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Reasons Why Buses and Trains Are and Are Not Being Used More Extensively as Travel Mode in Malaysia*

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Abstract: The rise in population and motorization, however, has led to an increase in road traffic accidents. A shift away from car driving towards other safer modes is essential to reduce the number of road fatalities among car users. A cross-sectional survey among bus, car and train users were conducted to analyzes travelers' choice behavior in Malaysia. This study sought to identify the factors preventing own transport users from shifting to public transport and to develop model shift from car to public transport in order to formulate the policies to achieve this. A survey was carried out on users of private and public (both bus and urban train transport) using the Stated Preference (SP) and Revealed Preference (RP) techniques (n = 1200). A Multinomial logit models were developed for the three alternative modes, Car, Bus and Train. This study found that the most important variables found likely to encourage the use of public transport were higher parking charges, reduced travel time and subsidized fares. As expected, for the commuter to switch to public transport he would have to be incentivated to do so.

Key words: Public transport policy, traveler attitudes and perception, logit model and SP and RP

INTRODUCTION

In Malaysia, the car, due to its inexpensive cost, has been a popular mode of transport in developing countries. Consequently, casualties among car users constitute a high portion of total fatalities in these countries. Increasing car users involvement in accidents and casnalties has prompted the Malaysian government to undertake various studies to address this problem One of these studies was the shift of transportation mode from private car to public transportation (Bus and Train) in Malaysia (Riza, 2004). The study targeted to evaluate policies and strategies than can help to formulate, model shift of transportation mode from private car to public transportation in Malaysia, to formulate the modeling of possible model shift from private car to public transportation and to predict the future model shift. The current study is a part of the research that has focused on model shift initiatives. These initiatives focused on shifting car users to safer modes of transport in order to increase road safety and enhance road environment.

The measures to shift transport from private to public have been studied in many cities and insurmountable problems have nearly always surfaced. One is the lack of alternative modes of transport, another the cheapness of car travel. Once a car has been bought, the increased variable cost for a journey is very little, possibly even less than the fare for public transport. The car has also many other advantages, such as convenience and comfort and confers prestige on the user to boot.

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To date, Many cities have attempted to restrict the use of private cars in favour of public transport Steg (2003). Such policies exist in France (Harrison *et al*., 1998), Germany (FitzRoy and Smith, 1998), Britain (Mackett, 1994; Harrison *et al*., 1998); (Sayed Sharafuddin and Ata Khan, 2000), Netherlands (Cheung and Hoen, 1996), Romania (Marshall and McLellan, 1998), Australia (Black, 1996), Asian countries (Shimazaki *et al*., 1994; Land Transport Authority, 1996) and Canada (Schimek, 1996).

The purpose of this study is to examine the factors that influence car use and the potential of a mode shift from car to other safer modes of transport and to explore the differences in the characteristics of bus, train and car use, specifically in testing the hypotheses as to whether car users have outperformed buses and train in relation to key characteristics especially travel times and costs. A multinomial Logit model was used to identify factors that are significant in determining the choice of transport and to predict the probability of a change in bus and train ridership with respect to various travel times and cost.

MATERIALS AND METHODS

To achieve the objectives of this study, survey was carried out in the state of Kuala Lumpur city center over four months from (1 September to 1 February 2005). A survey was designed for users of three modes of transport: private car, bus and urban train (n = 1200). The SP and RP methods were adopted because of their successful previous use (Kores and Sheldon, 1988). The SP survey was designed to gather information on the choice of commuting by private and public transport (bus and train) using a series of hypothetical route choice questions.

The questionnaire was in three parts. The first contained 9 questions on general information (persoual characteristics and socio-demographic influence): age, income, convenience, trip perception and purpose, education, household size, car ownership and occupation. The second part (12 questions) was on the trip characteristics and preference for driving versus public transport, weather, comfort, satisfaction, flexibility and prestige. The last part (11 questions) asked the respondents to consider policy tools in choosing his travel mode and to choose the factors most likely to persuade him to use public transport. In the survey, the respondents were asked to reflect on their last trip. They were asked their destination, how they traveled and how much it cost. Then they were asked for another way by which they could have traveled instead had their mode of travel not been available. The answers provided the RP data. The survey also hypothetically varied the public transport fares for the respondents' current and alternative modes of travel under a series of pricing scenarios and asked what they would have done in each situation. The responses were recorded - as the mode of transport they would have used and the fare they would have liked to pay - for the SP data. The questiounaire took about 20 min to answer. A face-to-face approach was used, on 100 each of drivers and bus and rail transport users. The survey was carried in a selected corridor in Kuala Lumpur city center where there was high car ownership and use and public transport (bus and rail) available.

A Multinomial logit model was developed for three alternatives namely, bus, train and car, with the aim of comparing the utility of these travel modes and to identify the factors that would influence car users to move from traveling by car to choosing the public transport alternative. In these models, the dependent variable was 0 if the commuters' traveled by car and 1 for bus use and 2 if the commuters traveled by train. The explanatory variables were: age, gender, income, travel time, travel cost, some of the explanatory variables such as age, income per month and gender were categorized. For instance, the income was categorized as; <RM 1000, RM 1001-2000, RM2001-3000, RM 3001-4000, >4001 (1USD = RM3.65) while gender was categorized as 0 for male and 1 for female. Age was also categorized as; 16-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55 and >56.

RESULTS

Estimation of Multinomial Logit Model

In order to test the significance of the contribution of demographic, socio-economic and mode attribute variables in explaining mode choice behavior, the multinomial logit work mode choice model was estimated. The model constituted demographic, socio-economic characteristics and mode attributes. Travel time and travel cost represented mode related attributes and were specified as generic variables in the utility specification. Age, income and gender are represented demographic and socio-economic variables. The analysis concentrated on the mode choice decision for people who used car, bus and train and the variables that explained their mode choice behavior. The result of the multinomial logit for mode choice for all trips on the factors thought to influence the travel mode, mode attributes, demographic and socio-economic variables is seen in Table 1. The coefficients were estimated using the maximum likelihood method.

The Model examined the influential attributes for car users and bus users relative to train use. In this case, the utility of the car had been set to zero as the base alternative. The estimated results were provided in Table 1. It was found that the estimated coefficient on travel time and travel cost for bus and train modes were significant. The negative signs of coefficients indicated that the increase in bus and train travel time and travel cost were likely to increase the probability of bus and train users shifting to car. For the demographic and socio-economic variables, the income coefficient of the bus and train users was negative indicating that an increase in bus and train user's income is likely to decrease utility of bus and train use.

Findings on interpreting the logit coefficients for the categorical variable are consistent with our expectation of mode choice. For the gender factor, the model estimation suggests that females are more likely to prefer car rather than bus and train use. If the traveler is a male, the odds of selecting car will decrease by 6.6 times compared to female for bus users, If the traveler is a male, the odds of selecting car will decrease by 1.4 times compared to female for train users. For the age factor, elderly people were more likely to use the bus and train opposed to car. The odds ratio increases about 3 times for older people compared with the younger bus riders; the odds ratio increases about 1.6 times for older people compared with the younger train riders.

Table 1: Estimation Results for Multinomial Mode Choice Model (n = 1200)

Mode of transport (a)		B	t-tests	df	p-value.	Odds ratio
Bus (Choice of bus relative to car)	Intercept	-0.5	0.078	1	0.000	
	Age	1.111	0.043	1	0.000	3.037
	Gender	1.888	0.000	1	0.013	6.606
	Travel time	-0.16	-0.456	1	0.000	0.852
	Travel cost	-0.052	-0.540	1	0.026	0.949
	Income	-0.717	-0.003	1	0.005	0.488
Train (Choice of train relative to car)	Intercept	-4.5	1.239	1	0.000	
	Age	0.452	0.000	1	0.000	1.571
	Gender	0.326	0.000	1	0.001	1.385
	Travel time	-0.2	0.129	1	0.000	.818
	Travel cost	-0.432	-0.569	1	0.000	0.649
	Income	-0.555	-1.850	1	0.001	0.574

Table 2: Predicted vs. Observed outcomes (n = 1200)

	Predicted			
Observed	Train	Bus	Car	Percent correct
Train	188	47	14	75.5
Bus	47	239	2	83.0
Car	9	1	653	98.5
Overall percentage	20.3	23.9	55.8	90.0

The model has R square values of 0.8, which indicate that the independent variables explain about 80% the amount of the variation in the dependent variable. Classification matrices were calculated to assess the fit of the model to the data. It was found that the model correctly classified about 98.5% of car cases while for bus and train modes, it classified about 83.0 and 75.5% cases, respectively. Accuracy of prediction was 90.0% (Table 2).

The Model chi-square value in the table assesses the overall significance of the logit model. It is computed as -2LL for the null model with only constants used as explanatory variable minus -2LL for the fully specified model. the model coefficients are significant (Sig.<0.05), rejecting the null hypothesis that knowing the independents makes no difference in predicting the dependent variable. -2 Log Likelihood (-2LL) measures how well the model fits the data, also called the deviance. It is based on the squared differences between the observed and predicted probabilities. The -2LL statistics is called the goodness of fit test in SPSS. A well-fitting model will show a large observed significance level (greater than 0.05). That is indeed the case in our analysis, all the p values (Sig.) are insignificant (1.000>0.05), which confirms that the fit of the model is good. Since -2LL reflects the prediction deviation (error) associated with the model.

Probability Prediction

The mode share probabilities categorized by various levels of travel time are shown in Fig. 1. Mode choice probabilities ranged from 97% likelihood of car use with current bus total travel time per trip (50 min) to 17% likelihood of car use with a reduction in bus total travel time per trip (5 min). At the same time, the probability of bus ridership increased from 3% with current bus total travel time of (50 min) to 83% of likelihood with a 5 min reduction in bus total travel time per trip. A 50:50 split may be achieved when the travel time are set at 17 min per trip for bus travel.

As shown in Fig. 2, Mode choice probabilities for travel cost ranged from 90% likelihood of car use with current bus total travel cost (RM = 50) to 62% likelihood of car use with a reduction in weekly bus total travel cost (RM = 5). At the same time, the probability of bus ridership increased from 10% with current bus total travel cost of (RM = 50) to 38% of likelihood with a (RM = 5) reduction in weekly bus total travel cost.

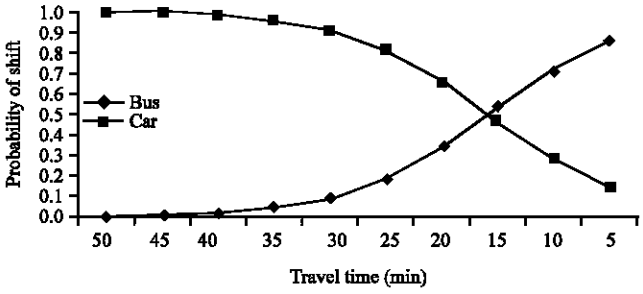

Fig. 1: Effect of bus travel time reduction on car users mode choice probability

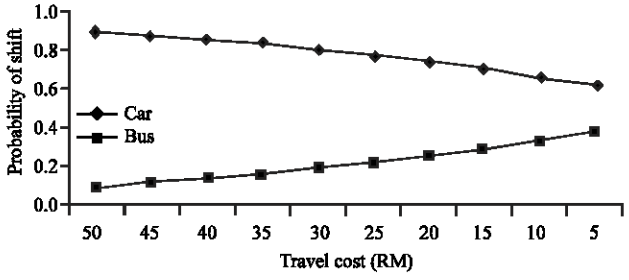

Fig. 2: Effect of bus travel cost reduction on car users mode choice probability

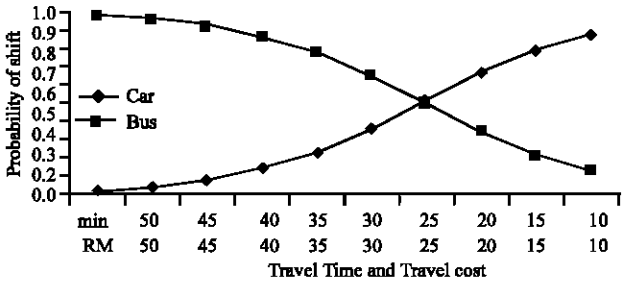

Fig. 3: Effect of bus weekly travel cost and travel time per trip reduction on car users mode choice probability

Table 3: Effect of train weekly travel cost and travel time per trip reduction on car users mode choice probability

Train travel time (min)	Train travel cost (RM)	Probability of shift to car (%)	Probability of shift to train (%)
50	60	63	37
45	55	58	42
40	50	50	50
35	45	47	53
30	40	42	58
25	35	37	63
20	30	32	68
15	25	28	78
10	20	25	75

At the same time the mode share probabilities categorized by various levels of travel time and travel cost are shown in Fig. 3. Mode choice probabilities ranged from 97% likelihood of car use with current bus total travel time and current weekly travel costs (50 min and RM = 50) to 13% likelihood of car use with a reduction in weekly bus total travel cost and travel time (10 min, RM = 10). At the same time, the probability of bus ridership increased from 3% with current bus total travel time and weekly travel cost of (50 min, RM 50) to 87% of likelihood with a RM10 and 10 min reduction in weekly bus total travel cost and travel time. A 50:50 split may be achieved when the travel cost and time are set at RM25 per week and 25 min per trip for bus travel. Thus, by promoting the appropriate policy, in relation to travel time and cost, one could provide opportunities for mode shifts among car users, which in return, will reduce their exposure and therefore the risk of injury.

For the train commuters, the mode share probabilities categorized by various levels of travel time and travel cost are shown in Table 3. Mode choice probabilities ranged from 68% likelihood of car use with current train total travel time and current weekly travel costs (50 min and RM=60) to 25% likelihood of car use with a reduction in weekly train total travel cost and travel time (10 min, RM = 20). At the same time, the probability of train ridership increased from 32% with current train total travel time and weekly travel cost of (50 min, RM 60) to 75% of likelihood with a RM20 and 10 min reduction in weekly train total travel cost and travel time. A 50:50 split may be achieved when the travel cost and time are set at RM45 per week and 35 min per trip for bus travel.

DISCUSSION

The findings of this research can be concluded that the travel time, travel cost reduction are the contributing factors that influence the model shift from car to public transport in Malaysia. The study attempted to conduct mode choice behavior of travelers of three modes of transport namely car, train and bus and determined the trade-offs travelers make when considering choice of their mode of transport. Utility of the three modes were compared to determine the important reasons behind the choice of a particular mode and the circumstances, which might cause travelers to change their choice for the car.

In order to promote greater use of public transport, this study examined the effect on car use if total bus and train travel time and travel costs were reduced. This was understood by solving the binomial logit equation for probability using several options of travel time and cost scenarios. The results suggest that travel time and travel cost are characteristics that determine why car use is a favored modal choice. Present findings revealed that these parameters were significant in explaining mode choice behavior. For the car mode, bus and train alternative comparison, the results of model estimation revealed that, lower travel time; lower travel cost the major barriers for car users not choosing the bus mode. In order to promote greater use of public transport and less dependence on car, an efficient public transport system is clearly needed. Higher capacity transit systems, use of bus lanes, bus gates and ITS systems are among initiatives that could be implemented to improve the public transport system. The use of traffic restraint policies such as in France (Harrison *et al*., 1998), Australia (Black, 1996), Area Licensing in Singapore (Geok, 1981) or London Road Pricing (Litman, 2005) could further enhance a policy that promotes public transport; a policy that is moving towards a more sustainable transport system compared with total dependence on private vehicles.

In light of the above discussions, some reflection is necessary in relation to the modal split model for developing and newly developed countries. Although the tendency is more towards shifting to public transport, this has proven unsustainable, long-term, in the developed countries. As such, promoting a shift from car to an efficient public transport system would be advocated as a model in a sustainable transport policy in highly car-registered countries such as Malaysia. Although, in the short-term, the introduction of a comprehensive public transport system will require government infrastructure funding, such a system is sustainable and will result in higher road crash cost saving. Developing countries should not repeat the mistakes of earlier industrialized countries.

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