PREDICTING THE IMPACT OF THE EDSA MASS RAIL TRANSIT ON THE MODE CHOICE BEHAVIOR OF CAR USERS FOR WORK TRIPS

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abstract: In recent years, the problem on traffic congestion mainly caused by the increasing number of private cars is becoming more widespread and severe in Metro Manila. However, the government appears to have no significant program to restrain the increasing rate of car ownership. Transport policies are focused only on the implementation of traffic restraint measures and lately, the development of mass rail transit systems. The study therefore investigated several transport policy measures that could affect the car user's decision to switch to the EDSA Mass Rail Transit (MRT3) to determine the potential impact of the rail-based mass transit system on the mode choice behavior of car users. Based on the findings, these policy measures could effectively promote the shift of car users to mass rail transit for work trips which in turn could serve as one alternative solution to the worsening traffic congestion.

1. INTRODUCTION

Like the other big cities of developing countries, the growing number of private cars has been dominating the transport system in Metro Manila. Although private cars have accommodated much of the demand for transport, traffic counts tend to shift most of the blame for the worsening traffic congestion to its increasing number. The latest data from the Land Transportation Office (LTO) indicate that about 41.5% of vehicles concentrated in Metro Manila are private cars which has been growing at an average rate of 10% per annum. The rising number of car registrations could be traced from the improved car sales which registered a 21.1% leap in sales from 1994 to 1995. Inspite of the negative effects of the mounting car traffic on the present traffic situation, not much attention has been given to promoting policies that will limit the growth of car ownership. The policies of the government have only focused on other measures such as the Transport Demand Management (TDM) schemes that restrain car use. Apart from these, the implementation of numerous infrastructure projects such as the construction of new roads and flyovers, and the widening of existing major thoroughfares has been initiated to cope with the increasing traffic volume. These policy measures, nonetheless, seem to be insufficient in solving the traffic problems.

Cognizant of the worsening traffic problem, many sectors believe something should be done about the current trend in car ownership. However, instead of a policy restricting the growth of private vehicles in Metro Manila, the car liberalization policy has been put in-place to further promote the car industry. The signing of Memorandum Order No. 346, amending the guidelines on the Car Development Program, by Pres. Fidel V. Ramos fully liberalized the country's automotive industry. By the year 2000, 71% of the transport demand are expected to

be served by the private transport mode. By 2010, the share of the private mode vehicle trips is forecasted to further increase to about 75% of the total transport demand as opposed to 25% share of the public transport. Thus, without a strong policy that will restrain car ownership, the likelihood of a tremendous increase in the volume of cars and a more serious traffic scenario could be expected in the future.

To cope with the present and future traffic scenario, there is a need for the government to concentrate on the development and improvement of the public transport system as one option in mitigating transport problems. This is with the hope that selected improvements might promote the mode shift of a considerable number of car users to mass transit to reduce traffic congestion significantly. The government's plan to develop a network of rail-based mass transit system appears to be a very timely solution to the worsening congestion problem. It could be envisioned as the most promising and important mode of transport which could provide a good alternative for private car users especially for work trips. Moreover, it could play a role that will constrain the growth of car transport and, thus, reduce dependence on private cars.

1.1 The EDSA Mass Rail Transit

The EDSA Mass Rail Transit or MRT Line 3 (MRT3), is presently being implemented. It is part of the integrated strategy to alleviate the chronic traffic congestion experienced in Metro Manila, particularly along EDSA, the premier corridor of Metro Manila which serves as the main link to all the major business districts and residential areas. The EDSA MRT, also known as MRT3 is generally designed to cater not only to the public transport users but also to the car users since this route is one of the most congested in the city and likewise, one of the major thoroughfares with the highest volume of car traffic.

Since the solution to this traffic problem entails the development of a long- term strategy aimed at improving public transport and at the same time addressing the increasing number of private cars, Transport Demand Management (TDM) measures directed at reducing private car travel and promoting the widespread use of the EDSA MRT, were also integrated in the research.

To test the potential of the MRT3 in attracting car users, an assessment of the factors which may influence their mode switching behavior specifically for work trips was undertaken. Aside from investigating the attractiveness of the MRT3 due to its basic features and characteristics, the effects of car restraint measures to the mode switching behavior of car users to MRT3 were also examined. Several TDM measures which were taken into account include the park and ride scheme, the car restraint measure particularly the odd-even scheme and the parking control measures in terms of increased parking fees at work destinations. Hence, prediction models which are capable of accounting for these effects were developed in this research.

1.2 Objectives of the Study

The many studies of transport modal choice have shown that various factors influence the behavior and decisions of individuals in their choice of mode. Thus, in considering the potential strategies for influencing modal choice, it is important to study the different components which are likely to have an effect on choice.

The principal objective of the research, therefore, was to investigate the factors that may affect the post- MRT3 mode choice behavior of private car users for work trips along EDSA. The specific objectives include the following:

- To determine the influence of MRT3 to private car users given its basic features and characteristics.
- To assess the effectiveness of the TDM measures (i.e., park and ride scheme, parking control measures and physical car restraint measures) in influencing the switch of car users to MRT3.
- To analyze the effects of time and cost factors in influencing the mode switching behavior of car users to MRT 3.

2. DATA COLLECTION

2.1 Survey Methodology

A Stated Preference (SP) survey was undertaken. This type of survey involves asking the individuals what they would choose given one or more hypothetical scenarios (Ortuzar 1990). In this survey, the respondents were asked to choose the more preferred options between the car and MRT3 modes given the different hypothetical scenarios. The first part of the stated preference survey dealt solely with the individual's perception regarding the impact of the MRT3 features and the effects of the TDM measures on their decision to switch mode from car to MRT3. For the second part, the options were presented through the hypothetical scenarios limited to two attributes only, namely; the total travel time and total cost with four levels for each attribute. This is considering that more number of attributes would involve more combinations of attributes, increasing the number of scenarios per respondent. In view of the complexity of this experiment, the number of attributes was narrowed down to the two above-mentioned factors.

The SP interview survey was designed to capture regular work trip makers who are currently using their cars for their travel to work. The survey areas were limited to subdivisions within the vicinity of Quezon City as shown in Figure 1. Since the study focused on the EDSA corridor, the respondents selected were those presently working in the two major employment centers in Metro Manila, namely; Makati Business District and Ortigas Business Center. The household interview survey was conducted through a combined personal interview and self-administered questionnaire.

2.2 Survey Design

The survey questionnaire was designed comprising of five sections. Part I included the socio-economic characteristics of the individuals such as household, personal and job-related information. Part II dealt with the current work trip information while Part III put emphasis on the alternative mode data. Part IV focused on perceptions questions about the EDSA MRT, its basic features and services and the effects of the TDM measures.

Particular questions were designed to determine the respondent's perception regarding the influence of a) the improved features and characteristics of MRT3, b) the

park and ride scheme, c) the odd-even scheme and d) increased parking fees at work destination, in his decision to switch to MRT3.

The section dealt with the second part of the stated preference involving car to MRT3 mode switch as influenced by changes in travel time and cost. Three hypothetical scenarios were presented to the respondents and were defined in terms of two attributes namely: travel time and cost. The response elicited from the respondent takes the form of choices and preferences expressed in terms of the cost he would be willing to pay to switch to MRT3 corresponding to the reduction or increase in his current travel time by car.

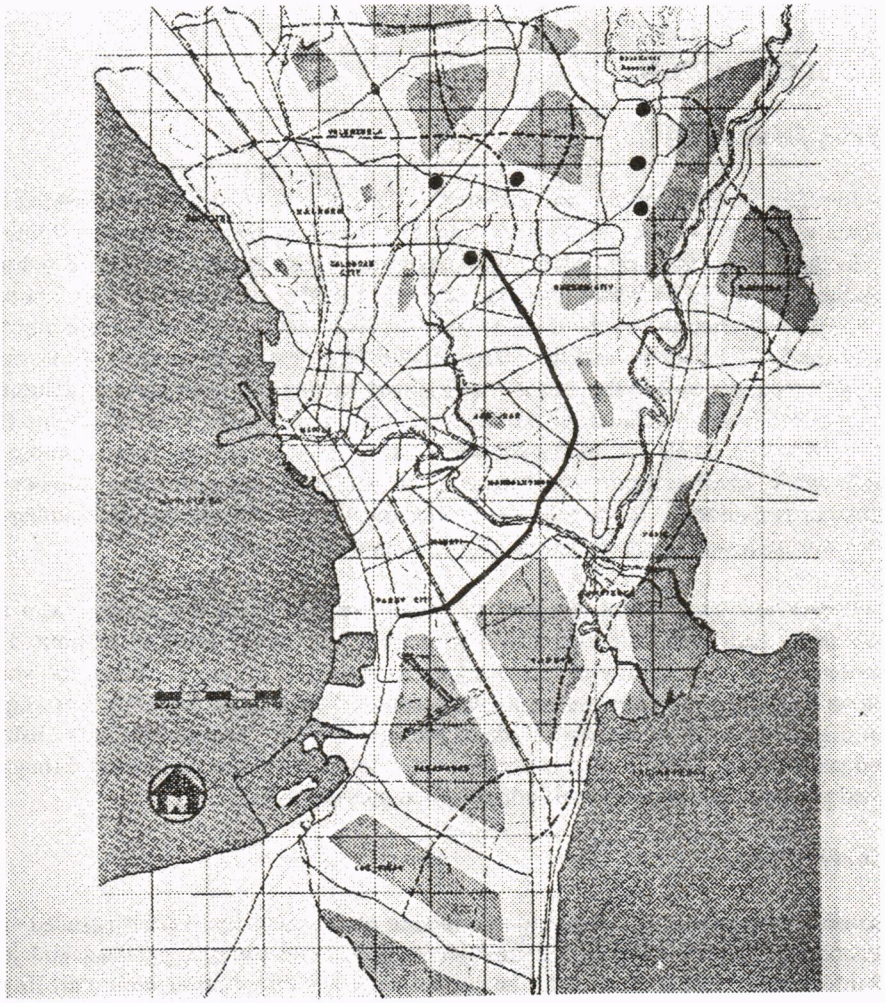

Figure 1
The Study Area

- Survey Areas
  EDSA

3. DATA RESULTS

A total of 215 samples was collected, of which about forty-six percent (46%) reside near the proposed MRT3 North Station while fifty-four percent (54%) live 5 to 10 kilometers away. About 15 of these samples were rejected due to inconsistent and missing information on the respondents, hence, only the remaining 200 samples were utilized for data processing and analysis.

3.1 Socio-economic Profile of Respondents

As expected, majority of the respondents belong to the middle and upper-middle income groups with about 86% having a combined monthly household income of P30,000 and above. The average number of working members is 2.68 while for members with driver's license, the mean is 2.51. The available cars in the household vary from one to seven cars per household with an average of 2.25 cars. This was also observed to match the mean number of working members and those with driver's license. The almost similar averages among them indicate a one car per working adult pattern.

There were more male (67%) than female respondents (33%). Most of them are in the middle age group (30 to 50 years old) and accounted to about 65% of the total number of respondents. With respect to civil status, the married respondents made up 66% of the total while those who are single comprised the remaining 34%. The distribution pattern of personal income of respondents exhibited a more or less uniform distribution very distinct from the combined household income trend, and shows a mode in the range of P30,000 to P39,000 per month.

The respondents are predominantly employees of private firms comprising about 89% of the total. The rest are government workers. Of those interviewed, 62 % are executive and managers. The remaining 36 % belong to the supervisory and rank and file positions.

3.2 Work Trip Data

Almost all the respondents own their car with only 6 and 16 % of the respondents using cars owned by the family or the company, respectively. Only about 5 % have company drivers and 13 % with family drivers.

During the time of survey, the Odd-Even scheme was being implemented as a form of car restraint measure. Under this scheme, cars with plate numbers ending in odd numbers were restricted to use EDSA from 7-9 A.M. and 5-7 P.M during Mondays, Wednesdays and Fridays. On the other hand, cars with plate numbers ending in even numbers were restricted to use EDSA from 7-9 A.M. and 5-7 P.M. during Tuesdays, Wednesdays and Saturdays. Of those interviewed, about 75 % use alternate routes in going to their respective workplaces, but not regularly. The remaining 25 % use EDSA with or without the odd-even scheme.

Majority of the respondents make more activity stops in the evening than in the morning on their way to and from work.. On their parking at work destinations, almost 72 % of the total respondents are provided with free parking spaces by their employers. Only the remaining 4 and 24 % park their cars on side-streets and pay parking, respectively. From

the survey results, it was observed that only the majority of those in the lower ranks pay for parking.

3.3 Perceptions and Stated Preferences

In this section, the respondents were asked to give their perceptions and stated preferences about the MRT3, its facilities, its level of service in terms of travel time and cost; and the influence of the TDM measures on their mode choice behavior such as the Odd-Even scheme, the Park and Ride scheme and the increased parking fee at work destinations. The most significant findings under this section is summarized in Figure 2.

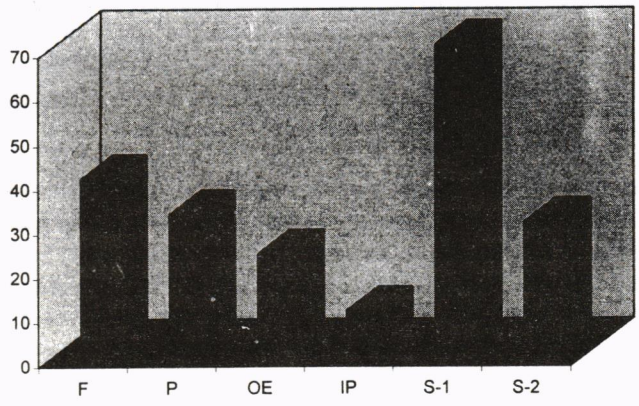

Figure 2
Likelihood of Switching to MRT3 Based on the Given Scenarios

The results show that mode switching to MRT3 can best be attained through an improved level of service in terms of a shorter travel time at a cheaper cost of travel (**S-1**). As can be inferred from the same figure, a percentage of the car users would be willing to switch to MRT3 even at a higher cost than they presently incur in exchange for a reduction in their current travel time (**S-2**). This implies that still, a considerable number of car users value time over comfort and convenience in their choice of mode.

Based on these results, the basic features and characteristics of the MRT3 (**F**) would attract more shifts from car users than the effects of the Travel Demand Mangement (TDM) measures. Among the TDM measures presented, the park and ride scheme (**P**) elicited the most number of response to mode switching, followed by the odd-even scheme (**OE**) and the increased cost of parking at work destinations (**IP**). The high response to the park and ride scheme can be attributed to its being part of the features of the MRT3. The results only further affirm the observation on the car users' relative preference for policy measures that increase choices over those that give restrictions. The statistics show that there is not much difference in the respondents' travel time during days of restricted and unrestricted use of EDSA. Aside from behavioral reasons, this

could also explain the very low percentage of possible diversion from car to MRT3 due to the odd-even scheme.

Only 10% of car users would be affected by any increase in the cost of parking at work destinations. The low turn-out could be explained by the fact that only 25% of the total respondents pay for parking. The rest are provided with free parking space by their employers.

4. CONCEPTUAL AND MODELING FRAMEWORK OF THE STUDY

Traditionally, transport policy has been primarily concerned with measures to respond to private car demands. In recent years, however, new, balanced approaches have been considered which no longer imply reliance on private car as the vehicle for urban passenger transport, and which may contribute to the development of effective and acceptable policies for other transport modes, particularly public transport (OECD Road Research 1980). At present, government efforts are focused on improving the quality and scale of public transport services to elicit the patronage not only of the general riding public but of the more affluent section of society who are privileged of owning one or more cars.

Attempts at improving the public transport system in Metro Manila are now being taken into account through the planned mass rail transit network. For one, the EDSA MRT improvements have been so designed as to provide reliable, comfortable and economical transportation that passengers will accept and appreciate and these include the car-owning populace who are well known for their high preference for a comfortable and convenient means of transport. The policy of promoting the widespread use of public transport through the EDSA MRT system ushers in the shift from a car-dependent system to a mass rail-based transport system that is made possible by the *public and current political emphasis on increasing choice rather than restricting behavior (*Jones 1992).

However, past experience suggests that without a carrot and stick approach (i.e. new options plus restraints) there will not be a substantial shift to public transport. It is evident from researches that the only acceptable solution to traffic problems is to adopt a comprehensive package approach, which contains a mixture of restraint and transport improvements (Jones 1992). In the same way, shifting from car use to rail transport can be carried out through this approach.

4.1 Modeling Framework

To explain the above concept, a modeling framework shown in Figure 3 was developed. The framework suggests that the individual car user's decision to switch to MRT3 can be influenced by the attractiveness of the mode itself through its improved level of service in terms of a faster travel and reasonable fare, together with the improvement of its planned features and built-in characteristics. The simultaneous implementation of other TDM measures likewise, may have an effect on the mode choice behavior of car users by encouraging a switch to this mode.

The response of the individual car user to the different scenarios will however depend on his household and individual characteristics, his job characteristics, and his current work trip

characteristics together with the perceived commuting trip attributes by MRT3. Based on the foregoing, the research attempted to develop models to explain and predict the mode choice behavior of car users given the TDM measures such as the park and ride scheme and the car restraint measures in terms of the odd-even scheme and increased parking costs, the improvement in the alternative modes of transportation which in this case is shown in the planned features of MRT3, and the changes in travel time and cost.

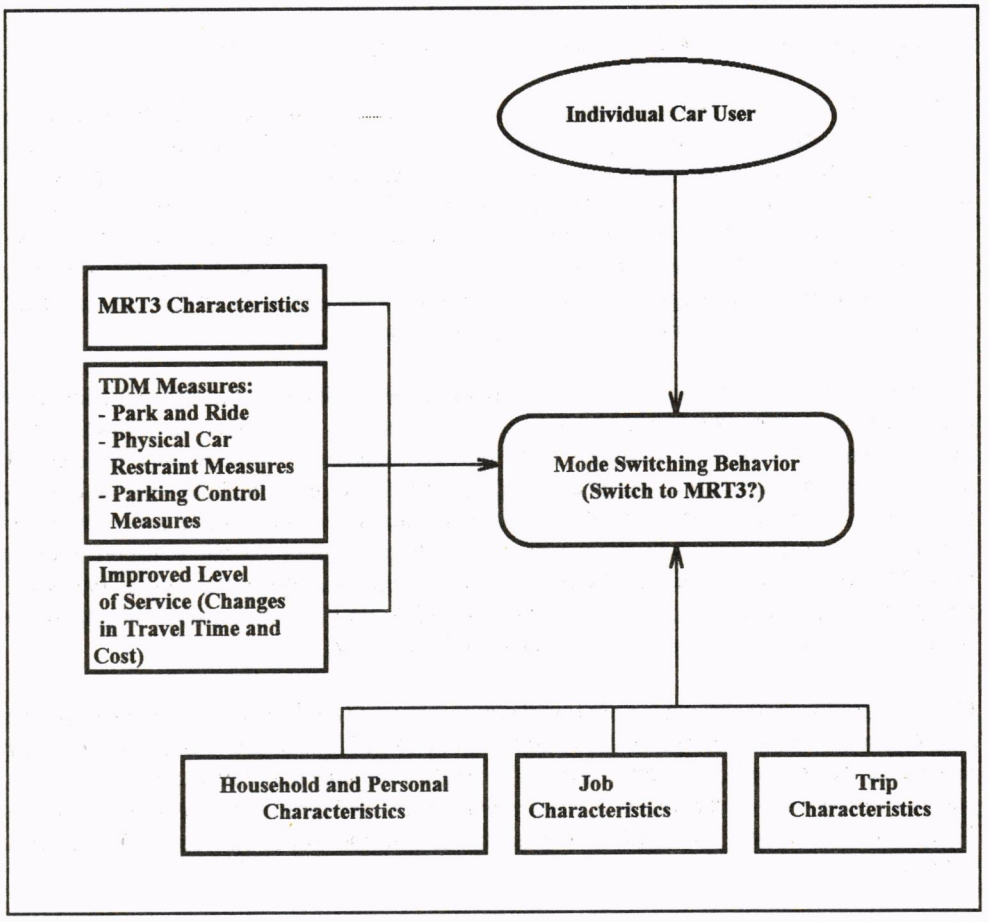

Figure 3
Modeling Framework

4.2 Hypotheses

Based on the modelling framework, the following hypotheses were formulated:

- The planned features of MRT3 and its improved level of service will have an impact on the switching behavior of car users to this mode.

- The Travel Demand Measures (i.e., odd-even scheme, park and ride scheme and increased parking costs at work destinations) will have an effect on the mode switching behavior of car users for work trips.

- The decision of the individual car user to switch to MRT3 as induced by the TDM measures and the characteristics of MRT3 will depend on the following factors:
  - ◊ Socio-economic characteristics of the individual car user which include his household , personal and job characteristics
  - ◊ Work trip attributes including total travel time and total cost
  - ◊ Distance of residence from the MRT3 stations

4.3 Modeling Approach

The decision of the car users to switch to MRT3 was investigated by adopting the disaggregate modeling approach. This approach makes use of the discrete choice analysis where the unit of analysis is the individual, which in this case, is the individual car user. The discrete choice models developed described the car user's decision to switch mode given the attractiveness of the new mode and the effects of the TDM measures. The probability of switching to MRT3 was seen as a function of his socio-economic characteristics and the characteristics of the two options: car and MRT3.

4.4 Model Calibration

Since the MRT3 is a new mode, the model calibration made use of the stated preference data derived from the stated preference survey, apart from the individual car user's characteristics and the attributes of his current mode. Five models were calibrated corresponding to the five responses of the individual car user on the different hypothetical scenarios presented him.

- The first model modeling process was intended to ascertain the most relevant factors that would affect the car user's decision to switch to MRT3 given its features and characteristics.
- The second model calibration was carried out to determine the most significant factors that would influence the decision of a car user to shift mode as motivated by the park and ride scheme.
- The third model was calibrated with the aim of finding out the most relevant factors that would exert significant effects on the decision of car users to switch from car to MRT3 as induced by the odd-even scheme.
- The fourth model calibration was undertaken to verify the factors that would be significant in the decision-making process of an individual car user as effected by the increased cost of parking at work destinations.

The last modeling process was designed to come up with a model that would describe the factors exerting significant associations with the car user's stated preferences given various hypothetical scenarios involving changes in travel time and cost.

5. ANALYZING THE CAR USER'S MODE SWITCHING BEHAVIOR

5.1 Model Specification

A binary logit model was specified in the model estimation. The decision of the individual car user takes the form of binary choices of whether to switch to MRT3 or not given the different hypothetical scenarios. In the modeling process, two mode alternatives were considered, car as the current mode and the MRT3 as the future alternative mode. For the five calibrated models, the independent variables specified in the models include the socio-economic attributes respondents (household, personal, job attributes), current work trip attributes and jpb attributes, while the dependent variables are briefly described below. This takes the value of 1 if respondent will most likely switch and 0 otherwise.

- *Model 1*: Response of individual car user to mode switching as influenced by the attractiveness of the MRT3 features and characteristics.
- *Model 2*: Response of individual car user to mode switching as motivated by the park and ride scheme.
- *Model 3*: Response of individual car user to mode switching as induced by the odd-even scheme
- *Model 4*: Response of individual car user to mode switching as effected by the increased cost of parking at work destinations.
- *Model 5*: Response of individual car user to mode switching as influenced by changes in travel time and cost.

5.2 Model Estimation

The model estimation was done using the SAS (Statistical Analysis System) Software Version 6.0, specifically the SAS Logistic Procedure. This procedure fits linear logistic regression models for binary or ordinal response data by the method of maximum likelihood The Logistic regression analysis is often used to investigate the relationship between the response probability of the response variable and the explanatory variables.The list of variables specified in the model estimation is presented in Table 1.

5.3 Results of Model Estimation

The results of model estimation are summarized in Table 2.

5.3.1 Model 1 (Response as influenced by the attractiveness of the features of MRT3)

For the model estimation of Model 1, 200 observations were utilized. The resulting model takes the form of:

$$R = 1.041 - 0.3128 * CAR + 1.2123 * AGE1 - 0.3639 * CDY + 0.7272 * SEX1 - 1.0751 * CSTAT1 - 0.868 * HINC4 + 0.7240 * WSCHED2 + 0.7902 * FLEX1$$

Model 1 stresses the importance of safety, convenience and reliability on the mode switching decision of car users to MRT3. One important aspect that would attract a car user to MRT3 is their perception of the time they would save through this mode. As can

be noted in the model, only the male (SEX1) and the younger set of respondents (AGE1) would have a tendency to be attracted to the basic features of the MRT3. The model implies that except for the younger males who value time more than comfort or safety, the rest of the car users would not be attracted to the mode on the aspect of time savings alone. Apparently, there are still groups of car users such as the female and the older counterparts who value safety and convenience over other factors in their decision to switch mode. The model also shows the importance of the mode's reliability on the mode choice behavior of car users. Only those with flexible time (FLEX1) would be attracted to the MRT3. This implies that among those who have strict work time arrival requirements, there is still this perception of the car mode having more flexibility. The model further suggests that no matter how good the features of MRT3 would be, there will still be those who would remain captive to the car mode on the basis of social standing (HINC4). Moreover, those having multiple cars (CAR) and who used their cars often would have no tendency to shift to MRT3.

Table 1
Lists of Variables Specified for the Model Estimation

Variable	Description	Variable	Description
Household Attributes		**Job Related Attributes**	
HSIZE	Household Size	WSCHED1	Decides own work schedule
WA	Working Adults	WSCHED2	Company decides work schedule
DL	Members with Driver's License	FLEX1	Company observes flexi–time
CAR	Available cars in Household	FLEX2	Company does not observe flexi–time
HINC	Combined Household Income		
HINC1	below P15,000	**Current Work Trip Attributes**	
HINC2	P15,000–P29,999		
HINC3	P30,000–P59,999	CDY	No. of days traveling by car
HINC4	P60,000 and over	OWC1	Personally–owned car
Personal Attributes		OWC2	Company car
		OWC3	Family car
SEX1	male	DOC1	Drive to work personally
SEX2	female	DOC2	With company driver
AGE	age	DOC3	With family driver
AGE1	below 30 yrs.	AR1	Use alternate routes
AGE2	30 – 39 yrs.	AR2	Do not use alternate routes
AGE3	40 – 49 yrs.	TTAM1	A.M. travel time (non–restricted days)
AGE4	50 – 59 yrs.	TTPM1	P.M. travel time (non–restricted days)
AGE5	60 yrs. and above	TTAM2	A.M. travel time (restricted days)
CSTAT1	Civil Status, single	TTPM2	P.M. travel time (restricted days)
CSTAT2	Civil Stattus, married	AMST1	without activity stops
PRIVATE	Employed in private sector	AMST2	with activity stops
GOVT.	Employed in the gov't. sector	COST	Total Cost (fuel+parking)
OCC1	Engineers	DST1	Short distance from station
OCC2	Architects	DST2	Long distance from station
OCC3	Lawyers	PRK1	Free parking
OCC4	Accountant	PRK2	Side–street parking
OCC5	Computer Related Profession	PRK3	Pay parking
OCC6	Researcher	AMODE1	alternative mode – BUS
OCC7	Bank Related Jobs	AMODE2	alternative mode – carpool
OCC8	Clerical Jobs	AMODE3	alternative mode – FX/taxi
OCC9	Others		
PC1	Executive and Managerial Level		
PC2	Supervisory Level		
PC3	Rank and File		

Table 2
Results of Model Estimation

Variables	Model 1	Model 2	Model 3	Model 4	Model 4A	Model 5A	Model 5B
INTERCEPT	1.0401	-2.3340	-1.2797	-3.5873	-6.8965	-4.1761	-0.6858
HSIZE		-0.1409					
WA						0.2588	
CAR	-0.3128		-0.2938				
CDY	-0.3639						
HINC1							6.1246
HINC3				1.3183	2.2003		
HINC4	-0.8168						
SEX1	0.7272				4.2350		
AGE1	1.2123	-1.1507	0.8917		2.7828		
CSTAT1	-1.0751	-1.1876					
CSTAT2			0.9598				
ES1				-1.3964			
WSCHED1						0.6912	
WSCHED2	0.7240						
FLEXT1	0.7902	1.1163					
OWC1				1.6224			
OWC2			-1.5240				
DOC1		0.9246					
AMST1						0.6751	
PRK1							-1.3288
PRK3				1.6173			
DST2		0.7198					
TTAM1						-0.0727	-0.0625
COST						-0.1684	0.3468
AMODE1					2.3996		
L (β)	-98.819	-102.877	-96.446	-50.974	-17.472	-123.650	-71.886
p value	0.0001	0.0001	0.0063	0.0001	0.0003	0.0001	0.0001
ρ^2	0.1732	0.1315	0.0692	0.1882	0.3751	0.6594	0.7643
% Correct	60.0	69.3	78.3	90.5	78.9	82.6	93.6

5.3.2 Model 2 (Response as motivated by the park and ride scheme)

For Model 2, the same 200 observations were used for the model estimation with 8 observations deleted due to missing values for the response or explanatory variables. It takes the form of:

$$R = -2.3340 - 0.1409 * HSIZE + 0.0125 * TTAM1 + 1.1507 * AGE1 - 1.1876 * CSTAT1 + 1.1163 * FLEX1 + 0.9246 * DOC1 + 0.7198 * DST2$$

Model 2 shows that the park and ride facilities would have an impact on car users living at a distance from the MRT3 station (DST2) and those who drive their own car (DOC1). It is a common knowledge that not all access roads to EDSA are in good condition in terms of traffic and public transport provision. The presence therefore of the park and ride facilities would provide car users willing to take the MRT3 an easy access to the stations. The model also conveys that the decisions of car users to switch to MRT3 would depend on their activities and the necessity to travel by car. In addition, the decision of car users to park and ride would also rely on the length of time it would take traversing EDSA

(TTAM1). As the travel time along EDSA gets longer, more car users would be induced to take MRT3 and avail of the park and ride facilities. The effect of the park and ride scheme also showed a strong influence on the younger set of car users (AGE1) and those with flexible working time (FLEX1). Conversely, it would have no impact on the single individuals (CSTAT1) and households with more members (HSIZE).

5.3.3 Model 3 (Response as induced by the odd-even scheme)

The Model 3 estimation used 198 observations with 2 observations deleted due to missing values of the response or explanatory variables. The final model is expressed as:

R = -1.2797 - 0.2938 * CAR - 1.5240 * OWC2 + 0.8917 AGE1 + 0.9598 CSTAT2

The model emphasizes the importance of time on the mode choice behavior of car users. The results indicate that only those who were highly affected by the car restraint scheme in terms of longer travel time and who at the same time believed they could save time if they commute by MRT3 would be induced to switch mode because of the scheme, which in this case are those belonging to the AGE1 group (ages below 30 years old) and those who are married (CSTAT2). The model also suggests the insignificance of the scheme on car users owning more than one car (CAR) and those who uses company-owned car (OWC2).

5.3.4 Model 4 (Response as effected by increased cost of parking at work destinations - includes all observations)

For this specific scenario, two model estimations were run. The first model utilized all the data regardless of whether or not the respondents pay for parking at work destinations. The second one, on the other hand, made use only of the observations with pay parking. This was carried out to be able to come up with a model that would better explain the data considering the scenario on increased parking.

5.3.4.1 Model 4A (Response based on both with and without free parking at work destinations)

The model estimation for model 4A made use of the same data with 200 observations. For this particular model estimation, all the respondents were included regardless of whether they pay for parking at their workplaces or not. The small number of resulting variables maybe attributed to the limited number of positive responses to mode switching given the scenario of increased parking cost at the work destination. The final model takes the form of:

R = - 3.5873 - 1.3964 * ES1 + 1.6173 * PRK3 + 1.31873 * HINC3 + 1.6224 * OWC1

The model shows the relative preference of car users for the car mode as reflected by the negative intercept. The result reveals the potential impact of the parking control measure on those who pay for parking at their work destinations (PRK3), those with income of P30,000 to P59,999, and those who personally own their cars. On the other hand, car users working in the private sector (ES1) indicate a tendency to remain in their current mode. This is considering that majority of this group would not be affected by any

increase in the parking fee as most of them are provided with free parking spaces by their employers.

5.3.4.2 Model 4B (Response based only on those who pay for parking at work destinations)

The model estimation utilized 57 observations. The observations included in the model estimation are only those who pay for parking at their workplaces. The final model can be expressed as:

$$R = -6.8965 + 2.2003 * HINC3 + 4.2350 * SEX1 + 2.7828 * AGE1 + 2.3996 * AMODE1$$

All the variables have positive coefficients indicating the positive inclination of the groups concerned to switch mode. Those with household income between P30,000 to P59,999 (HINC3) would tend to be attracted to the MRT3 with the prospect of an increased parking fee at their work destinations. Similarly, the male car users (SEX1) and those with ages below 30 years old (AGE1) would have more tendency to switch to MRT3 under this scenario as compared to their counterparts. Moreover, those who take the bus as an alternative mode (AMODE1) would have a propensity to switch to MRT3 with an increase in parking fee. This is not surprising considering that between the two modes, the MRT3 is a better alternative than the bus.

Comparing the model estimation results of the two models, Model 4A and 4B, it can be noted that model 4B explains the data better. This means that for any increase in parking cost, only those who pay for parking would be influenced to switch to MRT3. This was confirmed in the results of Model 4A where the variable PRK3 which stands for those who pay for parking turned out to have the most significant effect on the model together with variable OWC1, representing those who personally own their cars.

5.3.5 Model 5 (Response influenced by the changes in travel time and cost)

For the stated preference, two model estimations were run, Models 5A and 5B. The stated preference data were used with observations of 530 for both models. No model was arrived at for the third scenario (MRT3 having a longer travel time and lower cost) because no convergence was attained owing to the very small number of positive response.

5.3.5.1 Model 5A (Scenario 1: MRT3 having shorter travel time and lower cost as compared to car)

The final model derived has five (5) explanatory variables, WA(Working Adults), WSCHED1 (Work Schedule), AMST1 (A.M. Stops), TTAM (A.M. Travel Time) and Cost (Total Cost) and can be written as:

$$R = -4.1761 + 0.2588 * WA + 0.6912 * WSCHED1 + 0.6751 * AMST1 - 0.0727 * TTAM - 0.1684 * COST$$

The model suggests that as the differences in the total travel time (TTAM) and total cost (COST) between the MRT3 and the car increases, there would be more car users who

would switch to MRT3. However, its impact would be more on those with flexible work time arrival (WSCHED1) and those who go directly to work in the morning without other activity stops (AMST1). The inclusion of the number of stops in the morning explains the captivity of the respondents to the car mode. Obviously, those who travel to work by car out of necessity due to many activity stops would definitely not switch to MRT3 no matter how much the reduction in travel time and cost would be. On the whole, the model tells us that MRT3 could compete with the car mode in terms of shorter travel time and cheaper cost of travel.

To determine the trade-off between the travel time and cost, the marginal rate of substitution was derived by comparing the parameter estimates of the attributes. The result shows that the trade-off between time and cost is 2.3 which means that for every minute reduction in travel time, the car user would be willing to pay an equivalent P2.30. As an example, for 15 minutes reduction from say, 45 minutes travel time, the individual would be willing to switch to MRT3 and pay the total price of P34.50 which is also lower than the current cost he incur of say P60.00 for fuel and parking.

5.3.5.2 Model 5B ((Scenario 2: MRT3 having shorter travel time but at a higher cost as compared to car)

As in Model 5A, the travel time and cost showed a significance of 0.0001. The other other two variables which made it to the model include HINC1 (Household Income), PRK1 (Parking). The resulting model can be expressed as:

$$R = -0.6858 + 6.1246 * HINC1 - 1.3288 * PRK1 - 0.625 * TTAM + 0.3468 * COST$$

The model results show that certain groups of car users such as those belonging to the lowest income bracket would be willing to switch to MRT3 at a correspondingly higher cost in exchange for a shorter travel time (HINC1). The variable HINC1 has a positive parameter estimate showing their willingness to switch to MRT3 at a higher price they presently incur by car for a corresponding reduction in travel time. On the contrary, the scenario would have a negative impact on those provided with free parking spaces by their employers (PRK1). The model suggests that the willingness of the car users to switch to MRT3 under this condition will not be dependent on the income nor on the cost of travel for that matter. The total travel time (TTAM) and cost have negative and positive coefficients, respectively, which indicate that as the difference in travel time between the MRT3 and car mode increases, the car users would be inclined to switch to MRT3 at a correspondingly higher cost than presently incurred.

The marginal rate of substitution between travel time and cost as computed from the ratios of the parameter estimates resulted to 5.5 which indicates that for every minute of reduction in travel time, the car user would be willing to pay P5.50. This means that at this rate, which is almost 60 percent more than that under scenario 1 (P2.30), there would still be those willing to pay more for MRT3 in exchange for shorter travel time.

6. CONCLUSIONS AND RECOMMENDATIONS

With the passing years, transport problems are becoming more widespread and severe in Metro Manila. The rapidly increasing car traffic and transport demand are resulting to traffic congestion, a problem that is not likely to disappear in the near future. Mindful of the magnitude of this problem, the government sectors concerned are continually experimenting on various schemes with the hope of finding the right formula that would provide the answer to the worsening traffic congestion. Yet, unless the right policy measures get into the main root of the problem, any solution in effect would only give a short breathing space. Considering the effects of the increasing number of cars on the present traffic situation, a more likely remedy to congestion would be to de-emphasize the private car and promote the mode shift to a better public transport alternative. The development of the rail-based mass transit systems in Metro Manila is proving to be a very timely plan by the government as the rail transport is perceived as a good alternative to the car. The shift of car users to the mass rail transit therefore could be envisaged to consequently bring about a decongesting effect on the transport system.

In line with these concerns, the study attempted to establish the likelihood of the mode shift of car users from the private car mode to the rail-based mass transit system. The impact of various policy measures that would promote the mode shift of car users to the mass rail transit were investigated giving particular emphasis on work trips. The study also focused on the EDSA Mass Rail Transit which is currently on its first stage of implementation. Meanwhile, the policy measures analyzed concentrated on those which increase and restrict the choices of the individual car user. The policy measures which increase the individual's choice of transport mode gave emphasis on the public transport improvements in terms of the EDSA MRT's basic features and improved level of service. On the other hand, those that restrict the car user's choice of mode dealt with the simultaneous adoption of the Transport Demand Management (TDM) measures such as the park and ride scheme, the odd-even scheme and the increased parking charges at work destinations.

The study revealed that the mode shift of car users to the EDSA MRT or to any mass rail transit system for that matter, is attainable. On the whole, it was found that all the policy measures examined could be effective instruments in promoting the shift from the car mode to the mass rail transit for work trips. The separate investigation of measures, however, disclosed the superiority of the public transport improvements over the TDM measures in attracting a significant number of car users to the mass rail transit. As may be inferred from the results, the improvements of the MRT3 in terms of its improved level of service, its basic features and characteristics which also include the park and ride facilities proved to be the more effective strategies in effecting the shift of car users to this mode. The findings of the study also unveiled the potential of the TDM measures investigated as promising tools to influence the mode switch of car users to the rail transit mode.

Based also on the research findings, the prospect of the mass rail transit competing with the car mode could be made possible by giving special attention on: a) the safety and security aspects of its transit riders; and b) the transit's reliability in terms of a reliable service that is on time and the frequency of service especially during peak hours. Moreover, it was also found that the MRT3 could give the car a good competition through its improved level of service in terms of a faster and lower cost of travel.

The study shows that a better and improved public transport alternative like the EDSA MRT would have a significant impact on the mode choice behavior of car users for work trips. Given MRT3's improved features and level of service coupled with the simultaneous adoption of various TDM measures, the car users would, in no doubt, consider the shift to this new public transport mode. However, their decision to switch to MRT3 would depend on their socio-economic attributes, job attributes and work trip attributes. The study further suggests that with the rail-based mass transit in-place and the interest shown by the car users in switching to mass transit, there is a large potential for reducing car dependence in Metro Manila and consequently, a big possibility of solving the traffic congestion along the major roads.

6.1 Policy Recommendations

The efficacy of transportation policy decisions depends on the policies of the government governing the overall development of the urban area. However, although the government recognizes the gravity of the present transport situation in Metro Manila, its policies seem to be not too well coordinated. In most instances, it appears that transport is viewed as a separate sector to which policy priorities are specified in isolation and not as part of an overall strategy for the metropolis. Apparently, this isolation has resulted to the lack of coordination among all levels of decision-making creating several conflicts in the government's policies. What is alarming is the fact that many of these policy decisions have serious transport implications. The seemingly uncoordinated stance of the government, particularly on the issue of the rapidly increasing car ownership and its effect on the fast deteriorating traffic situation makes even more pressing the need to redefine transport policy objectives and to update the existing transport priorities. Considering the foregoing, the following points are therefore recommended:

6.1.1 Review and update of existing policies on car ownership

Of the many policy decisions of the government, its uncoordinated policies concerning car ownership have the most serious effects on the overall transport system. The standing policy on car liberalization, although beneficial to the growth of the car industry, is proving to be detrimental to the existing traffic situation in Metro Manila. While one sector of the government is persistently engaged in promoting the growth of the car ownership, other sectors, on the other hand, are tasked with the implementation of transport plans and policies which are aimed at containing and mitigating the traffic congestion caused by this increasing car traffic. Hence, with this conflicting policies between car ownership and use, and the uncontrollable rise in the number of private cars, there is a need for the government to review and reconsider its policies regarding these major concerns. To do this, the policy decisions pertaining to car ownership must not be compartmentalized by sector or by agencies to avoid transport implications resulting from opposing policies. The policy formulation must be more centralized and must involve all sectors concerned. This would enable a more thorough review of the issue on car ownership to determine (a) whether the benefits accrued from the continuous support to its promotion far outweigh the cost it imposes on the existing transport system and the society as a whole; and (b) if a strong and firm policy on the regulation of car ownership would be more beneficial in the long term. The government must also recognize that while measures that would restrain car ownership may prove to be unpopular, a strong

policy that would restrain its rapid growth is far more important to avert the impending likelihood of a more serious traffic scenario in the future.

6.1.2 Reorientation of transport policies toward the public transport improvement particularly the rail-based mass transit system

The rapidly increasing rate of car ownership, which for years has continued unabated, calls for more positive policy actions that would negate its effect on the transport system. This could be achieved by reorienting transport policies towards a better performing public transport mode that could provide a good alternative to the private transport. The improvement of the public transport system would not only provide better transportation service to individuals who have limited mobility. It would likewise enable the shift of a great proportion of private transport users to realize various objectives, foremost among them, is to reduce traffic congestion.

In the past and even up to the present, a big share of public investments is allocated to road infrastructure. The building of more roads, while essential to cope with the increasing traffic demand, tends to be biased towards those privileged of having a private transport alternative. Likewise, it has the tendency to further promote car ownership growth and encourages more car use in the city centers. This therefore, necessitates the reorientation of transport priorities to shift the balance in favor of the public transport. To this end, the government's current thrust to develop the rail-based mass transit system can be considered as timely and relevant. The mass rail transit system can be envisioned as a major factor that could improve the transport system and alleviate the existing transport problems especially congestion. The promotion of the rail transport therefore, must not only focus on the public transport users, but also on the private car users. The study has shown that this could be made possible by including provisions for public safety and security in any public transport plan. Likewise, the provision of a reliable and improved level of service comparable to the private transport should also be considered. While improvements on road infrastructure must not be totally ruled out, investments on transport must give higher priority to public transport improvements. In so doing, it would also resort to savings on investments in roads and other transport infrastructures.

6.1.3 Adoption of a comprehensive package approach that would influence the mode shift of car users to the rail-based mass transit system

In the absence of a strong policy that would restrain the growth of car ownership, one alternative solution to the traffic problems in Metro Manila is to reduce car use by attracting car users to the public transport in terms of the rail-based mass transit system. However, to realize the switch of car users to the mass transit systems, transport policies must identify and implement radical changes that will facilitate the change in attitudes and behavior of car users towards the public transport and influence their switch particularly, to the rail-based transport.

Most measures which have been intended to influence the mode choice behavior of car users, basically focus on car restraints measures. On the other hand, policies on public transport improvements, usually concentrate only on attracting public transport users. While policies that relate to car restraints undoubtedly have their role, as do policies associated with public transport improvements, each should not be taken in isolation.

They both need to complement each other to ensure their effectiveness in influencing the shift of car users to the mass rail transit. What is suggested therefore, is to adopt a comprehensive package approach encompassing all possible policy measures that could influence the mode choice behavior of car users in favor of the public transport. As explored in this research study, the policy measures in terms of public transport improvements and the Transport Demand Management measures have proven to have an impact on the switching behavior of the car users to the EDSA MRT.

With the future operation of the EDSA MRT and the other MRT lines, the implementation of transport policies focusing on the public transport improvements coupled with the simultaneous adoption of TDM measures to attract the car users to the mass rail transit is highly recommended. Building the image of the MRT3 alone in terms of improving the level of service and its basic features will not be enough, "little" restrictions through the TDM schemes will be needed to further promote the ridership to car users. Restrictions can be provided by physical car restraint measures like the odd-even scheme and the parking control measures in terms of increased parking charges at work destinations. The park and ride facilities at the major stations of the MRT3, on the other hand, can be part of the integrative strategies to reduce the necessity of bringing the car to the city centers. Through the park and ride scheme, the best mix of modes, that of the car and MRT modes can be attained. Thus with the presence of the parking facilities at major stations, the shift of car users to the MRT3 would be further supported.

6.2 Concluding Remarks

Unless the government reorient its transport policies and objectives, the private transport will continue to dominate urban transportation in Metro Manila and other fast urbanizing cities in the country. Accordingly, something must be done to mitigate, if not eliminate the negative effects of the growing numbers of cars on the present transport situation. There is a need to recognize that while the car plays a significant role in the transport system, revising the policies on car ownership would greatly benefit the society as a whole. In contrast, the public transport improvement must be prioritized to attract the shifting of car users particularly to the mass transit system. To further promote the public transport among car users, a comprehensive package approach can be adopted where public transport improvements could be supported by restrictions through the Transport Demand Management measures.

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