Factors Influencing the Future Choices of Mass Rapid Transit Use in Motorcycle Dependent Cities of Developing Countries

Le Quan HOANG [a], Toshiyuki OKAMURA [b]

[a] *Division of Public Transportation, Department of Transportation, Ho Chi Minh City, Vietnam*
[b] *Graduate School of Regional Development Studies, Toyo University, Tokyo, 112-8606, Japan*
[a] *E-mail: hlquan.sgtvt@tphcm.gov.vn*
[b] *E-mail: okamura@toyo.jp*

Abstract: This study diagnoses the determinants for the future choices of MRT use. Stated Preference technique is applied to achieve actual choices of MRT. Those who have a high level of bus safety belief, are pro-environment or have measure acceptance are likely to have mass rapid transit intention. Although Pro-Automobile and Pro-Motorcycle have no relationship with MRT intention, these factors do have influences on MRT choices. However, trip length and traffic condition are major predictors of MRT choice behaviour in comparison with other factors. It indicates that the motorcycle dependence will not be a main obstacle for future MRT use. Motorcycle use for bus access is an important factor affecting both MRT intentions and choices. The results of Structural Equation Modelling and the Binary logit model shows that applying the Stated preference technique alongside the Reveal preference data contributes to commuters' MRT choices with consideration.

Keywords: Future Choice, Mass Rapid Transit, Motorcycle, Developing countries

1. INTRODUCTION

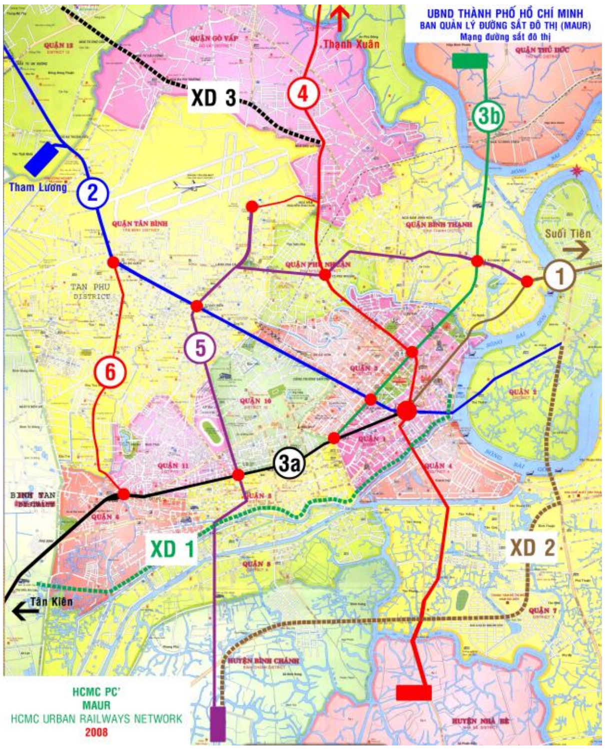
1.1. Background

Developing countries are facing accelerated motorisation that results in increased private vehicles and limited public transport services (Koizumi et al., 2003). Motorcycles have become an important mode in many cities of developing countries, particularly in Asia (Araya &Morchi, 2007). Motorcycles accounted for a high proportion of urban transport in Ha Noi (Vietnam), Jakarta (Indonesia), Bangkok (Thailand), Phnom Penh (Cambodia), and Vientiane (Laos). Barter (1999) mentioned the concept of 'motorcycle cities' or 'motorcycle oriented cities' when the author discussed the imbalance between high motorcycle growth and limited public transport services in many Asian cities during the late 1990s.

Since it is impossible to develop road infrastructure to meet the demand of private mobility, many cities within developing countries have adopted policies and strategies to implement mass transit systems including MRT and BRT for tackling traffic congestion and pollution. Due to high population density and limited road networks, many cities do not have "automobile dependent" characteristics, but are full of diverse transportation means (Barter, 2004). Para-transits such as motorcycle taxis or minibuses provide flexible trips with low rates, but also have low capacity and other negative limitations (Cervero& Golub 2007). The popularity of motorcycle use challenges public transport, particularly mass rapid transit. It is noted that many medium-sized cities lacking economic resources to develop mass rapid transit, have high motorcycle growth. These cities will potentially become megacities facing urban problems such as inefficient public transport service, high population growth, overloaded infrastructure, and high private vehicles. If motorcycle use becomes popular in the long term, before public transport is developed into a high quality service, motorcycle dependence will undermine the performance of public transport, particularly mass rapid transit. Therefore, motorcycle management should be conducted before MRT development, in order to limit future difficulties by motorcycle dependence, and to encourage motorcycle users to use public transport more. In this context, it is important to understand people's intentions and choices regarding new transit alternatives to assist with implementing appropriate measures in motorcycle use. This study selects Ho Chi Minh City (HCMC) as a typical case of a developing city for research implementation.

1.2. Study area

Ho Chi Minh City is a major commercial centre and the most dynamic city in Vietnam. During the rapid urbanisation, the urban transport situation of HCMC has worsened, especially in the highly urbanised and emerging urban areas. Motorcycles became the primary mode while bus services hold a limited role and MRT have not yet been established. The rise of motorcycle use and the growth of car ownership occur in many developing cities. However, the unusual characteristic of HCMC is the high rate of motorcycle ownership. By May 2014, the number of registered private vehicles in HCMC is 6.5 million including 0.5 million cars and 6 million motorcycles (Department of Transportation, 2014).



(Source: Ministry of Transportation, 2013)
Figure 1. Mass rapid transit plan

Transport service currently includes road–based modes such as bus, taxi, and motorcycle taxi. From 2002 to 2009, the number of taxis has increased rapidly from 3,597 units to 10,700 units (Department of Transportation, 2013). Although motorcycle taxis have not been regulated, it provides convenient trips with reasonable price in comparison with taxis. Motorcycle taxis appeared in the period bus service became deteriorated and motorcycle growth increased. Cyclo used to be a cheap and popular mode, but it was banned from certain streets and areas in city centre. Water transport is limited to local users' needs along rivers. Railway system that mainly operates for inter provincial transportation is not used as urban transport while mass rapid transit systems are being implemented.

According to the Public Transportation Master Plan toward 2025, bus systems will include 67 inner city routes; inter province routes, and 6 bus rapid transit routes. According to the Transport Master Plan toward 2020, there will be seven metro lines, two monorails, and one tramway with 167 km in length (see Figure 1) (Ministry of Transportation, 2013). Since public transport system has only conventional bus, it fails to compete with private vehicles which account for a major share in daily transportation.

Currently, the first two MRT routes, namely MRT 1 and MRT 2, have been launched in HCMC. Their construction will be finished in 2019 and 2020 respectively. While MRT 2 route lies on an eleven-kilometre-corridor, the total length of MRT 1 is approximately 20 kilometres. Since the last station of MRT 1 is located near the boundary of HCMC and Binh Duong province, MRT 1 supplies travel demand not only for HCMC's urban transport but also for inter-provincial need. Ben Thanh station is located on the previous bus terminal and is planned as the main station of the MRT system.

1.3. Objectives and hypotheses

This study aims to identify factors influencing the future choices of mass rapid transit use by meeting the following objectives:

- To assess the causal relationship between mass rapid transit intention and other predictors
- To identify the main predictors affecting mass rapid transit choice, considering policy implications

It is hypothesized that the intention of mass rapid transit has stronger impacts on mode choice behaviour over other influencing factors; and predictors of MRT intentions may be different from that of MRT choices

2. LITERATURE REVIEW

The relationships between psychological factors and travel intentions have been explored widely in the transportation field. The basic construction of Theory of Planned Behaviour (TPB) has been utilised in a range of studies (Bamberg et al., 2003; Hsiao and Yang, 2010; Kerr et al., 2010; Chen & Chao, 2011; Eriksson & Forward, 2011; Hoang Tung et al., 2015). Furthermore, others have focused on the association between attitudinal aspects of travel modes and intentions (Choocharukul, K. et al., 2006; Javid et al., 2016). Some authors combined TPB and NAM (Norm activation model) for improving explanatory power of their travel behaviour models (Choocharukul et al., 2007; Chang & Lai, 2013). Similarly, the relationships between perceived transit services and intentions were discussed (Van & Fuji, 2009; Fu & Juan, 2016; Javid et al., 2013). Socio-economic characteristics and demographics that were included in the original model also had significant influences on travel intentions (Chowdhury & Ceder, 2013; Nordlund& Westin, 2013; Bando et al., 2015). Personalities, preferences, personal norm, belief, interest, and other psychological determinants such as auto oriented, transit oriented, service oriented, and car oriented were found to be predictors of intentions (Abrahamse et al., 2009; Nordlund & Westin, 2013; Okamura et al., 2013).

There are few studies relating to the intentions of using rail-based public transport. Attitudes concerning mass transit accessibility and perceptions on para-transit services have association with mass transit intention (Tangphaisankun et al., 2009). Public transport users who hold high concern over eco-friendly levels are most likely to use mass transits (Tangphaisankun et al., 2011). Similarly, belief about local environmental benefits positively influences train use intention (Nordlund & Westin, 2013). The intention of alternative transit use is associated with bus safety belief (Le Quan & Okamura, 2016).

In particular, some relevant literatures focus on predictors of rail-based public transport use. The effects of transit service on rail transit choices have received extensive discussion. As a part of travel cost, high fare is considered the leading cause of passengers' dissatisfaction on light rail transit in Manila (Okada et al., 2003). Using Stated preference and Reveal preference data, Fujiwara et al. (2003) found that travel time, travel cost, waiting time, access time, and egress time are negatively related to new transit systems in Yangon City (Myanmar). The cost and time incurred by workers' commuting affected their rail transit behaviours (Sanit, 2013). Moreover, Wibowo and Chalermpong (2010) noticed that a reduction of travel time had more influence on mass transit choices than a decrease of travel cost. Shorter travel time by train makes an officer to less likely to commute by automobile (Cevero, 2006).

For transit accessibility, Park-and-Ride facilities increase rail ridership by providing travel options for local people living beyond walking distance from stations (Ducan & Christensen, 2013). People find train stations more accessible by Park-and-Ride provision. Moreover, proximity to train stations is also the main predictor of mass transit use. The more people live near transit stations, the higher the number of transit ridership is (Wibowo &Chalermpong, 2010). A shorter distance to stations increased the probability of rail transit being chosen (Jayme & Chalermpong, 2013). Cervero (2007) found that living within half a mile of a train station increased the likelihood of commuting by rail. Access and egress distances to train stations are relatively related to the probability of using rail (Beimborn et al., 2003). Lindsey et al. (2010) found that commuters whose workplaces are close to train station are more likely to use transit.

The advantages of land use density and diversity have been a point of focus, particularly in Transit-Oriented-Development areas. Mixed use development around transit stations contributes to the exploitation of transit capacity in rail transit catchment areas (Arrington & Ceveron, 2008). Urban design, particularly for pedestrian paths, enhances walkable environment for transit access. However, streetscape improvements and neighbourhood design have little effect on transit choices among individual living in station areas (Litman, 2008).

Socio-economic characteristics are considered as important variables in order to explain the likelihood of choosing mass transit. Income is a determinant for rail transit behaviour (Sanit, 2012). It is also supported by Fouracre et al. (2003) that high income people limit to shift from personal modes to MRT. People who have car ownership are less likely to use mass transit systems (Wibowo &Chalermpong, 2010). In addition, the presence of children and a middle income negatively influenced the likelihood of being a transit user (Sanit, 2013).

The roles of attitudes and preferences have been examined as important determinants of mode choice behaviour. Sanit et al. (2014) found that people who have positive attitudes toward commuting by train are likely to be rail passengers. As pointed out, people with a preference for travelling by rail transit are likely to live in a residential location with easy access to a station (Pickup & Town, 1983). In general, Bagley and Mokhtarian (2002) investigated the relationships among attitudes, lifestyles, residential locations, and travel behaviours. It was found that attitudinal and lifestyle variables had the more of an influence on travel behaviour than residential location characteristics. The relationships between built environment variables and travel behaviours are mainly explained by residential self-selection - the effects of attitudes on the choice of residential location.

3. METHOD

3.1. Measurement

While MRT system has not established in HCMC yet, it is important to explore the relationships between future mass rapid transit choices and existing variables such as personal characteristics, trip patterns, preferences, and attitudes. The survey questionnaire consists of the following four parts: (1) Individual information (Q1-Q11 items); (2) Travel attributes (Q12-Q16 items); (3) Preferences, attitudes; and intentions (Q17-Q45 items); and (4) Mass rapid transit choices (Q46 item). The first part includes socio-demographic characteristics. The second part consists of current travel behaviours and trip patterns. The third part comprises preferences and attitudinal items, regarding travel modes and policy measures, and travel intentions. The fourth part aims to understand commuters' choices in scenarios relating to future MRT use.

3.1.1 Preferences, attitudes, and intentions

Travel preferences include statements about convenience, comfort, bus services, motorcycle taxis, motorcycle rides for bus access. These preferences were identified by yes-no questions. The questions were designed in order to achieve trade-off answers. For example, people were asked to select travel modes that provide convenient trips even though it might be uncomfortable. Bus service or motorcycle taxis were considered in case no vehicle was available at the household. Travel attitudes contain statements relating to travel modes (motorcycle, bus, and car) and policy measures. Previous studies explored latent variables relating to private vehicle dependence such as car dependent, auto oriented, car oriented, and pro car (Handy et al., 2005; Tangphaisankun et al., 2011; Javid et al., 2012; Okamura et al., 2013; Kamruzzaman et al., 2013). Some attitudes toward motorcycle, bus and car include attitudinal items in previous studies (Le Quan & Okamura, 2015; Le Quan & Okamura, 2016). Attitudes toward motorcycles aim to evaluate motorcycle dependence by trade-off comparisons between motorcycle use and other travel modes. For instance, respondents were asked whether they would want to ride motorcycles if it would take only 15 minute to walk from the origin to the destination. The other attitudes focus on policy measures for motorcycle use, such as: '*Motorcycle use should be limited for emission reduction*' or ' *I am willing to accept policies increasing penalties and fines for acts of violating safety rules in order to reduce motorcycle accident fatalities*'. Respondents also provided their intentions in using buses, motorcycles, and mass rapid transit. All attitudinal items were measured in four-point Likert scale for further construction of latent variables.

3.1.2 Mass rapid transit choices

Stated preference technique has been applied in some studies on rail-based system in developing countries. Travel time and cost are commonly chosen as basic SP variables (see Table 1). Moreover, other variables for SP choice experiment can be frequency and discount rate (Bando et al., 2015), annual accidents rate (Rizzi & Ortúzar, 2003), or crowding level (Basu & Hunt, 2012). In this study, some attributes of Stated preferences questions (travel time, travel cost) were calculated in details and provided for respondents in order to attain actual choice behavior.

For MRT use with non-egress trips, access modes such as walking, motorcycle, and motorcycle taxis are considered (Figure 2). For MRT use with egress trips, walking, buses, and motorcycles are assumed as egress modes, while motorcycles are the main access mode (Figure 3). It is assumed that it takes 15 minutes by walking, 10 minutes by bus, and 5 minutes by motorcycle taxi from Ben Thanh station to the destination. It is the same duration from the respondent's house to both places. The waiting time for MRT use is 10 minutes for all cases.

Respondents were requested to answer the question "*Which alternative would you like to choose between MRT and motorcycle?*" They were provided two scenarios based on destination locations. In the first scenario, the destination is located nearby Ben Thanh station. In the second scenario, destination is located around Ben Thanh station.

Table 1. Stated preference studies relating to new transit alternatives

Study	Alternative	Stated preference attributes	Attributes based on existing situation
Jimene & Villoria (1997)	Mass Rail Transit	Travel time, Travel cost	
Hayashi et al. (1998)	Car, bus, rail	Travel time, travel cost	
Fujirawa et al. (2003)	Car, bus, railway, new transit system	Travel time, travel cost, waiting time, and punctuality (public transit)	Access time, egress time (public transit)
Sivakumar et al. (2006)	BRT, Bus	Travel time, travel time variance, fare, comfort	
Basu & Hunt (2012)	Suburban train	Ride time, headway, train fare, crowding level	
Satiennam et al. (2013)	BRT, motorcycle, car	Waiting time, Fare	Access time, In-vehicle time, egress time
Bando et al. (2015)	Motorcycle, Angkot, LRT	Travel time, Delay time, Total cost, Walking access time (Angkot, LRT), Frequency (Angkot, LRT), Discount rate (LRT)	

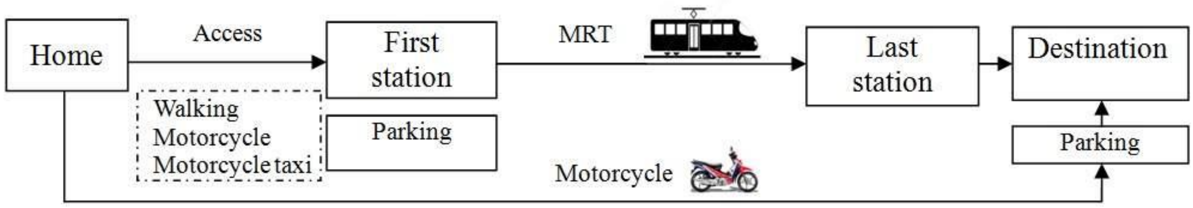


Figure 2. MRT use with non egress trips (Scenario 1)

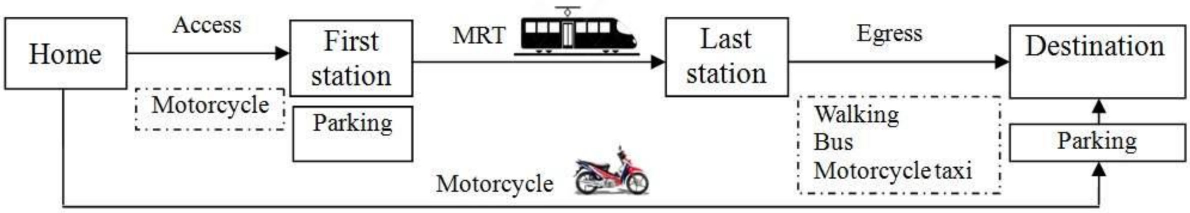


Figure 3. MRT use with egress trips (Scenario 2)

Table 2. Variables for Stated preference questions

Code	Description (Station……………………………………………)	Value
A	Travel time by motorcycle from respondent's house to city centre (minutes)	…….
B	Fuel cost from respondent's house to city centre by motorcycle(VND)	…….
C	Travel time by motorcycle from respondent's house to MRT corridor (minutes)	…….
D	Fuel cost by motorcycle from respondent's house to MRT station (VND)	…….
E	Travel time by MRT from the nearest station to city centre (minutes)	…….
F1 F2	Travel cost from the nearest station to city centre by MRT (VND)	……. …….
G	Walking duration from respondent's house to MRT station (minutes)	…….

Table 3. Levels of Stated preference variables

Variable	Level	
	Scenario 1	Scenario 2
Traffic condition (Delay duration by congestion) (minutes)	0 (no congestion) 15 (traffic congestion)	0 (no congestion) 15 (traffic congestion)
Access mode	Walking Motorcycle Motorcycle taxi	Motorcycle
Parking fee for motorcycle in CBD (VND)	5,000 10,000	5,000 10,000
Parking fee for motorcycle at stations (VND)	2,000 5,000	2,000 5,000
MRT fare (VND)	F1 F2	F1 F2
Egress mode		Walking Bus Motorcycle taxi

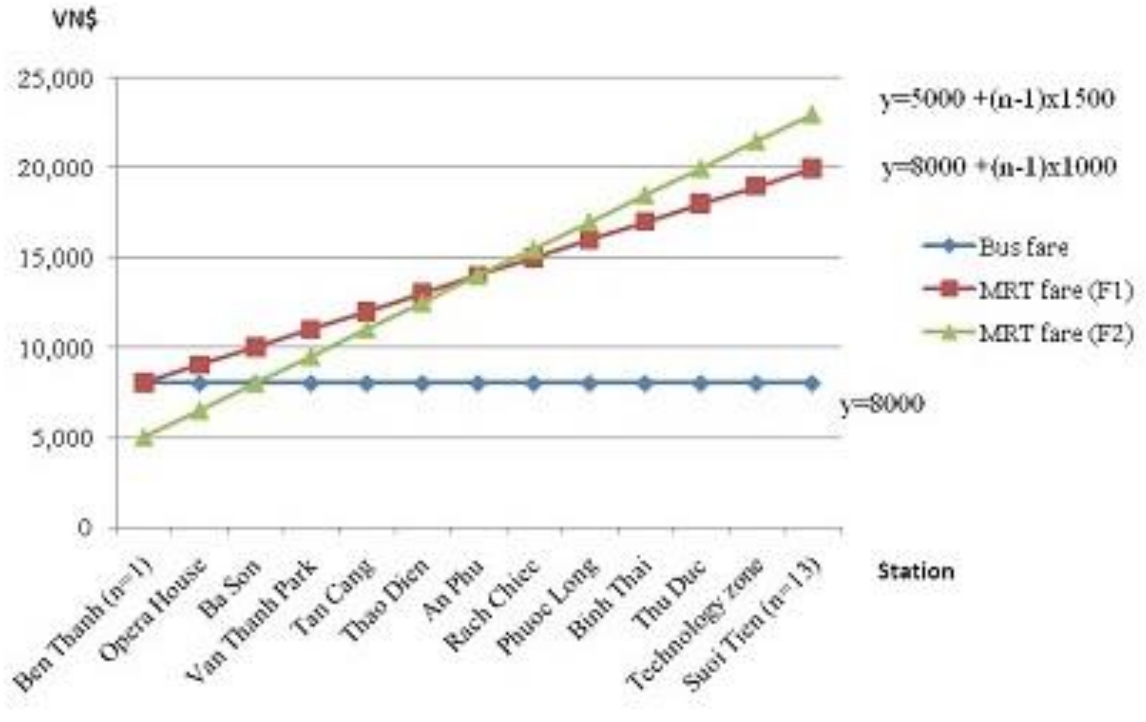


Figure 4. MRT fare to city centre by stations

Variables for SP questions are summarized in Table 2. Based on respondent's house location, fuel cost and travel duration by motorcycle were calculated for SP questions. Travel cost and duration by train were identified by assumptions (see Figure 4). In every scenario, travel patterns including travel time (access, in vehicle, egress) and travel cost (fuel cost, parking fee, motorcycle taxi expense, MRT fare) are presented for alternative consideration. Respondents might understand that access mode, parking fee, MRT fare, and traffic condition varies in some levels. The levels of variables for SP questions are summarized in table 3. For example, parking fee will be increased or decreased, MRT fare will be changed by distance, and travel time of motorcycle ride can be longer in peak hours than in off peak hours.

3.2. Sampling and survey

A field questionnaire survey was conducted to get required data in order to achieve objectives of this study. Department of Civil Engineering, University of Transportation involved in organising survey teams. The survey was conducted in February and March 2016. Contacts with local authorities had been prepared in one week before survey was carried out. Interviewees focus on target population in specific stations and along MRT corridor. There are 13 stations located in 5 districts and along MRT 1 corridor. However, interviews were only conducted in residences around 11 stations in 4 districts. Since trip destinations were assumed around Ben Thanh station in Stated preference questions, respondents living near first two stations, Ben Thanh and Ba Son, were excluded from survey population.

Face to face interview is the main method used in the survey. In every meeting, interviewers began with the explanation for questionnaire content. Based on residence locations, such as MRT zones and access distances to station were identified. Participants were provided with careful instruction on survey questions, especially attitudinal items and Stated preference scenarios. Every respondent has SP questions different from that of the others since travel time and cost are based on their residence address. First, interviewers identified where respondent's houses are located so that distances to MRT stations and city centre were estimated. Second, total travel time and cost were summarised after other expenses and durations such as fuel cost, parking fee, MRT fare, MRT access duration, and duration from nearest station to city centre were calculated. Finally, interviewers asked respondents' choices in every hypothetical case. There are two scenarios relating to MRT use with non-egress trips and with egress trips. In every scenario, eight cases were extracted by orthogonal design in SPSS software. However, only four cases were randomly introduced to every respondent in order to limit answer's bias.

As can be seen in Table 4, while there are more respondents living near the city centre than the others, most of respondents' residence are located outside 1-km distance from future stations.

Table 4. Distribution of residence location

		MRT Zone		
		Zone 1	Zone 2	
Access distance	<= 1 km	68	20	88 (40.2%)
	> 1 km	54	77	131 (50.8%)
		122 (55.7%)	97 (44.3%)	

Table 5. Distribution of samples' characteristics (n=219)

Category	Description
Gender	Male (45%), Female (55%)
Age group	<=20 (10%), 21-30 (31%), 31-40 (42%), 41-50 (11%), >50 (17%)
Occupation	Office Staff (17.4%), Official (15.5%), Manager (7.8%), Professional (21.9%), Sale persons (4.1%), Laborer/Worker (1.8%), Student (16.9%), Teacher/Lecturer (5%), Housewife (3.7%), Retired (2.3%), Other (3.7%)
Individual income (mil. VND)	<= 1 (14%), 1-5 (22%), 5-10 (37%), 10-15 (12%), 15-20 (5%), >20 (11%)
Vehicle ownership	Bicycle (16%), Motorcycle (90%), Car (10%)
Main mode for commuting trips	Walk (2.9 %), Bicycle (4.4%), Motorcycle (79.9%), Car (3.4%), Bus (9.3%)

Note : 10,000 VND ≈ 0. 5 USD (2015)

Table 5 shows that the majority of respondents were female (55%) and mostly aged between 21 and 40 years (73%). Office staff, officials, professionals, and students were the main groups of the survey samples. Personal monthly income ranges mainly from 5 million VND to 10 million VND (37 %). Most of respondents' household had motorcycle ownership (90%). While the rate of car ownership was 10%, 27% of respondents had car driving licenses). Motorcycles were the main mode for commuters' travel (79.9%).

The number of questionnaire sheets was 230; however, only 219 samples were collected. Since some respondents suggested returning questionnaire after self-completion, interviewers carefully explained respondents how to answer Stated preference questions. However, some given questionnaires lack information about MRT choices. Finally, only 187 samples have enough data for Stated preference questions.

3.3. Data analysis

Different analyses were performed to explore predictors for existing behaviours, travel intentions, and future MRT choices. First, factor analysis was conducted to identify underlying dimensions. Second, Structural Equation Modelling was conducted to find structural relationships among underlying factors and mass rapid transit intention. Observed and latent variables were identified by factor analysis with varimax rotation. Other observed variables were constructed by coding socio-economic characteristics and preferences on convenience, bus, and motorcycle. Finally, Binary logit models were applied to assess the relative impacts of predictors to mass rapid transit choices. Independent variables included not only previous variables of Structural Equation Modelling but also Stated preference variables such as trip chain complexity and traffic condition.

4. RESULTS AND ANALYSIS

4.1 Data description

Table 6 presents respondent's preferences on convenience, bus service, and motorcycle access to bus stops. While it was found that people slightly prefer travel modes that provide comfortable trips more than a convenient mode of transport, buses were selected more than motorcycle taxis. There was a balance in the preference of using motorcycle to access bus stops.

Table 6. Distribution of preference statements

Item	Variable	Statement	Frequency (%)
Q17	Convenience mind	I prefer the travel mode that provides convenience, though it might be an uncomfortable mode of travel.	104 (47 %)
Q18	Bus preferred than motorcycle taxi	I prefer to go somewhere by bus service rather than motorcycle taxi when no vehicle is available in my household.	131 (60%)
Q19	Bus access by motorcycle	I like to drive motorcycle to access bus service if I intend to get on bus.	111 (51%)

An can be seen in Table 7, respondents have low evaluation for going to destinations far from their last station (Q43) over other MRT intentions (Q42, Q44, & Q45). This reveals that people prefer MRT use without egress trips. Statements relating to motorcycles (Q20, Q21, &Q22) points out that people are less likely to ride motorcycles when the distance is only a 15-minute walk (Q20) or near to a workplace/school (Q21) in comparison with a long trip (Q22). This indicates that people still have a strong habit to ride motorcycles long distances. In statements relating to buses (Q23, Q24, Q25), people have similar feelings regarding the comparison of riding a bus and driving motorcycle. This shows that motorcycles are more risky than cars in comparison with bus. Respondents have a low evaluation for the feeling joyful in riding bus. It can be explained that people do not satisfy with present status of bus service. For statements relating to policy measures, people are less likely to support regular motorcycle inspection (Q37) than the other measures (Q34, Q35, Q36, & Q38).

4.2 Factor analysis

A factor analysis was run in IBM SPSS Statistics 22.0.0.0 with varimax rotation on the attitudinal items (see Table 7). Items having factor loadings >.5 were utilised. Six factors were identified and named as Pro-Motorcycle, Bus Safety Belief, Pro-Automobile, Pro-Enviroment, Measure Acceptance, and Mass rapid transit intention.

Table 7. Factor loading (FL) and Cronbach's alpha (α) of factors extracted

Item	Factors/ Items	Mean	FL	α
	Pro-Motorcycle			.572
Q21	Though my work place/school is near my house, I still want to ride a motorcycle there.	2.37	.812	
Q20	I always ride a motorcycle even if it takes only 15 minutes to walk from the origin to the destination.	2.55	.689	
Q22	During a long trip, I would like to ride a motorcycle even though it is probably faster to use a bus.	2.65	.657	
	Bus Safety Belief			.840
Q23	Taking transit is safer than driving a car.	2.86	.886	
Q25	Using public transport make me feel safe during daily travel.	2.70	.848	
Q24	Riding on a bus is safer than driving a motorcycle.	3.16	.818	
	Pro-Automobile			.870
Q31	Car ownership increases my social status.	2.69	.885	
Q32	Driving car makes me feel more confident in communication.	2.68	.879	
Q33	Using a car makes me more efficient at work.	2.58	.843	
	Pro-Environment			.573
Q35	Motorcycle fleets that do not meet environmental standard, should be forbidden for daily-use	3.10	.820	
Q34	Motorcycle use should be limited for emission reduction.	2.93	.709	
	Measure Acceptance			.775
Q36	I am willing to accept Traffic Demand Management measures such as bans on motorcycle use based on specified hours and specified areas for congestion reduction.	3.31	.850	
Q38	I am willing to accept policies that increase penalties and fines for acts of violating safety rules in order to reduce motorcycle accident fatalities.	3.44	.790	
Q37	I am willing to accept regular inspections for motorcycle fleets in order to contribute to air quality improvement.	2.93	.782	
	Mass rapid transit intention			.756
Q42	Though I have my own car, under certain circumstances I might use MRT.	3.31	.805	
Q44	In case of increased parking charge in the city centre, I am willing to use mass rapid transit for the trip to the city centre.	3.26	.743	
Q45	If the parking-charge at train stations is lower than the normal cost, I would use mass rapid transit after driving motorcycle to MRT stations.	3.14	.740	
Q43	I intend to use MRT if my destination is only a 15-minute-walk from the closest station.	3.04	.611	

The factor scores were calculated by regression method and are normalized to set the neutral position at zero. Cronbach's alphas were computed to confirm factor reliability. It was found that alpha values for Pro-Motorcycle and Pro-Environment are lower than that of the other factors. This indicates that people still have diverse opinions about motorcycle dependence and environment reservation.

4.3 Structural equation modelling

Based on the results of factor analysis, Structural Equation Modelling by AMOS (an add-on module for IBM SPSS Statistics 22.0.0.0) was utilised to identify structural relationships. At the beginning, the basic model includes possible structural paths among all latent variables. As can be seen in Table 8, the covariance between Pro-Motorcycle and Pro-Automobile (.123) is higher than that between Pro-Motorcycle and the others. It means that there tends to be predictable association between Pro-Motorcycle and Pro-Automobile. Similarly, Pro-Environment is respectively predicted to have relationships with Bus Safety Belief and Pro-Automobile. Additionally, Mass rapid transit Intention is likely to have relations to Bus Safety Belief, Pro-Environment, and Measure Acceptance.

Table 8. Covariance matrix

	PM	BSB	PA	PE	MA	MRTI
Pro-Motorcycle (PM)	.333					
Bus Safety Belief (BSB)	-.077	.848				
Pro-Automobile **(**PA)	.123	.097	.621			
Pro-Environment (PE)	-.034	.184	.175	.339		
Measure Acceptance (MA)	-.059	.067	.051	.098	.386	
Mass rapid transit intention **(**MRTI)	-.057	.212	.063	.156	.166	.341

Note: The off-diagonal elements represent the covariances between the variables that make up the column and row headings. The variances of the variables are displayed in the diagonal elements.

The final model with significant regression coefficients is shown in Figure 5. The majority of structural relationships were significant at 99% and 95% level of confidence. Parameters for model fit are described as $\chi2/DF < 5$, GFI ≈ 0.90, AGFI ≈.90, CFI> 0.90 and RMSEA < .08. There are different measures assessing goodness of fit of SEM model. For example, Marsh and Hocevar (1985) suggest the ratio of chi-square to the degree of freedom ($\chi2/DF$) should be less than 5. Moreover, GFI, AGFI, and CFI values must be greater than .90 and RMSEA values less than .08 (Bentler, 1982). Since it is difficult to attain full goodness-of-fit statistics, and sample size is limited, the model is reasonably considered as a good-enough fit.

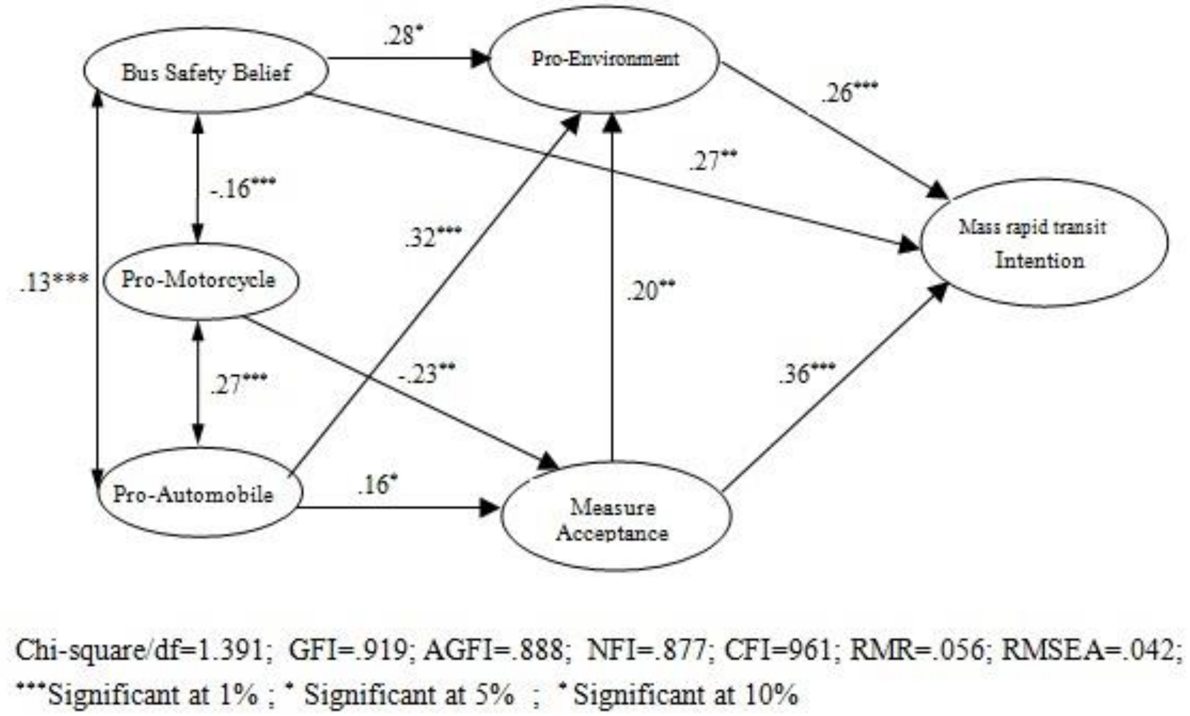


Figure 5. Structure of attitudinal variables and intention

It has been found that Bus Safety Belief, Pro-Environment, and Measure Acceptance has a positive effect on MRT intention. High belief in bus safety and high concerns on environment corresponded with respondents being more likely to choose MRT. The positive coefficient (0.36) for the path from Measure Acceptance to Mass rapid transit intention indicates that how people accept motorcycle controls has the highest impact on MRT intention in comparison with the others variables.

4.4 Binary logistic regression

The binary logit model may be appropriate in a motorcycle-dependent context, where motorcycles hold a major role in daily transport. A binary logistic regression was conducted by SPSS 22.0.0 application. While dependent variable (Y) is MRT choice, independent variables include socio-economic information (Gender, Age), attitudinal factors extracted, preferences on bus access, residence location (MRT zone and access distance), and Stated preference data (Total travel time, total travel cost, trip chain complexity, and traffic condition).

Table 9 provides results of five binary logit models on predicting mass rapid transit choices. While variables of Model 1 are Gender, Age, MRT zone, Access zone, Total travel time, Total travel cost, and trip chain complexity, Model 2 includes variables of Model 1 and Traffic flow. Model 3 includes variables of Model 2 and Bus access by motorcycle. After adding attitudinal factors such as Pro-Motorcycle, Pro-Automobile, Bus Safety Belief, Pro-Environment, and Measure Acceptance, Model 3 becomes Model 4. Finally, variables of Model 4 and MRT intentions are included in Model 5. For assessment of overall model fit, McFadden's pseudo R-squared of Model 1 (0.085) is lower than that of Model 2 (0.153), Model 3 (0.163), Model 4 (0.187) and Model 5 (0.197). This indicates that SP variables (trip chain complexity and traffic condition), preferences, attitudes, and intentions result in the improvement of model fit.

Table 9. Estimation results for binary logit model

Variables	Model 1	Model 2	Model 3	Model 4	Model 5			
	B	B	B	B	B	Odd ratio	Std. Deviation	B*
Gender (*1=Male; 0=Female*)	-.437***	-.458***	-.420***	-.551***	-.548***	.578	0.499	-.102***
Age (*Years*)	.021***	.024***	.022***	.024***	.022***	1.022	11.196	.092***
MRT zone (*1= > 10 km; 0= <=10 km*)	1.692***	1.787***	1.676***	1.605***	1.641***	5.162	0.498	.305***
Access distance (*1= > 1 km; 0= <= 1km*)	-.322**	-.356***	-.299**	-.294**	-.368***	.692	0.495	-.068***
Total travel time (*minutes*)	-.041***	-.043***	-.041***	-.036***	-.036***	.964	7.645	-.104***
Total travel cost (*1,000 VND*)	-.081***	-.085***	-.083***	-.081***	-.079***	.924	3.198	-.095***
Trip chain complexity *(1=MRT use with egress trip; 0=MRT use without egress trip)*	-.414***	-.474***	-.514***	-.601***	-.620***	.538	0.500	-.116***
Traffic condition *(1=Congested; 0=No)*		1.362***	1.394***	1.454***	1.482***	4.4	0.500	.276***
Bus access by motorcycle (*1= Yes; 0=No*)			.529***	.507***	.398**	1.489	0.500	.074**
Pro-Motorcycle				-.296***	-.304***	.738	1.001	-.113***
Pro-Automobile				-.297***	-.284***	.753	1.018	-.108***
Bus Safety Belief				.009	.022	1.022	1.007	.008
Pro-Environment				-.102	-.103	.902	0.985	-.038
Measure Acceptance				.063	.057	1.059	1.002	.021
MRT Intention					.284***	1.329	1.013	.107***
Constant	2.087	1.413***	1.106**	.889	1.014*	2.757		
Number of observation	1496							
Initial -2LL	1995.944							
Converged -2LL		1826.251	1690.216	1671.153	1623.184			
Cox & Snell R Square		.107	.185	.195	.221			
Nagelkerke R Square		.146	.251	.265	.299			
McFadden ρ^2		.085	.153	.163	.187			
Percentage correct (%)		66.6	71.9	71.9	72.7			

Notes:

LL: Log likelihood ; B: Unstandardized coefficient ; B: Standardized coefficient*;

***** Significant at 0.01 level; ** Significant at 0.05 level; * Significant at 0.1 level;*

In Model 1, it can be seen that being female, older age, long-distance trip, and the proximity to MRT station are all significant predictors of increased mass rapid transit choices. Travel time and travel costs are traditional variables decreasing the probability of using MRT. In Model 2, significant variables include predictors found in Model 1 and traffic condition. In Model 3, significant variables include predictors found in Model 3 and preference for driving motorcycles to gain bus access. In Model 4, significant variables include predictors found in Model 4 and attitudinal factors such as Pro-Motorcycle, Pro-Automobile. Bus Safety Belief, Pro-Environment, and Measure Acceptance are not to be significant in binary logit models. In Model 5, significant variables include predictors found in Model 4 and mass rapid transit intention. In five models, all significant relationships are evaluated at 1% or 5% level of significance.

As can be seen in Table 9, the odd ratio values of Model 5 indicate that people living far from city center are 5.162 times likely to choose MRT than the others (a 416.2% increase in the odds of MRT use). Traffic congestion results higher odds of MRT use by a factor of 4.4 (a 340% increase in the odds of MRT use). High complexity in trip chains decrease the odds of MRT use by a factor of 0.538 (a 46.2 % decrease in the odd of MRT use).

The standardized coefficients of independent variables were additionally calculated in order to find important predictors of Model 5 by using the following formulas (Menard, 2011).

$$B_i^* = B_i s_{X_i} R / s_{\log it(Y)} \qquad (1)$$

where R is based on Cox & Snell R^2, s_{X_i} is the standard deviation of the independent variable X_i, $s_{\log it(Y)}=1.288$ is the standard deviation of logit (Y), logit(Y)= ln (P/(1-P)) is predicted by binary logistic equation, and P is the probability of choosing MRT.

It is found that access distance to MRT stations (B^*= -0.068) is the least important predictor of MRT use, followed by driving motorcycle to access bus (B^*= 0.074), age (B^*= 0.092), and total travel cost for MRT use (B^*= -0.095). Trip chain complexity (B^*=-0.116) and being dependent on riding motorcycle (B^*= -0.113) have similar influences on MRT use. Trip length (B^*= 0.305) and traffic condition (B^*= 0.276) have more impacts on MRT use than the others.

5. FINDING AND DISCUSSION

The growth of motorcycle use is a distinctive characteristic of motorisation in developing countries. There is a high rate of motorcycle ownership and use in Asia in comparison to other regions in the world. Additionally, cities within developing countries have built mass rapid transit system in recent decades. The challenge faced is to understand how to shift private vehicle users, especially motorcycle users, to mass rapid transit. In the case of Taiwan, motorcycle use continues to prevail in spite of improved public transport and higher capita income. There is an assumption that motorcycle dependence has existed for a long time, which has an effect on public transport behaviour. Due to limited resources, cities within developing countries, particularly small and medium sized cities, may develop MRT system in the future after motorcycle use has become popular. In that condition, shifting motorcycle users to MRT will be more difficult and challenging due to motorcycle dependence. However, analysis results show that motorcycle dependence can negatively influence MRT choices, but it is not the most important predictor. Trip length and traffic condition have more impacts on MRT choices than the others. Moreover, Pro-Environment, Measure Acceptance, and Bus Safety Belief have relationships with MRT intention, whereas these factors are not predictors of MRT choice. In contrary, Pro-Motorcycle and Pro-Automobile have negative impacts on MRT choice, while they are not associated with MRT intention. Preference of driving motorcycles to access bus services has an effect on both MRT intentions and choices. Therefore, the hypothesis that MRT intention has stronger impacts on mode choice behaviour over other influencing factors is rejected. However, the hypothesis that predictors of MRT intentions may be different from that of MRT choices is confirmed.

The results need to be interpreted and analysed in comparison with previous studies. A study in Northern California shows that car dependency has a higher influence on vehicle miles driven (VMD) per week than other underlying factors (Handy et al., 2005). Tangphaisankun et al. (2011) find that car oriented commuters tend to have more car use than non-car oriented groups in Bangkok (Thailand). Javid et al. (2012) identify that being auto oriented has negative impacts on public transport use intention, but the magnitude of being auto oriented is still lower than that of transit oriented. In Manila (Philippines), car oriented has more influence on the limitation of using jeepney's in comparison to service oriented (Okamura et al., 2013). Corresponding to previous studies, the results are consistent with the view that private vehicle dependence has negative effects on public transport use and positive influences on private vehicle use.

It was found that being Pro-Motorcycle has direct effects on MRT choices but has no relationship with MRT intention. This is different from previous studies in which auto/car oriented was negatively associated with the intention of public transport use (Javid et al., 2012; Okamura et al., 2013). It can be explained that the lack of MRT use experience makes respondents have MRT intention without any considerations. Therefore, there is no association between Pro-Motorcycle and MRT intention. SP questions with detailed descriptions make respondents understand MRT use in real conditions. Therefore, the results of binary logistic regression identify the relationships between Pro-Motorcycle and MRT choice behaviours.

The results of the SEM model and Binary logit model shows that independent variables have different influences on MRT intentions and choice behaviours. Some factors such as Pro-Motorcycle and Pro-Automobile are insignificantly related to MRT intention, but they undermine MRT choice over time. Bus safety belief, Pro-Environment, and Measure Acceptance contribute to MRT intention that directly affect MRT choice. Therefore, it is necessary to have policies on raising environmental awareness, emphasising safety functions of bus services, and managing motorcycle use in order to enhance future MRT development.

The important roles of trip chaining complexity and traffic condition can be explained by local characteristics. First, door-to-door trips make motorcycle transportation the most convenient mode. Commuters prefer a travel mode that provides trip chain that is less complex. Therefore, destinations that are far away from their previous station will not be a priority for MRT use. Second, motorcycle use accounts for more than 90% of travel demand in Ho Chi Minh City. As a result there are many motorcycles on the streets during peak hours. Previous studies indicate that motorcycle use is very useful to overcome traffic congestion. If people prefer MRT to motorcycles in peak hours, it means that the number of motorcycles has reached a critical level. If there is a higher possibility of traffic congestion then travellers will choose to select of alternative mode of transport for a more reliable trip. In SP questions, 15 minutes is assumed as delay time in peak hours. Since traffic condition affects MRT choices, it indicates that fifteen-minute periods of time may be the threshold for behaviour change in motorcycle use. In comparison with Bangkok (Thailand), this duration is not so high. It is likely that motorcycle dependence makes motorcycle users have different definitions on what is an acceptable waiting time during peak hours.

It was found that traffic condition and trip chaining complexity have a higher impact on mass rapid transit choices rather than intention. However, these predictors were assumed in Stated preference questions. Although respondents received a careful explanation about the condition of mass rapid transit use, hypothetical bias may still occur. The effects of trip chaining complexity might be overestimated if respondents have prejudices on congestion and multi-chain trip. Therefore, influences of trip chaining complexity on travel intention need to be explored more.

It can be seen that the application of SEM identifies important factors contributing to MRT intention, while the Binary logit model combined with Stated preference data is appropriate for mode choice modelling. The combination of the two methods is consistent with MRT choice forecast while MRT has not yet operated in a motorcycle dependent context.

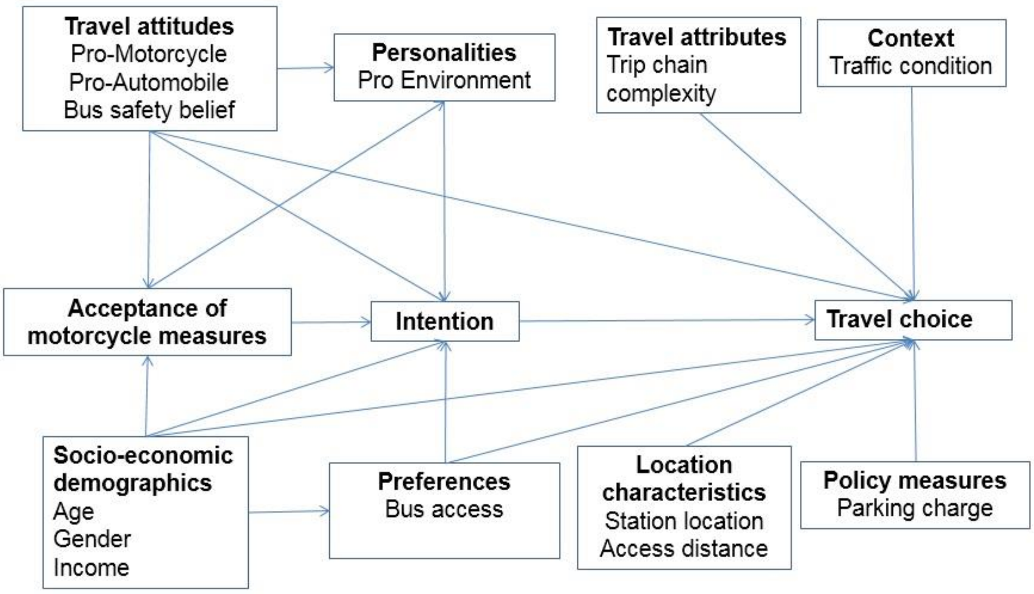


Figure 6. Conceptual framework

The results confirm that Pro-Motorcycle negatively affects MRT choices. However, the acceptance of trip chaining complexity and the concerns on traffic congestion are important predictors influencing MRT choices. The relationships among predictors, travel intentions, and travel choices are summarised in a conceptual framework (see Figure 6). This result can be used to implement transport planning policies for motorcycle dependent regions where MRT systems have not yet been constructed, and public transport services cannot meet increasing travel demand. Although data is collected in Ho Chi Minh City- a megacity, this result can be applicable for medium-sized cities that may become motorcycle dependent cities in the future.

Since motorcycle is the dominant mode of transport in Ho Chi Minh City, most of the respondents have great reliance on motorcycles in daily travel. The application of the binary logit model is appropriate since the other modes such as bus, car, motorcycle taxi, and taxi account for just a small proportion of travel demand. However, the findings must be interpreted in the context of a number of potential limitations. First, MRT systems have not been implemented in HCMC yet. Therefore, it is challenging to expect respondents to perceive the advantages and disadvantages of using MRT in data sampling process. Second, the comparison between motorcycle and other public transport modes such as bus and taxi are un-balanced. Motorcycle taxis are regarded as a personal service with high travel costs. Buses provide affordable fares, but are limited in service quality and accessibility. On the contrary, motorcycle use is always more convenient and cheaper than taking buses and motorcycle taxis. Consequently, respondents may have bias answers for many “trade-off” questions.

6. CONCLUSION

As a phenomenon of motorisation, motorcycle use becomes an important aspect of urban transport within many cities in developing countries. The popularity of motorcycle use provides opportunities for personal mobility and creates challenges for transport planning. Since MRT systems were introduced in megacities of developing countries, it is important to identify the new role of motorcycles to meet the goal of sustainable development. This study has explored factors influencing travel intention in a motorcycle-based city, in order to contribute to the integration of mass rapid transit and motorcycle use.

Although this study focuses on travel intention, the effects of intention on mode choice behaviour are also explored. Travel intention is seen as a mediating factor affecting future mass rapid transit choice. However, predictors of travel intention do not always have a correlating relationship with the actual choices made. Whether mass rapid transit systems will be implemented soon and whether motorcycle use will become a long standing habit will result in a different outcome for the role of motorcycles in cities within developing countries. Reliance on motorcycle use will negatively affect transit choices. However, the existence of mass rapid transit systems also affects the intentions of using public transport in a motorcycle-based context. It is necessary to explore travel intentions regarding the difference in time in order to verify changes in determinants of travel intentions and mode choice behaviours in motorcycle dependent cities.

While motorcycles are used as a private mode of urban transport in many cities of South and South East Asia, motorcycles are primarily utilised as public transport modes in sub-Sahara cities. It is forecasted that motorcycles will soon be used as private modes of transport, and the implementation of MRT systems will begin late in African cities. Therefore, the findings of this study may be considered for motorcycle mobility management in those cities. Further studies should focus more on travel intentions of low and high income people to provide comprehensive views. It aims to encourage motorcycle to become a part, rather than a dominant mode in the diversity of urban transport.

ACKNOWLEDGEMENT

This study was a part of the first author's dissertation at Toyo University, Japan. The authors would like to acknowledge the financial support by the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT) and the survey support of Ho Chi Minh City Department of Transportation, Vietnam.

REFERENCES

Arrington, G. & Cevero, R. (2008) Effects of TOD on housing, parking, and travel: TCRP

Bagley, M.N. & Mokhtarian, P.L.(2002) The impact of residential neighborhood type on travel behaviour: A structural equations modeling approach. *Annals Regional Science*, 36, 279–297.

Bamberg, S., Rölle, D., & Weber, C. (2003). Does habitual car use not lead to more resistance to change of travel mode? *Transportation*, 30 (1), 97-108.

Bando, T., Fukuda, D., Wicasono, A., & Wardani, L.K. (2015) Stated Preference Analysis for New Public Transport in a Medium-sized Asian City: A Case Study in Malang, Indonesia. *Journal of the Eastern Asia Society for Transportation Studies*,11, 1452-1466.

Barter, R.P. (1999) An international comparative perspective on urban transport and urban form in Pacific Asia: The challenge of rapid motorization in dense cities (Doctoral Thesis, Murdoch University). Retrieved from http://researchrepository.murdoch.edu.au/3332/1/Barter_1999.pdf

Barter, P. (2004) Transport, urban structure and 'lock-in' in the Kuala Lumpur Metropolitan Area, *International Development Planning Review*, 26 (1), 1-24.

Basu, D. & Hunt, J.D. (2012) Valuing of attributes influencing the attractiveness of suburban train service in Mumbai city: A stated preference approach, *Transportation Research Part A*, 46 (9), 1465-1476.

Beimborn, E.A., Greenwald, M.J., Jin, X., (2003) Accessibility, connectivity, and captivity: impacts on transit choice. *Transportation Research Record*, 1835, 1–9.

Bentler, P.M. (1982) Confirmatory factor analysis via non-iterative estimation. A fast inexpensive method. *Journal of Marketing Research*, 25A(5), 309-318.

Cervero, R. (2007) Transit-oriented development's ridership bonus: a product of self-selection and public policies. *Environment and Planning A*, 39, 2068–2085.

Cervero, R., & Golubb, A. (2007) Informal transport: A global perspective. *Transport Policy*, 14, 445-457.

Chang, H.L., & Lai, C.Y. (2013). Reduction of Private Vehicle Usage in Response to Fuel Price Rise: A Comparison between Automobile Drivers and Motorcycle Riders. *Journal of the Eastern Asia Society for Transportation Studies*, 10, 647-659.

Chen, C.F., & Chao, W.H. (2011). Habitual or reasoned? Using the theory of planned behaviour, technology acceptance model, and habit to examine switching intentions toward public transit. *Transportation Research Part F*, 14, 128-137.

Choocharukul,K. & Fujii, S. (2007). Psychological Factors Influencing Behavioural Intention of Private Car Use In Future Work Trips. *Journal of the Eastern Asia Society for Transportation Studies*, 7, 211-222.

Chowdhury, S., & Ceder, A. (2013) A psychological investigation on public-transport users' intention to use routes with transfers. International Journal of Transportation, 1(1),1–20.

Department of Transportation (2013) *Urban Public Transportation Development Plan toward 2025*. Consulting Centre for Transportation development, Ho Chi Minh City (in Vietnamese)

Department of Transportation (2014) *Programs for traffic congestion mitigation*, Ho Chi Minh City (in Vietnamese).

Duncan, M., & Christensenb, R.K. (2013) An analysis of park-and-ride provision at light rail stations across the US, *Transport Policy*, 25, 148-157.

Eriksson, L. & Forward, S. E. (2011). Is the intention to travel in a pro-environmental manner and the intention to use the car determined by different factors? *Transportation Research Part D*, 16, 372-376.

Fouracre, P., Dunkerley, C., & Gardner, G. (2003) Mass Rapid Transit Systems for Cities in the Developing World, *Transport Reviews*, 23 (3), 299–310.

Fu, X., & Juan, Z. (2016). Understanding public transit use behaviour: integration of the theory of planned behaviour and the customer satisfaction theory. Transportation.

Fujiwara, A., Zhang, J., Okamura, T. & Thein, S. (2003) *Analysis of Mode Choice Preferences under Changes in Travel and Socio-economic Environments in Yangon City based on Stated Preference*. Proceedings of Infrastructure Planning, Japan Society of Civil Engineering 28 (CD-ROM)

Handy, S.L., Cao, X.Y., & Mokhtarian, P.L. (2005) Correlation or causality between the built environment and travel behaviour? Evidence from Northern California. *Transport Research Part D*, 10, 427-444.

Hsiao, C.H., & Yang C. (2010). Predicting the travel intention to take high speed rail among college students. *Transportation Research Part F*, 13, 277-287.
Hayashi, Y., Anurakamonkul, K., Okuda, T., Osman, O., & Nakamura, H. (1998) Examining the Effects of a Mass Rapid Transit System on Easing Traffic Congestion in Auto-dependent Bangkok. *Regional Development Studies:UNCRD*, 4, 65-85.
Hoang Tung, N., Kojima, A. & Kibota, H. (2015). Travellers' Motivations to Use Public Transportation: A Changing Strength of Pro-environmental Motivation in Deciding Bus Use Intention. *Journal of the Eastern Asia Society for Transportation Studies*, 11, 1522-1534.
Javid, M.A (2012) A study on commuter’s preferences and satisfaction with urban public transportation: A case of para-transit service in Lahore, Pakistan. *Journal of International City Planning*, 225-236.
Javid, M.A., Okamura, T., Nakamura, F., Tanaka, S. and Wang, R. (2013) Factors Influencing the Acceptability of Travel Demand Management (TDM) Policies in Lahore: Application of Behavioural Theories, 11, 447-466
Jayme, J.L. & Chalermpong, S. (2013) Travel Behaviour of Condominium Residents near Urban Rail Transit Stations: Case of Metro Manila. *Proceeding of the Eastern Asia Society for Transportation Studies*, 9.
Jimene, N.R. & Villoria, O.G. (1997) Predicting the impact of the EDSA mass rail transit on the mode choice behaviour of car users for work trip. *Journal of the Eastem Asia Society for Transportation Studies*, 2(4), 1123-1142.
Kamruzzaman, M., Baker, D., Washington, S., & Turrell, G. (2013) Residential dissonance and mode choice. *Journal of Transport Geography*, 33, 12-28.
Kerr, A., Lennon, A., & Watson, B. (2010). The call of the road: factors predicting students’ car travelling intentions and behaviour. *Transportation*, 37,1–13.
Koizumi, Y., Nishimiya, N. & Kaneko, M. (2013) Urban transportation Characteristics and Urban Mass Transit Introduction in the Cities of Developing countries. *Journal of the Eastern Asia Society for Transportation Studies*, 10, 81-99.
Le Quan, H. & Okamura, T. (2015) Influences of Motorcycle Use on Travel Intentions in Developing Countries: A Case of Ho Chi Minh City, Vietnam. *Journal of the Eastern Asia Society for Transportation Studies*, 11, 1555-1574
Le Quan, H. & Okamura, T. (2016) Analyzing behavioural intentions in new residential developments of motorcycle dependent cities: A case of Ho Chi Minh City, Vietnam. *14th World Conference on Transport Research*, July 19-16, 2016, Shanghai, China.
Lindsey, M., Schofer, J.L., Durango-Cohen, P. & Gray, K.A., (2010) Relationship between proximity to transit and ridership for journey-to-work trips in Chicago. *Transportation Research Part A*, 44, 697–709.
Litman, T. (2008) Valuing Transit Service Quality Improvement. Victoria Transport Planning Institute. Retrieved from http://www.vtpi.org/traveltime.pdf
Marsh, H.W., & Hocevar, D. (1985) Application of confirmatory factor analysis to the 121 study of self-concept: First- and higher-order factor models and their invariance across groups. *Psychological Bulletin*, 97, 562–582.
Menard, S. (2011). Standards for standardized logistic regression coefficients. *Social Forces*, 89(4), 1409-1428
Ministry of Transportation (2013) Master Plan toward 2020 and vision after 2025. Tedi South Co, Ho Chi Minh City (in Vietnamese).
Nordlund, A. & Westin, K. (2013). Influence of values, beliefs, and age on intention to travel by a new railway line under construction in northern Sweden. *Transportation Research Part A*, 48-95.

Okada, H., Doi, K., Gaabucayan, M., & Hosomi, A. (2003) Quantification of passengers' preference for improvement of railway stations considering human latent traits: A case study in Metro Manila. *Journal of the Eastern Asia Society for Transportation Studies*, 5, 1408-1421.

Okamura, T., Kaneko, Y., Nakamura, F., Tanaka, S., & Wang, R. (2013) Passengers' Attitudes to the Service items of Jeepneys in Metro Manila by Different Lifestyles. *Journal of the Eastern Asia Society for Transportation Studies*, 9, 1384-1395.

Pickup, L., Town, S.W. (1983) *Commuting patterns in Europe: an overview of the literature*. (TRRL Supplementary Report 796). Berkshire: Transport and Road Research Laboratory.

Rizzi, L.I. & Ortúzar, J.D. (2003). Stated preference in the valuation of interurban road safety, *Accident Analysis & Prevention*, 35, 9-22.

Sanit, P., Nakamura, F., Okamura,T. & Wang, R. (2012) Evaluating Transit-Oriented Development along Urban Railway in Bangkok, Thailand. *Journal of International City Planning*, 111-123.

Sanit, P., Nakamura, F., Tanaka, S.& Wang, R. (2013) Location and Mode Choice Decision Mechanism Analysis of Multi-Worker Household in Bangkok, Thailand. *Journal of the Eastern Asia Society for Transportation Studies*, 13, 1243-1257.

Sanit, P., Nakamura, F., Tanaka, S., Wang, R (2014) Analysis of Location Choice Behavior and Urban Railway Commuting of Bangkok's Households. *Urban and Regional Planning Review Journal*, 1, 1-17.

Satiennam, T., Jaensirisak, S., Satiennam, W., & Detdamrong (2013) Potentials for Modal Shift towards Bus Rapid Transit (BRT) in an Asian Developing City. *Proceeding of the Eastern Asia Society for Transportation Studies*, 9.

Sivakumar, T., Okamura, T., & Nakamura, F. (2007) A systematic approach for questionnaire design on new transit system implementation in developing countries. *Journal of the Eastern Asia Society for Transportation Studies*, 7, 1664-1679.

Tangphaisankun, A., Nakamura, F. & Okamura, T. (2009) Influences of Paratransit as A Feeder of Mass Transit System in Developing Countries Based on Commuter Satisfaction. *Journal of the Eastern Asia Society for Transportation Studies*, 8, 1341-1356.

Tangphaisankun, A., Osada, C., Okamura, T. & Nakamura, F. (2011) Influences of Commuters' Personality and Preferences on Travel Intention in Developing Countries: A case of Bangkok. *Journal of the Eastern Asia Society for Transportation Studies*, 9, 370-381.

Van, H.T. & Fujii, S. (2009), Psychological Determinants of the Intention to use the bus in Ho Chi Minh City. *Journal of Public Transportation*, 12(1), 97-110.

Wibowo, S.S., & Chalermpong, S. (2010) Characteristics of Mode Choice within Mass Transit Catchments Area. *Journal of the Eastern Asia Society for Transportation Studies*, 8, 1261-1274.