Very important	Positive
Age	Years	Positive
Gender	1= Male, 2= Female	Positive
Marital status	1= Single, 2= Married, 3= Widowed, 4= Divorce	Positive
Family size	Number	Positive
Education	1 = Grade level, 2 = Diploma/ level IV, 3 = Degree, 4 = PhD and above	Positive
Employment	1 = Employed, 2= Unemployed	Positive

Source: Authors' (2020)

The expectations in terms of affecting the dependent variable (a multichotomous response variable that included four choices such as Minibus blue taxi, private car, bus, and train) were developed based on the literature surveyed by the authors. The summary of how the variables were measured and the expected sign on the dependent variable are presented in Table 3.

3. RESULTS AND DISCUSSION

3.1 Descriptive Summary Results

The results of this study is based on a survey of 156 people with a response rate of 91.7%. The cross-tabulation tables below reflect the emphasis information about the factors that affect the choice of mode of transportation. Out of the total 143 participants, 128 (90%) had no private cars but there is only 15(10%) of them had private car ownership. In the case of the mode of transportation chosen by participants, 53.8% of the travelers were used minibus taxi, 25.2% of the travelers were used bus and 21% of the travelers were used both private cars and trains.

As shown in table 3 from the total of 9 travelers whose educational level is grade level (1-12) are 6(66.7%) of the travelers were used minibus taxi, 2(22.2%) were used bus and only 1(11.1%) used train transportation mode in different activities. Out of 48 travelers, those educational level is diploma is 21(43.8%), 17(35.4%), 8(16.7%), and 2(4.2%) of the travelers were used bus, mini taxi, train, and private car respectively. Of 48 travellers whose educational level is degree and masters are 50(62.5%) of them were used taxi, 13(16.2%) used bus, 11(13.8) used private cars and 6(7.5%) used train transport mode.

Table 3: Cross-tabulation between Educational level of Travelers and choice of transport mode

Education Level	Statistics	Choice of Mode of Transport				Total
		Private car	Minibus taxi	Bus	Train	
Grade level (1-12)	Frequency	0	6	2	1	9
	%	0%	66.7%	22.2%	11.1%	100%
Diploma	Frequency	2	17	21	8	48
	%	4.2%	35.4%	43.8%	16.7%	100%
Degree and Masters	Frequency	11	50	13	6	80
	%	13.8%	62.5%	16.2%	7.5%	100%
PhD and above	Frequency	2	4	0	0	6
	%	33.3%	66.7%	0%	0%	100%
Total	Frequency	15	77	36	15	143
	%	10.5%	53.8%	25.2%	10.5%	100%
χ^2 $_{(9)}$= 24.87, p = 0.003						

Source: Authors' analysis result (2020)

There are 6 travelers whose education level is PhDs and above, out of this 4(66.7%) of the travelers were used taxi and 2(33.3%) of them used a private car. The p value result showed that there is a difference in transport mode choice due to variation/ difference in educational level (Table 3).

Table 4 shows the employment status of travelers who were used mode of transportation, from 123 employed travelers 61(49.6) were used minibus taxi, 34(27.6%) were used bus, 13(10.6%) used to train and 15(12.2%) were used a private car. From a total of 20 unemployed travellers, 16(69.6%) was used minibus taxis. The unemployed travelers were used the bus and train are equal values. Employed people have more chances to choose transport mode than

unemployed people. The travelers who are employed use/choose minibus taxi, bus, private car, and train respectively. Unemployed people use/choose minibus taxi, bus, and train but not use private cars. We can say there is a difference in the mode of transport choice among employed and unemployed travelers.

Table 4: Cross-tabulation between the status of Employment and Choice of Transport Mode

Employment Status	Statistics	Choice of Mode Transport				Total
		Private car	Minibus taxi	Bus	Train	
Employed	Frequency	15	61	34	13	123
	%	12.2%	49.6%	27.6%	10.6%	100%
Unemployed	Frequency	0	16	2	2	20
	%	0.0%	80%	10%	10%	100%
Total	Frequency	15	77	36	15	143
	%	10.5%	10.5%	53.8%	25.2%	10.5%

$\chi^2_{(3)} = 18.64$, p = 0.005

Source: Authors' analysis result (2020)

As presented in table 5, the travelers who used transport for the working purpose was 109. From this 60(55%) of the travelers were used minibus tax, 27(24.8%) were used bus, 12(11%) were used private cars and 10(9.2%) were used the train. 34 travelers have used transport mode for other activities, among these 17(50%) were used minibus taxi, 9(26.5%) were used bus, 5(14.7%) were used the train and 3(8.8%) were used a private car. The result indicates that most of the people were used/chosen transport mode to work activities and it uses minibus taxis. P-value indicates that there is a difference in the mode of transport choice for working activities and other activates.

Table 5: Cross-tabulation between Purpose of Travel and Choice of Transport Mode

		Choice of Mode of Transport				
Purpose	Statistics	Private car	Minibus taxi	Bus	Train	Total
Working	Frequency	12	60	27	10	109
	%	11%	55%	24.8%	9.2%	100%
others	Frequency	3	17	9	5	34
	%	8.8%	50%	26.5%	14.7%	100%
Total	Frequency	15	77	36	15	143
	%	10.5%	53.8%	25.2%	10.5%	100%
χ^2 (3)= 26.95, p = 0.025						

Source: Authors' analysis result (2020)

Table 6 indicates the choice of transport mode of the travelers regarding their monthly income. Out of 16 travelers who had less than 2000 birr income per month was 9(56.3%), 4(25%), 2(12.5%), and 1(6.3%) were used minibus taxi, bus, private car, and train mode of transportation respectively. 51 travelers had 2000-3500 birr per month were used minibus taxi, bus, train, and private car with 24(47.1%), 16(31.4), 10(19.6), and 1(2%) respectively. Similarly, out of 45 travelers who had more than 5000 birr income per month used minibus taxi, private car, bus, and train for transportation services with 25(55.6%), 12(26.7%), 5(11.1%) and 3(6.7) respectively. The travelers were used/chosen minibus taxi, bus, and train transport mode if their income level is less than 3500 birr per month. On other hand, the travelers were used/chosen private care when their income level is more than 5000 per month. The p-value result confirmed that there is a significant difference in the mode of transport choice because of their income level.

Table 6: Cross-tabulation between Income and Choice of Transport Mode

Income (ETB/Month)	Statistics	Choice of Mode of Transport				Total
		Private car	Minibus taxi	Bus	Train	
< 2000 birr	Frequency	2	9	4	1	16
	%	12.5%	56.3%	25%	6.3%	100%
2000−3500	Frequency	1	24	16	10	51
	%	2.0%	47.1%	31.4%	19.6%	100%
3501−5000	Frequency	0	19	11	1	31
	%	0%	61.3%	35.5%	3.2%	100.0%
>5000	Frequency	12	25	5	3	45
	%	26.7%	55.6%	11.1%	6.7%	100%
Total	Frequency	15	77	36	15	143
	%	10.5%	53.8%	25.2%	10.5%	100%

$\chi^2_{(9)} = 30.999$, p = 0.000

Source: Authors' analysis result (2020)

As presented in table 7 out of 34 travelers who had only 1 family member 13(38.2%) of the travelers used minibus taxi followed by private car, bus and train with value 10(29.4%), 7(20.6%) and 4(11.8%) respectively. Those households who had 2- 4 family members are 92, out of this 54(58.7%) of the travelers were used minibus taxi, 25(27.2%) were used bus, 9(9.8%) were used the train and 4(4.3%) were used private car for their daily movement. 17 travelers had more than 5 family members, among these 10(58.8%) were used minibus taxi, 4(23.5%) were used bus, 2(11.8%) were used the train and only 1(5.9%) of travelers used private care. The travelers were used/chosen minibus taxi and private car when their family member is less than 2. When the family members were increased, travelers were used/chosen public transport like minibus taxi, bus, and train for daily movements. The p-value result confirmed

that family size is a significant impact on the choice of mode of a transport system.

Table 7: Cross-tabulation between Family size and Choice of Transport Mode

Family size	Statistics	Choice of Mode of Transport				Total
		Private car	Minibus taxi	Bus	Train	
1	Frequency	10	13	7	4	34
	%	29.4%	38.2%	20.6%	11.8%	100%
2-4	Frequency	4	54	25	9	92
	%	4.3%	58.7%	27.2%	9.8%	100%
> 5	Frequency	1	10	4	2	17
	%	5.9%	58.8%	23.5%	11.8%	100.0%
Total	Frequency	15	77	36	15	143
	%	10.5%	53.8%	25.2%	10.5%	100%
χ^2 $(_6)$= 17.85, p = 0.007						

Source: Authors' analysis result (2020)

Table 8 shows the age of travelers, out of 18 travelers who have 20 up to 30 age group were used minibus taxi, bus, private car and train with the value of 8(44.4%), 7(38.9%), 2(11.1%) and 1(5.6%) respectively. The majority numbers of travelers in this study were age group between 31 up to 40 years old. Out of this 50(66.7%) of the travelers were used a mini-bus taxi, 15(20%) were used bus, 6(8.0%) were used the train and 4(5.3%) of the travelers were used private car. Out of 30 travelers whose age group between 41 up to 50 years old, 9(30%) was used minibus taxi. Surprisingly, there is an equal number of travelers were used bus and train with 7(23.3%) in the age group between 41 up to 50 years old. As the age of the travelers increases, they have used/choose taxi and bus transport mode respectively. The travelers' age is below 30 and above 50 years old gave less priority to used train and private car. We can say

there is a difference in the mode of transport choice in different age categories. So, age is an impact on the choice of different transport modes.

Table 8: Cross-tabulation between Age and Choice of Transport Mode

Age category	Statistics	Mode of Transport				Total
		Private car	Minibus taxi	Bus	Train	
20−30	Frequency	2	8	7	1	18
	%	11.1%	44.4%	38.9%	5.6%	100%
31−40	Frequency	7	9	7	7	30
	%	23.3%	30%	23.3%	23.3%	100%
41−50	Frequency	4	50	15	6	75
	%	5.3%	66.7%	20%	8%	100%
>50	Frequency	2	10	7	1	20
	%	10%	50%	35%	5%	100%
Total	Frequency	15	77	36	15	143
	%	10.5%	53.8%	25.2%	10.5%	100%
χ^2 (9) = 21.54, p = 0.010						

Source: Authors' analysis result (2020)

Table 9 shows that 52% of travelers chose bus, 41% of them chose minibus taxi and 4(7.1%) were chosen train form a total of 56 travelers who had paid 3-6 birr per day. There are 33(76.7%) of the travelers were used/ choose minibus taxi from a total of 43 travelers who had paid 7-10 birr per day. Surprisingly, bus and train had an equal number of travelers with 5(11.6%) from a total of 43 travelers who had paid 7-10 birr per day. There are 21(72.4%) travelers were chosen minibus taxi, 6(20.7%) of the travelers were chosen train and only 2(6.9%) of the travelers were chosen from a total of 29 travelers who had paid

more than 10 birrs per day. The travelers were used/chosen minibus taxi even though their transport cost is increasing per day.

Table 9: Cross-tabulation between Transportation Cost and Choice of Transport Mode

Transport cost		Choice of Mode of transport choice			
		Minibus taxi	Bus	Train	Total
3−6 birr	Frequency	23	29	4	56
	%	41.1%	51.8%	7.1%	100.0%
7−10 birr	Frequency	33	5	5	43
	%	76.7%	11.6%	11.6%	100.0%
>10 birr	Frequency	21	2	6	29
	%	72.4%	6.9%	20.7%	100.0%
Total	Frequency	76	36	15	127
	%	59.8%	28.3%	11.8%	100.0%
$\chi^2_{(6)} = 35.2$, p = 0.000					

Source: Authors' analysis result (2020)

Table 10 indicates that there are 2(100%) of the travelers were used taxis from a total of 2 travelers who had traveled 2 kilometers. This shows that people are used minibus taxi for a short distance than long distance. There are 17(63.0%) of the travelers were used minibus taxi, 7(25.9%) of the travelers were used bus and 3(11.1%) of the travelers were used to train from a total of 27 travelers who had traveled 2-5 kilometers. Peoples did not use a private car for a short distance. There are 46(67.6%) of the travelers were used minibus taxi, 10(14.7%) travelers were used train, 7(10.3%) of the travelers were used private car and 5(7.4%) of the travelers were used bus form a total of 68 travelers who had traveled 5-10 kilometers. Finally, there are 24(52.2%) travelers were used

bus, 12(26.1%) of the travelers were used minibus taxi, 8(17.4%) of the travelers were used private car and only 2(4.3%) of the travelers used the train from the total 46 travelers who had traveled more than 10 kilometers. To sum up, people have used bus transport mode for long distances and they are used/choice minibus taxi for a short distance and the p-value indicates that there is a difference in the mode of transport choice in different travel distances.

Table 10: Cross-tabulation between Distance and Choice of Transport Mode

Travel Distance	Statistics	Mode of Transport				Total
		Private car	Minibus taxi	Bus	Train	
< 2 Km	Frequency	0	2	0	0	2
	%	0%	100%	0%	0%	100%
2−5 Km	Frequency	0	17	7	3	27
	%	0%	63%	25.9%	11.1%	100%
5−10 Km	Frequency	7	46	5	10	68
	%	10.3%	67.6%	7.4%	14.7%	100.0%
>10 Km	Frequency	8	12	24	2	46
	%	17.4%	26.1%	52.2%	4.3%	100%
Total	Frequency	15	77	36	15	143
	%	27.7%	53.8%	25.2%	10.5%	100%
χ^2 (9) = 40.76, p = 0.000						

Source: Authors' analysis result (2020)

As table 11 indicated out of 44(30.8%) of the travelers were agreed that accessibility has the top factors to choose transport mode followed by security, comfort, safety, and prestige with 40(28%), 22(15.4), 20(14%) and 17(11.9%) respectively. So, accessibility is the most important factor to choose transport mode in Addis Ababa.

Table 11: Characteristics of Transport Mode considered by Travelers when Choosing a Transport Mode[2]

Factors	Frequency	Percentage
Comfort	22	15.4%
Accessibility	44	30.8%
Safety	20	14.0%
Security	40	28.0%
Prestige	17	11.9%
Total	143	100.0%

Source: Authors' analysis result (2020)

4.2. Econometric Estimation Result for Choice of Transport Mode

Multinomial logistic regression was employed for investigating the relationship between how the modes of choice of transportation depend on the determinants in the context of Addis Ababa. In any statistical model, if the nature of the variable is categorical or non-numeric with having more than one level, then the dummy variable approach should be used. Therefore for this study, the dependent variable mode of choice of transport has four levels. There is no scientific logic for setting a reference group, but it may be better if it has a common sense of understanding. Hence in our study Bus can be considered as a reference by assuming the above logic. Finally, the maximum likelihood estimation technique was used to estimate the coefficients and their probability value and odds ratio is reported. The model fitting information reflects that the intercept-only model has 382.549 Akaki information criteria and the final fitted model has an AIC of 312.00. As we know the minimum the better so that the final will be the most parsimonious model and everything was made on this

[2] Although while choosing a transport mode the possibility of considering more than one attribute of a transport mode is possible, the respondents were asked to pick the most important attribute of the transport mode in deciding to choose the service.

model. The model goodness of fit of the data was checked by both Pearson and deviance residuals. The Pearson residual uses a chi-square of grouped variables in each binary logistic regression. A Pearson residual value less than in absolute value to consider as lacks goodness of fit. Since the p-value greater than 0.05 indicates that the model is good in fit.

1) Econometric Result for Traveler's Characteristics

Table 12: Estimation Result for Traveler's Choice of Transport Modes using Traveler's Characteristics as a Correlate

Variables	Minibus taxi	Private car	Train
Age	1.5***	0.192***	9.36***
Family	0.56***	3.58***	8.43***
Income	1.001***	1.004***	0.998***
[Gender=1]	9.88	1.528	0
[Gender=2]Φ			
[Marital status=single]	0.99	1.002	0.25
Marriage	0.91	1.021	0.78
Widowed	0.997	0.999	0.01
Divorce Φ			
Education= Grade level	2.3***	1.01***	4.51**
Education=Diploma	0.559***	1.02***	0.39**
Education=Degree	3.683***	1.17***	8.59***
Education=PhD and aboveΦ			
Employed	3.971***	3.96	0.12 ***
UnemployedΦ			

Note: 1) The reference category is the bus. This parameter is set to zero because it is redundant; Φ= Indicates it is reference; ***Significant at p<0.01; **p<0.05; and *p<0.1

Source: Authors' analysis result

4.2.1 Comparison of minibus taxi and bus

Age: The odds of the Age of the travelers those who use/choose minibus taxi to have 1.5 times more than those who use/choose the bus. In other words, as compared to bus users in the log scale the rate of change of choosing minibus taxi is 0.41 when the age of the travelers' increases in a year keeping other variables remains constant. Since age is statistically significant at a ($p>0.01$), it has a great contribution to the choice of mode of transportation. Finally, we can conclude that when age in years goes on a year the preference for a mode of transportation becomes minibus taxi rather than a bus. Therefore the result is similar to the finding of Ashrafi and Neumann (2017) and According to Axhausen & Simma (2003), which may because elder people have the chance to provide enough income to buy their car. But it is different from the finding of Schwanen et al (2001), Thamizharasan et al (1996), and Mc Gillivray (1970)., So Age is inconsistent with the choice of transport mode.

Family Size: The odds of use/choice of minibus taxi for travelers having one more family size is 0.56 times less than for uses/ chooses bus. Similarly as compared to bus users the mode of transportation when the family has one more family size, in the log scale the rate of change of preferring minibus taxi was decreased by 0.58 keeping the effect of other determinants holding constant. Hence family size is statistically significant with a probability value of ($p<0.01$). From this, we can generalize as a family has a great impact on the mode of transport choice. The result is related to the finding of Ashrafi and Neumann (2017). If there are large numbers of family sizes there may be choice deferent transport mode because people have their perception to choose different transport modes. This shows family size is a consistent factor for mode choice.

Income: Those who have more income have 1.001 time's higher odds of choosing a minibus taxi than those who choose the bus. As income increased, the travelers have used a minibus then bus. Therefore income plays a great role in choosing a transportation mode with a probability value of $p<0.01$. This result is similar to the finding of Ashrafi and Neumann (2017). Travelers have more income had more chances to use/choose different transport modes. But this finding was not similar to Wilson (1967) so, income is a consistent factor for the choice of mode of transport.

Education: The odds of use/ choice minibus taxi the travelers who had a diploma are 0.559 times less than the travelers who had a PhD and above education level than a bus. Education had a significant effect on the mode of transport choice. It is positive and significant at a 1% level of significance. The significant effect of education on the mode of transport choice confirms the importance of education in increasing the capacity of choice transport mode. Education also affects to income, people which have lower education level tend to have lower income also, so it affects them on lack of owning a private vehicle, that is why they prefer to choose local bus while education level is high to increase people have to get more money and know the quality of transport mode. This study in line with Utami (2010), so education is a consistent factor for the mode of transport choice.

Employment status: The odds of travelers who had jobs were choosing minibus taxi is 3.97 times more than those who had not jobbed than a bus. Travelers use/choose minibus taxi those had good jobs because if travelers had a good job those of them had provided more income. It is a significant effect at the 1% level. This result is not similar to the finding of Thamizharasan et al (1996) which indicated occupation is inconsistent. Similar interpretations for both private cars and train transport mode. To sum up, age, family size, income,

education level, and occupation are a significant influence of mode of transport choice but gender and marital status are insignificant variables. The same fashion for private cars and train modes of transport.

2) Econometric Result for Characteristics of the Trip

Travel cost: the odds of those of the participants, who paid the high cost, choose/uses a minibus taxi was 2.43 times more than the participants choose/use a bus. Travel cost had a significant impact on the mode of transport choice at a 1% level of significance. Because people have choice low or fair cost accordingly their income and time. In Addis Ababa people are choosing Sheger and alliance bus rather than a private car or Anbessa bus and higher bus because of time and fair cost. This study is allied to Wilson (1967), Yu (1970), and Ponnuswamy (1992) this indicates travel time and travel cost is consistency for mode choice.

Travel time: Travel time had a significant impact on the mode of transport choice at a 1% level of significance. People had choice/used fast transport mode according to time. People are choosing minibus taxi rather than a bus because a taxi has only 12 set chairs and it did not take a long time in one station. This study is allied to Wilson (1967), Yu (1970), and Ponnuswamy (1992) this indicates travel time and travel cost is consistent for mode choice.

Travel Distance: The odds of a choice minibus taxi, travelers had traveled a long distance was 0.099 times less than those of use/choose the bus. Travel distance similar to travel time, it had a significant influence on the mode of transport choice at 1 % significant level. When Peoples' workplace and home are far, they may be choice long-distance travel modes like trains and buses relative to accessibility rather than taxi and minibus taxi. This result is consistent with the finding of Thamizharasan et al. (1996).

Table 13: Estimation Result for Traveler's Choice of Transport Modes using Characteristics of the Trip as a Correlate

Variables	Blue minibus taxi	Private car	Train
Transport cost	2.43***	2.29***	0.126***
Travel distance	0.099***	0.04***	0.153***
Travel time	1.881***	4.684***	0.006***
[Comfort=1]	0.303***	1.22***	0.14***
[Comfort= 2]	0.314***	0.05 **	0.16***
[Comfort= 3]	0.06***	0.12***	0.004***
[Comfort= 4]	0.052***	5.23***	0.86***
[Accessibility=1]	1.26***	0.218***	2.09***
[Accessibility=2]	0.416***	0.67***	3.25***
[Accessibility=3]	0.05***	0.79***	0.36***
[Accessibility=4]	0.69***	4.495***	0.24***
[Safety= 1]	0.851**	0.78***	1.002***
[Safety= 2]	0.932**	0.98***	1.32***
[Safety=3]	0.653***	0.02***	2.39***
[Safety= 4]	0.974**	3.12***	1.02**
[Security=1]	1.02***	1.695***	3.56***
[Security=2]	0.108***	0.22***	0.97***
[Security=3]	8.813***	0.012***	3.69***
[Security=4]	2.764***	0.84***	0.7**
[Prestige=1]	0.049	1.002	0.61
[Prestige=2]	0.036	1.02	0.56
[Prestige=3]	0.131	1.10	0.23
[Prestige=4]	0.022	1.021	0.001

Note: 1) The reference category is the bus. This parameter is set to zero because it is redundant; ***Significant at $p<0.01$; **$p<0.05$; and *$p<0.1$

2) Comfort= 5; Accessibility=5; Safety=5; security=5; and prestige=5 are references

Source: Authors' analysis result

Comfort: The odds of those of the travelers who gave less priority to comfort are 0.3 times lower to prefer minibus taxi than the bus as compared to the odds

of travelers who gave priority to comfort. In other words, those who need comfort are preferred a minibus taxi. It is a significant effect on the mode of transport choice at a 1% level of significance. Therefore, this result is similar and consistent with the finding of Ponnuswamy (1992).

Accessibility: the odd of those of the travelers who gave less priority to accessibility is 0.26 times lower than to choice minibus taxi than the odds of the choice bus as compared to those who gave priority to accessibility. This means peoples are preferred to the minibus taxi to the bus if there are a high number of taxi accesses. Accessibility is a significant influence at 1% of a significant level**.** Most of the time people have choice transport mode which has more access. Taxi is more accessible in Addis Ababa and the majority of people may have chosen taxi and minibus taxis. This result is not constant to the finding of Utami (2010) because in developed countries has more access in all transport mode.

Safety and Security: As compared to those who gave priority to safety, travelers who gave less priority to safety have 0.932 times lowered to choose minibus taxi than a bus. In addition to this traveler who gave less priority to security has 0.07 times less to choose a taxi than a bus. To conclude those of who needs both safety and security prefers to minibus taxi. Safety and security are important determinate for the mode of transportation since both have a probability value of $p<0.01$. the result of safety is similar to the finding of Ponnuswamy (1992). But security is not similar to the finding of Ponnuswamy (1992). So safety is consistent but security is not a consistency factor to choice transport mode. The same fashion for private cars and train modes of transport.

- ✓ Generally, Gender, marital status, and prestige of the travelers are not factors for the choice of transportation mode, while all other variables have a contribution to the choice of transportation mode.

5. CONCLUSION

The main objective of this study is to identify the determinants of the choice of transport mode in Addis Ababa. In ordered to test the hypothesis, multinomial logistic regression was specified and applied with the mode of transport choice as a function of a series of characteristics. In this case, the dependent variable is the function of socio-economic or demographic factors; traveler and trip-related characteristics. About 15 independent variables were specified from these series of characteristics and used in the econometric model. Important relationships were found in this analysis, which demonstrated the mode of transportation choice relates to one or more of the variables specified as a function of series characteristics or attributes.

From the finding of the study, the researchers come to the following conclusions. Transportation service is sensitive to the characteristics and performance of each mode of transportations. The following variables like Accessibility, travel cost, travel time, travel time, and income level are the most determining factors of modes choice. From the different modes of transportations in Addis Ababa city, the Minibus taxi is the most useable/ chosen transport mode in the city even if its travel cost is high as compared to other public transport.

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