Transport and Communications Science Journal, Vol. 75, Issue 01 (01/2024), 1125-1139

Transport and Communications Science Journal

ANALYSIS OF FACTORS AFFECTING VEHICLE CHOICE BEHAVIOR IN HANOI CITY

Vu Thi Huong*, Nguyen Thanh Chuong, Vu Trong Tich

University of Transport and Communications, No 3 Cau Giay Street, Hanoi, Vietnam

ARTICLE INFO

TYPE: Research Article
Received: 02/10/2023
Revised: 09/11/2023
Accepted: 20/11/2023
Published online: 15/01/2024
https://doi.org/10.47869/tcsj.75.1.2
Email: huongvt@utc.edu.vn; Tel:0971658138

Abstract. Motorcycles are rapidly changing transportation in Vietnamese cities. Motorcycles are dominant in all sixty-three provinces/cities of Vietnam and accounted for nearly 80 percent of passenger transportation. The sharp rise in motorcycle ownership and usage has contributed to several unique motorcycle-related transportation challenges in Vietnam, which are different from those in developed countries where car usage is predominant. These challenges include a high frequency of motorcycle-related accidents and fatalities; and increasing motorcycle-related pollution and congestion. To address these challenges, policymakers in Vietnam have introduced policies that promote alternative transportation modes replacing motorcycles. This study adopts a vehicle user perspective to elucidate the factors influencing the choice of alternative means of transportation instead of motorbikes. The study was conducted through 800 sample surveys among individuals in Hanoi. In addition to the conventional factors included in the model, such as demographics and socio-economic characteristics, trip attributes, vehicle characteristics, subjective norms, awareness, and the appeal of alternative transport modes… This study introduces two additional factors: attitude to vehicles and health awareness. These additions are based on the cultural characteristics and transportation context unique to the capital. The research demonstrates that cultural factors influence the choice of transportation means. Specifically, family structure and attitudes towards vehicles emerge as major barriers to altering the preference for motorbikes in urban areas. Additionally, health awareness is shown to be a factor influencing transportation choices. The findings of this research will contribute to the theoretical foundation for shaping the vehicle management policies of Hanoi capital in the future.

Keywords: vehicle selection, motorcycle replacement, attitudes towards vehicles, health awareness, family structure.

1. INTRODUCTION

Motorcycles are a popular mode of urban transportation in developing countries in general, and in Vietnam, in particular. In big cities like Hanoi and Ho Chi Minh City, motorcycles fulfill nearly 80% of people's travel needs [1]. This high rate of motorcycle ownership and use can be attributed to various factors, including weather and climate conditions, population density, cultural and lifestyle preferences, infrastructure, and economic characteristics. Motorcycles are favored in Hanoi and other Asian cities due to their low initial investment costs, affordable maintenance and repair expenses, and operational affordability for a wide range of income levels. The compact size and lightweight nature of motorcycles enable users to navigate their journeys effectively.

However, the dominance of motorcycles also brings about numerous consequences for cities heavily reliant on them, such as traffic accidents, congestion, and environmental pollution. Given the increased vulnerability of motorcycle users in traffic, the safety level of these vehicles is relatively low, especially in collision scenarios [2]. Motorcycles significantly contribute to urban traffic congestion [3], which not only affects the aesthetics of cities but also reduces the overall quality of urban life. Moreover, since the majority of motorcycles run on fossil fuels, they are considered a significant source of environmental pollution. Motorcycles were found to emit 12 times more total hydrocarbons and carbon monoxide per kilometer driven compared to cars equipped with catalysts [4].

In recent years, city governments have paid more attention to green transport development policies, such as limiting personal vehicles and gradually reducing motorcycle usage in favor of public transportation. This study aims to identify the influencing factors and their impact on the choice of alternative transportation modes over motorcycles in urban areas of Vietnam. The study's findings will contribute to the theoretical basis of transportation mode choice in urban settings and provide a foundation for proposing sustainable urban traffic management solutions.

The remainder of this article comprises four sections: research background, research methods, research results, and a discussion of the research findings.

2. RESEARCH BACKGROUND

2.1 Behavior of choosing a means of transport

Travel is a fundamental human necessity, and people have various transportation options to meet this need. When individuals need to travel, they make choices among different modes of transportation, akin to how consumers make choices. This behavior in selecting transportation options is influenced by theories such as consumer behavior, consumer decision-making, consumer utility, and rational choice [5-6]

2.2 Factors affecting the behavior of choosing means of transport.

Prior research on how people choose their mode of transportation has revealed that this decision is influenced by several factors. These factors can be grouped into the following categories:

On demographics and socioeconomic characteristics

Studies investigating how individuals choose their mode of transportation have shown a connection between these choice and demographic characteristics. For instance, Satiennam et

al. [7] and Thamizh Arasan and Vedagiri [8] discovered that women were more likely to switch to public transportation. Abuhamoud, Rahmat, and Ismail [9] also noted a positive correlation between car usage and factors such as household size, income, and car ownership. Furthermore, Wibowo and Chalermpong [10] emphasized the importance of car availability and accessibility to public transportation in mode selection behavior.

Trip characteristics

In earlier research, the category of trip characteristics encompassed factors such as travel distance, travel frequency, and trip destination. A study conducted by Vredin Johansson et al. [11] revealed a connection between the choice of transportation mode and factors related to travel time and distance. Travel distance, in particular has been investigated as a factor influencing mode of transportation selection, as examined in the study by Mintesnot G. and Shin-ei [12]

Vehicle characteristics

The attributes of a vehicle play a direct role in determining the quality of the service it provides. These vehicle characteristics encompass aspects such as efficiency, convenience, comfort, reliability, and safety. A study conducted by Jian Chen and Shoujie Li [13] highlights the significant impact of convenience on people's choices regarding passenger transportation while the influence of economy, through service fares, is a less apparent in shaping transportation behavior.

Subjective standards

As per Ajzen's definition [14], a subjective norm refers to an individual's perception of whether influential people believe they should or should not engage in a particular behavior. The concept of subjective norm was initially introduced in Ajzen and Fishbein's theory of rational action [15]. It comprises input from various sources, including the opinions of family and friends, public sentiment, and government policies. Experimental research, as explored in studies by Heath Y. and Gifford R [16], has identified a positive impact of subjective norms.

The appeal of alternative media

The alternative to motorbikes for meeting people's travel needs is public transportation. The convenience offered by public vehicles can influence people's decisions when choosing between a motorbike and public transport. In a study conducted by Beirao & Cabral [17], it was demonstrated that factors like cost savings, safety, and the avoidance of parking hassles have a impact on the choice of transportation mode.

Environmental awareness

Behavioral theory posits that attitude is one of the factors that shape human behavior. Transporting passengers is an environmentally related behavior, and as such, it is influenced by individuals' attitudes and perceptions concerning the environment. In an empirical study examining the connection between attitudes and environmentally related behaviors, conducted by Hini, Gendall, and Kearns [18], the relationship between environmental awareness, attitudes, and the choice of transportation for passenger travel was examined.

Attitude to the vehicle

In several studies, attitudes toward vehicles have been identified as a significant factor influencing the ownership and utilization of personal vehicles. The research findings of Van,

Choocharukul, and Fujii [19] reveal that varying attitudes toward vehicles are crucial determinants across the entire sample of respondents from Asian countries.

Health awareness

Health protection is a key consideration for vehicle users when selecting a mode of transportation, especially in times like the Covid pandemic. This has been shown in a study conducted by N.M. Hieu [20]. However, the author suggests that health awareness is also influenced by adverse weather conditions (such as rain and sun), exposure to dust, and the potential for injury in traffic accidents. As society progresses, people are increasingly prioritizing health protection when choosing their mode of transportation. Therefore, it is important to give greater attention to this factor in research, separate it into its own category, and assess its role thoroughly. In this study, the author isolated this factor into a separate category and evaluated its impact on individuals' transportation choices in urban areas.

3. RESEARCH METHODS

3.1. Research model

Regarding the computational model used to construct a behavior model for selecting passenger transportation in urban areas, the author employs a polynomial logit regression model. This model is implemented using SPSS 22.0 software as follows:

$$\log_e\left[\frac{P_i}{P_j}\right] = U_i - U_j = U_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \quad (1)$$

In there:

P_i, P_j : Probability of choosing means i and means j

$\beta_0, \beta_1, \ldots \beta_n$: Regression coefficient

$X_1, X_2, \ldots X_k$: Independent variables

Regarding the model of influencing factors, ceat on:

- Model theory of choice behavior. $\frac{P_i}{P_j}$
- Review of studies on vehicle selection behavior at home and abroad.
- Characteristics of the socio-economic situation, development characteristics of personal vehicles and the situation of using means of Hanoi people

The author presents a behavioral model for urban transportation mode choice, comprising one dependent variable with 4 options (motorcycle, car, bicycle, and bus) and 6 groups of independent factors. The research model is illustrated in Figure 1.

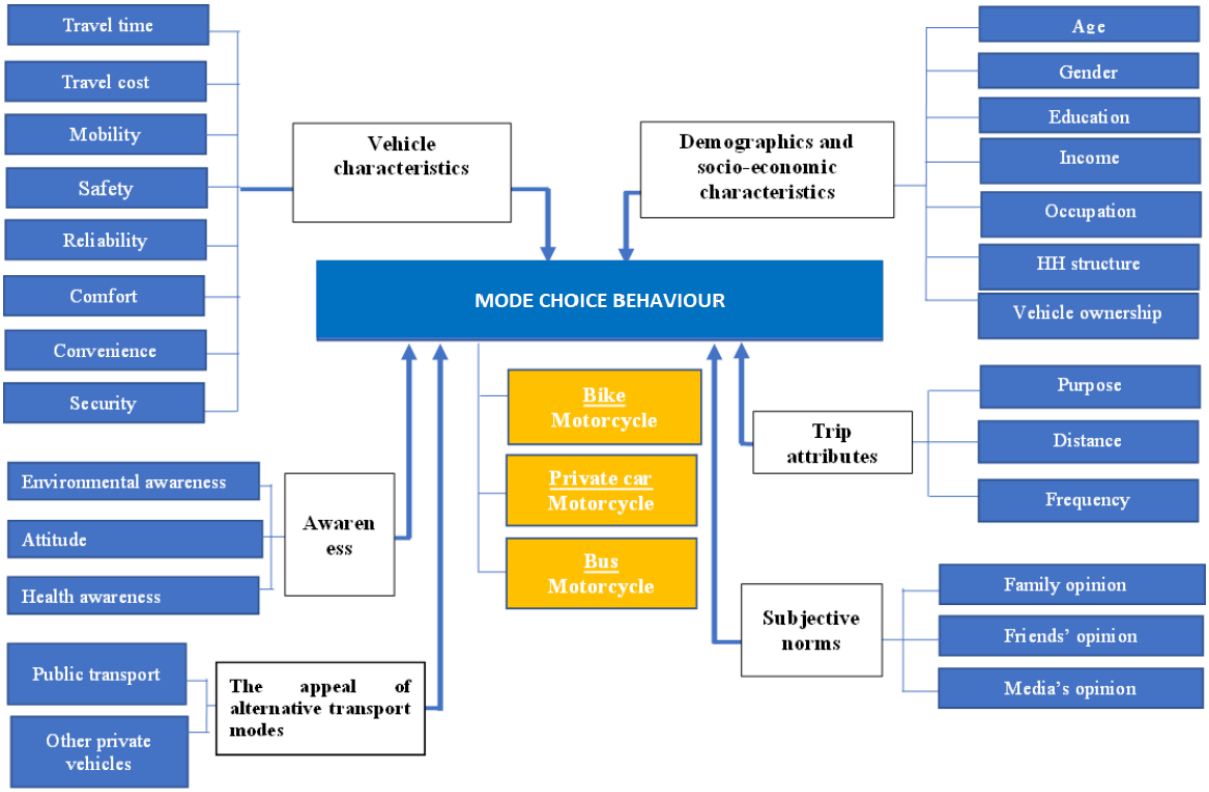

Figure 1. Path diagram showing the relationship between mode choice and influencing factors.

The dependent variable in the model is the vehicle selection variable, which is assigned specific values =1 for respondents using motorbikes, =2 for respondents using personal cars, =3 for respondents using bicycles, and =4 for respondents using the bus. The study focuses on these four types of vehicles for analysis because they represent the primary modes of transportation meeting the main travel needs of urban residents at the time of the research.

The independent variables in the model are the factors that influence individuals' choices of taking the bus. These factors are divided into six groups: demographics and socio-economic characteristics, trip attributes, vehicle characteristics, subjective norms, awareness, and the appeal of alternative transport modes. In addition to incorporating descriptions from previous studies, this research augments certain variables based on an analysis of regional, ethnic, and cultural distinctions within the context. These additional descriptions are as follows:

For the demographic and socio-economic characteristics group, the study adds the family structure factor. It measures the number of household members across different groups: those in Kindergarten, Primary and Secondary (2+3), University, and working individuals. In fact, Hanoi's travel culture reflects that the younger the child, the more reliant they are on adults for their travel needs. Adults in the household typically select a vehicle type that facilitates transporting children to school.

For the group of variables, the appeal of alternative transport modes, the author adds a description related to the perception that owning expensive motorbikes and cars signifies a modern lifestyle. This addition is based on the socio-cultural characteristics of Vietnam, where a portion of young individuals view vehicles not merely as transportation tools but also as a means of expressing their lifestyle.

Under the variable "Health awareness," the author introduces descriptions such as: “Motorcyclists are more directly affected by adverse weather conditions (like rain and sun)"; “Motorcyclists are more directly affected by dust”; “Motorcyclists are susceptible to respiratory infections”; “Motorcyclists have higher levels of injuries in traffic crashes.”

For the variable group vehicle characteristics, the study includes an additional descriptive variable " Able to work while the vehicle is moving." In today's information technology age, this feature is relevant and practical for road users.

3.2. Research data

a. Sample size

According to Tabachnick & Fidell [21], when considering the sample size for a quantitative regression model, it is determined using the formula:

$$n \geqslant 50 + 8.k \quad (2)$$

Here, 'k' denotes the quantity of independent variables within the model, and 'n' represents the sample size.

In the research model, there are 50 variables describing the independent factors. Therefore, the minimum sample size required for the study is 450 responses.

Based on the characteristics of the study population, which comprises the urban districts of Hanoi as of December 2020 with a total population of 3,835,000 people, the sample size is determined with a confidence level of 95% using the Slovin formula as follows:

$$n = \frac{N}{1+N(e^2)} \quad (3)$$

In there: N – overall size. e – Standard error.

From that:

$$n = \frac{3.835.000}{1+3.835.000(0,05^2)} = 400(\text{surveyform}) \quad (4)$$

The research has selected a total of 800 questionnaires, distributed as follows: 300 respondents are motorbike users, 150 are car users, 150 are bicycle users, and 200 are bus users. This sample size not only meets the minimum requirement but also ensures the reliability for both Exploratory Factor Analysis (EFA) and the estimation of the multivariable logit regression model.

b. How to take samples

The use of a convenient non-probability quota sampling method has been employed to gather information from various passenger vehicle users across different areas. This approach ensures that the research results accurately represent the diverse patterns of passenger vehicle utilization by the residents of Hanoi. The study's sampling scope encompasses 12 districts within Hanoi, specifically: Ba Dinh, Hoan Kiem, Dong Da, Thanh Xuan, Cau Giay, Hoang Mai, Hai Ba Trung, Tay Ho, Long Bien, Tu Liem, Ha Dong, Thanh Tri, and Gia Lam.

The survey was carried out using a direct survey method at various locations, including homes, workplaces, schools, and public places. Within each district, the research sample was selected following a distribution of 1/3 of the questionnaires distributed at agencies/schools, 1/3 through household surveys, and 1/3 through investigations in public areas.

c. Data processing method

The research data underwent a thorough cleaning and analysis process with the assistance of SPSS software. This process involved the following analytical steps:

Descriptive statistics of the study sample

The survey sample is described based on categorical variables, including the type of vehicle chosen, trip purpose, trip time, trip cost, importance assessment, choice of vehicle change, gender, age, educational level, etc. This description is done through basic descriptive statistics, which involve determining the number of observations and creating frequency tables for each characteristic provided in the survey.

Evaluation of scale reliability

The reliability of the scale was evaluated using two tools: Cronbach's Alpha coefficient and Exploratory Factor Analysis (EFA)

Cronbach's Alpha reliability test

Measuring reliability by Cronbach's Alpha coefficient is a statistical test of how closely the items in the scale are correlated.

Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) is a quantitative analysis method utilized to condense a large set of interrelated variables into a smaller set of variables known as "factors." These factors are designed to be more significant while retaining the majority of the information present in the original set of variables, effectively explaining the data's information content.

Multivariate regression

Multivariable regression enables the assessment of the extent to which each factor contributes, or does not contribute, to changes in the dependent variable.

4. RESEARCH RESULTS

4.1 Descriptive statistics

Based on the processing of the results, the following observations can be made:

Concerning gender demographics, the composition of the study sample displayed a notable degree of homogeneity. Nevertheless, when examining the subset of individuals who opted for automobiles, a marked disparity emerged. Specifically, males constituted a significant majority at 82.67%, whereas females comprised only 17.33% of this subgroup. This gender distribution aligns with contemporary trends observed within Vietnamese society, wherein a pronounced gender imbalance prevails in favor of men as primary car drivers, underscoring a prevalent societal characteristic.

Regarding age demographics, the study sample was categorized into seven distinct groups. Within these groups, the highest proportion was observed among young individuals aged 18 to 25, constituting 34.38% of the total sample. It's noteworthy that this age bracket consistently exhibited the highest average travel coefficient. Following closely, the 25 to 30-year-old age group accounted for 21% of the entire research sample.

In terms of occupation, the comprehensive study sample encompasses 8 distinct occupational categories, categorized based on the level of stability in their travel demand, considering factors such as travel frequency, distance, and destination. The most substantial representation within the sample is attributed to two occupational groups: students and office workers, including government officials. These two specific cohorts exhibit relatively consistent and stable travel requirements, encompassing both the frequency and distance of travel, as well as the destinations involved in their respective travel patterns.

The characteristics of the study sample are presented in the Table 1:

Table 1. Study sample characteristics.

Items	Using a car	Using a motorbike	Use a bicycle	Use the bus	Total
Total number of respondents	150	300	150	200	800
Percent	18.75%	37.50%	18.75%	25.00%	100.0%
Gender					
Male	82.67%	50.0%	48.00%	46.00%	56.67%
Female	17.33%	50.0%	52.00%	54.00%	43.33%
Age					
< 18 years old			16.67%	2.50%	2.29%
18-25 years old		25.00%	4.00%	58.50%	34.38%
25-30 years old	6.00%	44.33%	8.67%	25.00%	21.00%
30-40 years old	45.33%	18.67%	2.67%	5.00%	17.92%
40-50 years old	28.67%	6.33%	4.00%	4.00%	10.75%
50-60 years old	18.67%	3.67%	26.67%	2.00%	7.75%
> 60 years old	1.33%	2.00%	37.33%	3.00%	5.92%
Occupation					
Officer	58.67%	46.00%	1.33%	12.00%	29.50%
Worker	0.67%	3.67%	2.00%	8.50%	3.71%
Farmer		0.33%			0.08%
Small business	22.00%	8.00%	3.33%	2.00%	8.83%
University students		30.67%	57.33%	63.50%	37.88%
Pupil		0.00%	8.67%	3.00%	2.92%
Temporary job	2.00%	1.67%	0.67%	1.00%	1.33%
Housewife/ retired/ no job	16.67%	3.33%	20.67%	4.50%	11.29%
Other		6.33%	6.00%	5.50%	4.46%

4.2 Evaluation of scale reliability

The results of the data analysis, based on a sample size of N = 800, show that the Cronbach's Alpha coefficients for all scales exceed the threshold of 0.6. Additionally, the correlation coefficients among the variables are consistently greater than 0.3, indicating that all scales meet the necessary criteria (as summarized in Table 2).

Several scales exhibit particularly strong internal consistency, with Cronbach's Alpha values surpassing 0.7 to 0.8, signifying their robustness. For instance, the concept introduced

by the author to gauge the appeal of public transport, namely "Using public transport, you can work while traveling" achieves a notably high Cronbach's Alpha coefficient of 0.875, suggesting its suitability as a criterion for this specific assessment.

Furthermore, the concept "Riding expensive cars and motorbikes represents a modern lifestyle" also introduced by the author to measure Attitudes towards vehicles, demonstrates a Cronbach's Alpha coefficient exceeding 0.766, which is deemed acceptable.

In the context of health awareness, two descriptions, "Motorcycle users are more directly affected by dust and smoke" and "Motorcycle users are more susceptible to respiratory infectious diseases," exhibit Cronbach's Alpha values within the 0.6 to 0.7 range. This range is considered acceptable, particularly considering that these concepts are novel developments by the author, tailored to the urban setting in Vietnam [22].

4.3 Multivariable regression model

In order to assess the factors influencing the choice of transportation mode among urban residents in Hanoi, the research team employed SPSS 22.0 software for multinomial logistic regression analysis. The dependent variable in this analysis comprises various transportation modes, specifically: cars, motorbikes, bicycles, and buses. Motorbikes were selected as the reference vehicle for several reasons:

As per a current situational analysis, motorbikes are the primary mode of transportation that fulfills the majority of individuals' travel requirements in the region.

Motorbikes have been associated with adverse effects on sustainable urban transport development, including environmental pollution. They are also frequently involved in traffic accidents with severe consequences, contributing to safety concerns, and their widespread use can limit the overall aesthetic quality of the urban landscape.

The state's vehicle management policy is oriented towards transitioning from motorbike use to encouraging public transportation and the adoption of more environmentally friendly, modern, and civilized modes of transportation.

Following a rigorous analysis, variables prone to multicollinearity, such as Occupation, Income, Education level, Trip purpose, and uncertain reliability variables like Cost, Trip time, and Subjective norm, were deliberately removed from the analysis. This step was taken due to their limited significance in explaining the decision-making process related to selecting an alternative mode of transportation in place of motorbikes among Hanoi residents.

In the classification matrix of the constructed models, as presented in Table 3, the three models mentioned previously have been developed with a high degree of accuracy, achieving an impressive accuracy rate of 95.9%.

Table 2. Results of Cronbach's Alpha.test.

Observed variables	**Total variable correlation**	**Cronbach's Alpha**
Attraction of public transit: Cronbach's Alpha = 0.905 (N = 4)		
1. Using public transport saves money.	0.792	0.876
2. If you use public transport, you don't have to find a parking lot.	0.814	0.87

Observed variables	**Total variable correlation**	**Cronbach's Alpha**
3. Using public transport, you can work while traveling on the vehicle.	0.761	0.887
4. Using public transport is safer.	0.793	0.875
The attractiveness of private vehicles: Cronbach's Alpha = 0.928 (N=4)		
1. Using personal vehicle is more freedom.	0.882	0.895
2. Using personal vehicles saves more time	0.789	0.929
3. Personal vehicles are more flexible, can go anywhere, at any time.	0.873	0.893
4. Have a habit of using personal vehicles	0.829	0.91
Environmental Awareness (NTMT): Cronbach's Alpha = 0.819 (N=3)		
1. Using public transport is environmental protection.	0.644	0.783
2.Using public transport contributes to reducing traffic congestion	0.71	0.713
3.Use public transport to reduce traffic accidents	0.679	0.755
Attitudes towards means (TDD): Cronbach's Alpha = 0.804 (N=3)		
1.Driving expensive cars and motorbikes increases business and business opportunities	0.621	0.765
2. Driving an expensive car or motorbike shows success and high social status	0.719	0.658
3. Driving an expensive car or motorbike shows a modern lifestyle.	0.619	0.766
Health Awareness (NTSK): Cronbach's Alpha = 0.711 (N=4)		
1. Motorcycle users are more directly affected by adverse weather conditions (such as rain, sunshine).	0.511	0.717
2. Motorcycle users are more directly affected by dust.	0.685	0.614
3. Motorcycle users are more susceptible to respiratory infections.	0.660	0.630
4. Motorcycle users have a higher level of injury when a traffic collision occurs.	0.356	0.788
Subjective standard (CCQ): Cronbach's Alpha = 0.817(N=4)		
1. Did your family talk to you about your use of transportation and how it affects you.	0.711	0.840
2. Have your friends/colleagues talked to you about your use of transportation and how it affects you.	0.757	0.822
3. The agency / school has propaganda about the use of means of transport and that affects you.	0.694	0.846
4. Media channels propagate content about using means of transport and how it affects you.	0.735	0.83

Table 3. Classification of success rates of each PTVT/Classification model.

Observed	Predicted				
	Private car	Bicycle	Bus	Motorbike	Percent Correct

Private car	145	0	0	5	96.7%
Bicycle	0	140	2	8	93.3%
Bus	0	1	199	0	99.5%
Motorbike	5	12	0	283	94.3%
Overall Percentage	18.8%	19.1%	25.1%	37.0%	95.9%

The results of the polynomial logit regression analysis, conducted using SPSS 22.0 software to discern the determinants influencing the selection of passenger transport among urban residents in Hanoi, are summarized in Table 4 below:

Table 4. Results of MNL mode.

Element group	**Variable**	**Private Car**		**Bicycle**		**Bus**	
		Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
	Constant	-38.367	0.000	18.650	0.000		
Socioeconomic and demographic characteristics	Year old	0.466	0.014				
	Number of children in secondary school	1.689	0.004				
	Number of primary school children	1.798	0.009				
	Number of kindergarten children			-2.119	0.028		
	Number of motorbikes /adult	2.437	0.017	-3.694	0.000	-6.356	0.002
Trip characteristics	Trip distance			-0.495	0.000		
	Travel frequency					-2.106	0.019
Vehicle characteristics	Fast					-12.968	0.004
	Cheap					8.855	0.023
	Convenience	-2.300	0.066	-1.635	0.015	-6.794	0.008
	Comfort	3.404	0.000				
	On time					-8.441	0.003
	Safe	4.103	0.000	2.487	0.015	3.784	0.041
Alternative PT attraction	The attraction of public transport			1.972	0.001	15.074	0.009
	The attraction of private vehicles	1.887				-9.099	0.011
Attitude awareness	Attitude to the vehicle	2.221	0.028	-1.692	0.008	-13.829	0.001
	Health awareness	3.979	0.001	-6.722	0.000	4.859	0.058

Base level: Motorcycle,

-2 Log Likelihood = 193.5, Chi-square = 1953.8, df = 60, Sig = 0.000, $R^2 = 0.913$

Within the socioeconomic and demographic characteristics, the age factor exerts a positive influence on the preference for cars as alternatives to motorbikes, while it does not affect the choice of buses and bicycles over motorbikes.

The family structure factor reveals distinct patterns. Specifically, the presence of school-age children has a positive effect on the propensity to opt for cars as a substitute for motorbikes. Moreover, the presence of preschool children actively promotes the choice of bicycles over motorbikes. This phenomenon can be attributed to the prevalent location of preschools within

residential areas, where the transportation of children is predominantly handled by older family members. The close proximity of these preschools and the children's age make bicycles a favored mode of transportation for this purpose.

Regarding the number of motorbikes per adult in a household, there is a difference in reactions among different groups. In the case of those selecting cars, a higher number of motorbikes in the household correlates with an increased inclination to choose cars. This observation suggests that motorbike ownership often serves as an intermediary stage before transitioning to car usage within each household.

Convenience, for individuals opting for bicycles and buses, the presence of motorbikes exerts a negative impact on the choice of bicycles and buses. This effect is particularly pronounced within the bus group. This indicates that policies aimed at restricting motorbike usage may positively influence the shift from motorbikes to buses and bicycles. However, this restriction may not yield significant results for individuals utilizing umbrellas and baby carriers as part of their transportation preferences. Within the bicycle and bus selection group, the presence of motorbikes has a more pronounced negative impact, especially within the bus category.

Within the category of trip characteristics, the analysis findings indicate that as the travel distance increases, bicycles become a less favored option. Additionally, when travel frequency is higher, the appeal of buses diminishes. Consequently, motorbikes are found to be well-suited for medium to long-distance trips and those involving frequent travel. Interestingly, the purpose of the trip does not exert a significant influence on the choice of transportation mode.

In vehicle characteristics, there is a discernible shift in the decision-making process when it comes to choosing a mode of transportation among the population in Hanoi. Cost and time considerations appear to carry less weight, with greater emphasis placed on vehicle attributes. Among these attributes, convenience emerges as a particularly sensitive criterion in vehicle selection.

Motorcycles are perceived as highly convenient compared to other modes of transport but are viewed as less safe. They also score lower in comfort compared to cars while surpassing buses in terms of punctuality. These findings underscore the importance of convenience and punctuality as influential factors in the choice of transportation. Therefore, to encourage the adoption of buses as a preferred means of transport, city authorities should focus on enhancing the criteria of convenience and punctuality. This is further substantiated by the relatively large coefficients associated with these factors, signifying a significant degree of influence on decision-making processes.

Within the category the attractiveness of alternative means, the results suggest that individuals place a notable emphasis on the appeal of public transport. The stronger the perception of public transport's attractiveness, the greater the likelihood of individuals choosing cars, bicycles, or buses as their preferred mode of transportation. This preference for public transport is especially pronounced among bus users, as indicated by their relatively high coefficient. Conversely, the allure of private vehicles can pose a challenge when attempting to transition from motorbikes to buses. This underscores the importance of taking measures to curtail the appeal of private vehicles in order to foster the development of bus transportation. In essence, creating conditions that reduce the attractiveness of private vehicles is essential to promoting the growth of bus usage.

In the category of perceptions and attitudes, individuals' attitudes towards vehicles are influenced by factors such as the perception of high prices, the role of expensive personal vehicles in business opportunities, and the association of cars with class and lifestyle. These factors collectively contribute to the strong allure of cars in comparison to motorbikes. Additionally, they contribute to making bicycles and buses less attractive than motorbikes. This phenomenon aligns with findings from previous studies on attitudes towards vehicles in six Asian countries [19], suggesting that it may be attributed to cultural factors. Such cultural factors can represent significant barriers in the transition from private to public transport. To address this issue, there is a need to develop public transportation options in a direction that emphasizes modernity and high quality. This approach holds the potential to shift users' attitudes towards vehicles and encourage the adoption of public transport.

5. DISCUSSION OF RESEARCH RESULTS

Promoting the development of urban transportation in an environmentally sustainable direction involves encouraging greater use of public transportation while discouraging the use of personal vehicles. However, the research findings reveal a noteworthy trend: 9 out of 10 factors exert a positive influence on the choice of cars over motorbikes, whereas 7 out of 11 factors have a negative impact on the decision to choose buses over motorbikes. This trend underscores the clear emergence of a shift from motorbikes to cars as a preferred mode of transportation. In the current landscape of traffic infrastructure, this trend carries significant adverse consequences, resulting in unfavorable impacts on urban traffic conditions in Hanoi. It highlights the importance of addressing this shift strategically to mitigate its detrimental effects and to ensure a more balanced and sustainable approach to urban transportation.

The research findings suggest that cultural and social factors in Vietnam are fostering an environment conducive to the transition from motorbikes to cars. Several key factors contribute to this trend: 1) The high proportion of young individuals in the working-age bracket creates conditions that favor car usage; 2) A significant portion of families with children in primary and secondary school age opts for cars, as it aligns with their transportation needs and preferences; 3) Asian cultures, which place importance on symbolism and social order, tend to elevate the status of cars; 4) The growing awareness of health-related concerns also plays a role. These cultural and social dynamics suggest that the transition from motorbikes to cars may occur at a faster pace than that of public transport adoption.

To counteract the adverse trend of shifting from motorbikes to cars, it is necessary to adopt a multifaceted approach that combines limiting the attractiveness of private vehicles while simultaneously enhancing the appeal of public transportation. A crucial aspect is ensuring that the growth rate of public transport's capacity to meet travel demand outpaces the growth rate of private cars. According to the author's perspective, this strategic approach represents the linchpin for achieving sustainable vehicle management in urban areas.

In modern society, media users exhibit a heightened sensitivity to two critical factors: their Attitude towards different modes of transportation and their Perception of health. These factors can be effectively leveraged through the implementation of modern public passenger transport systems, such as urban railways. The swift expansion and comprehensive coverage of urban railway networks represent a valuable opportunity for Hanoi to accelerate the adoption of public transportation habits among its residents. Simultaneously, it is essential to continue implementing measures that create certain barriers to limit the convenience associated with

private vehicles, including cars. These solutions should be pursued concurrently and in accordance with a well-structured roadmap. Importantly, until the necessary infrastructure and public transport systems are sufficiently developed, it may not be advisable to enact an outright ban on motorbikes. A balanced and phased approach is recommended to ensure a smooth transition towards more sustainable and efficient urban transportation practices.

6. CONCLUSIONS

The study offers two important contributions. Firstly, the study sheds light on the factors influencing urban transportation choices in Hanoi's capital. Besides the usual factors, the research shows that two factors, "Attitude towards the vehicle" and "Health awareness," also affect how people choose their mode of transportation. These factors are linked to the specific culture and traffic situation in urban areas of Vietnam. Secondly, the study reveals the current trend in transportation choices in Hanoi. This trend is identified by looking at different factors, how they influence decisions, and how strongly they do so. These findings provide a solid scientific foundation for creating sustainable traffic management solutions. These limitations include, the first is not provide insights into the specific trends of choosing alternative convenient transportation modes to replace motorbikes in different areas or under varying conditions; the second is limited in scope to the inner-city districts of Hanoi, omitting suburban districts. Moving forward, it would be advisable to address these limitations in future research endeavors.

ACKNOWLEDGMENT

This research is funded by University of Transport and Communications (UTC) under grant number T2023-KT-012.

REFERENCES

[1]. C. C. Minh, K. Sano, S. Matsumoto, Maneuvers of motorcycles in queues at signalized intersections, Journal of advanced transportation, 46 (2012) 39-53. https://onlinelibrary.wiley.com/doi/epdf/10.1002/atr.144

[2]. Hsu, T. Pen, E. A. F. M. Sadullah, N. X. Đạo, A comparison study on motorcycle traffic development in some Asian countries: Case of Taiwan, Malaysia and Vietnam, J. East, Asia Soc, Transp, Stud, 5 (2003) 179–193.

[3]. Lan, W. Lawrence, C. W. Chang, Inhomogeneous cellular automata modeling for mixed traffic with cars and motorcycles, Journal of advanced transportation, 39 (2005) 323-349. https://doi.org/10.1002/atr.5670390307

[4]. C. C. Chan, C. K. Nien, C. Y. Tsai, G. R. Her, Comparison of tail-pipe emissions from motorcycles and passenger cars, J. Air Waste Manage, Assoc, 45 (2012) 116–124. https://doi.org/10.1080/10473289.1995.10467347

[5]. Samuelson, D. N. Palw, Translation by V. Cuong, Economics, first ed., Financial Publishing House, 2011.

[6]. M. R. Solomon, D. W. Dahl, K. White, J. L. Zaichkowsky, Behavior - Buying, Having, Being, 10th Edition, Pearson Education, Inc, 2013.

[7]. T. Satiennam, S. Jaensirisak, N. Nateongin, W. Kowtanapanich, Public transport planning for a motorcycle dominated community, Journal of the Eastern Asia Society for Transportation Studies, 9 (2011) 970-985.

[8]. V. T. Arasan, P. Vedagiri, Microsimulation study of the effect of exclusive bus lanes on heterogeneous traffic flow, Journal of Urban Planning and Development, 136 (2010) 50-58.

[9]. M. A. A. Abuhamoud, R. Rahmat, A. Ismail, Modeling of transport mode in Libya: A binary logit model for government transportation encouragement, Australian Journal of Basic and Applied Sciences, 5 (2011) 1291-1296.

[10]. S. S. Wibowo, S. Chalermpong, Characteristics of mode choice within mass transit catchments area, Journal of the Eastern Asia Society for Transportation Studies, 8 (2010) 1261-1274.

[11]. M. V. Johansson, T. Heldt, P. Johansson, The effects of attitudes and personality traits on mode choice, Transportation Research Part A: Policy and Practice, 40 (2006) 507-525.

[12]. M. Gebeyehu, S. Takano, Diagnostic evaluation of public transportation mode choice in Addis Ababa, Journal of Public Transportation, 10 (2007)

[13]. J. Chen, S. Li, Mode choice model for public transport with categorized latent variables, Mathematical Problems in Engineering, (2017). https://doi.org/10.1155/2017/7861945

[14]. I. Ajzen, The theory of planned behavior, Organizational behavior and human decision processes, 50 (1991) 179-211.

[15]. V. T. Sarver, Theory of reasoned action, A critical assessment, Journal for the Theory of Social Behavior, 13 (1983) 154–164. https://doi.org/10.1111/j.1468-5914.1983.tb00469.x

[16]. Y. Heath, R. Gifford, Extending the theory of planned behavior: Predicting the use of public transportation, Journal of applied social psychology, 32 (2002) 2154-2189. https://doi.org/10.1111/j.1559-1816.2002.tb02068.x

[17]. G. Beirão, J. A. S. Cabral, Understanding attitudes towards public transport and private car: A qualitative study, Transport policy, 14 (2007) 478-489. https://doi.org/10.1016/j. tranpol.2007.04.009

[18]. D. Hini, P. Gendall, Z. Kearns, The link between environmental attitudes and behaviour, Marketing Bulletin, 6 (1995) 22-31.

[19]. H. T. Van, K. Choocharukul, S. Fujii, The effect of transportation attitudes towards cars and public on behavioral intention in commuting mode choice —A comparison across six Asian countries, Transportation research part A, policy and practice, 69 (2014) 36-44. https://doi.org/10.1016/j.tra.2014.08.008

[20]. N. M. Hieu, Modeling school travel mode choice–the case of Hanoi, Vietnam, Journal of Transportation Science, 72 (2021) 778-788.

[21]. B. G. Tabachnick, L. S. Fidell, J. B. Ullman, Using multivariate statistics, Boston, MA, Pearson, 5 (2007).

[22]. H. Trọng, C. N. M Ngọc, Phân tích dữ liệu nghiên cứu với SPSS – 2 tập, Nhà xuất bản Hồng Đức, TP. Hồ Chí Minh, 2008.