How Travel Pattern Changes after Number Coding Scheme as a Travel Demand Management Measure was Implemented?

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Abstract: Due to serious increase of vehicle ownership in Metro Manila, number coding scheme (NCS) was introduced as travel demand management (TDM) measure to control the use of vehicles especially during rush hours. The scheme works by employing the last digit of vehicle's plate number to restrict them from running the streets. This study seeks to investigate and explore the possible effects of NCS on commuter's travel pattern, both the use of private and public transport for daily trips. Interview survey was conducted in early 2011 to gather the pertinent data used in the analysis. From the empirical investigation, the results reveal that during number coding scheme day, when their car is banned from plying the streets, commuter would still use their car in expense of extending their total activity time – meaning car use is not necessarily reduced but shifted to other times of the day.

Keywords: number coding scheme, daily trips, travel demand management, travel pattern

1. INTRODUCTION

The hasty increase of travel demand in urban areas can be associated with economic growth. However, when transportation infrastructures remain to be limited and slow to accommodate the huge demand, applicable approaches and policies are implemented, such case is the travel demand management (TDM) measures. For instance, the number of passenger car in Metro Manila is significantly increasing (LTO, 2011). As shown in Figure 1, the increase passenger cars together with the gross domestic product (GDP) per capita apparently forced Manila Metropolitan Development Authority (MMDA) to implement and encourage the reduction of the use of private car. One of the travel demand management (TDM) application employed in Metro Manila is number coding scheme.

The number coding scheme all started when "odd-even scheme" was created (also known as MMDA Regulation No. 95-001) way back in 1995 (MMDA, 2011). The scheme works to ban private vehicles with less than three passengers that ply the restricted thoroughfares during morning and afternoon rush hours on specific days. In particular, private vehicles with low occupancy and with license plates that with odd numbers are banned on Tuesdays, Thursdays, and Saturdays. On the other hand, those with license plates that end with even numbers are banned from plying the streets on Mondays, Wednesdays, and Fridays. The rush hours are considered to be between 7:00am to 9:00am and 5:00 to 7:00pm.

In 1996, the so-called "modified odd-even scheme" was issued (MMDA Regulation 96-004) in addition to the existing odd-even scheme. The modified odd-even scheme applies to public utility vehicles such as taxis, buses, public utility jeepneys. In the same year, MMDA

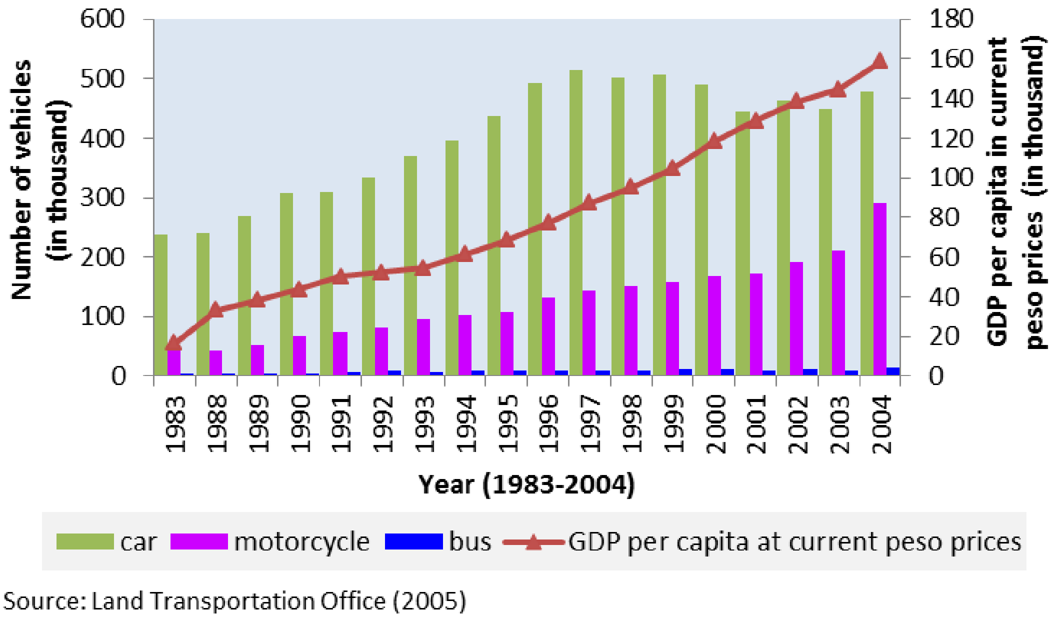

Figure 1 Comparison between GDP per capita in Metro and Volume of vehicles

adopted and promulgated entitled the "unified vehicular volume reduction program or UVVRP" (MMDA Regulation 96-005) regulating the operation of certain motor vehicles in all national, city and municipal roads in Metropolitan Manila and abolished MMDA Regulation Nos. 95-001 and 96-004. The UVVRP, firstly referred to as "color-coding", was adopted based from the previous "odd-even" scheme by the MMDA together with the Philippine National Police. Both public and private vehicles are included in this scheme, which are banned for longer hours (i.e. between 7:00am and 7pm).

With UVVRP refined, it eventually resorted to which is now known as "number coding scheme or NCS". And I would like to stress that throughout this paper number coding scheme will also be termed as NCS. The scheme banned vehicles from plying to all the streets of Metro Manila on specific days of the week 9:00am to 5:00pm based on the last digit of the plate number of each vehicle. For instance, vehicles with 1 or 2 as the last digit of their plate number are not allowed to run the streets on Mondays, while 3 or 4 are on Tuesdays, 5 or 6 are on Wednesdays, 7 or 8 on Thursdays, and 9 or 0 on Fridays. This regulation supposed to cover all roads in Metro Manila.

The original plan of the scheme was basically to use this measure in order to address congestion brought about by the many on-going road and rail infrastructure projects in the year 1990s. However, due to its perceived success in decreasing traffic along Metro Manila arterials, though no known formal study was carried out to attest its success, the implementation of the scheme was extended that eventually expanded to included public transport vehicles like buses, jeepneys, and taxis.

At some point in time, MMDA temporarily suspended the UVVRP but soon opted to restore the scheme. One of the probable reasons behind the restoration is that it was observed that the streets where clogged with heavy traffic after NCS was lifted. NCS works by banning vehicles according to the last digit of the plate number in the following schedule:

Assigned Number coding day		Car plate's last digit number
Monday	:	1 and 2
Tuesday	:	3 and 4
Wednesday	:	5 and 6
Thursday	:	7 and 8
Friday	:	9 and 0

An illustration of a public utility vehicle, in Figure 2 – a jeepney, with a plate number TYF 533 is not allowed to run the streets on Tuesdays since the last digit is 3. Other than public utility vehicles, the NCS also covers private passenger cars also.

The number coding scheme starts to ban vehicles during morning rush, i.e. by 7:00am, and is lifted by 7:00pm. Figure 3 shows the cities that observe the number coding scheme for the motorists. Cities that observe the 7am to 7pm with window hours starting from 10:00am to 3:00 in the afternoon are represented by the yellow area. Window hour was later considered which allows banned vehicles to still run but only during off-peak periods. Commonly window hours start at 10am and end at 3pm. However, there are also cities in Metro Manila that do not implement window hours (e.g., Makati, Malabon and Las Piñas) and these are the blue colored areas. Hence, the scheme is strictly implemented from 7:00am to 7:00pm in these three cities. There is only one city that starts the window hour early (by 9am) and ends late (by 4pm) and it is represented by the green colored area (Pasig).

Cities (like Parañaque, Marikina, and Muntinlupa) that totally do not implement the number coding scheme are represented by pink colored areas. In addition, a sole city (Taguig) that implements the scheme only for the national roads that lies within its boundaries and does not implement it in its internal roads is represented by the orange area. The electric blue area, which is the city of Pasay, implements the scheme to certain roads particularly those that connect the international and domestic airports.

Although the MMDA authorities claimed that about 20% of reduction on the major streets and highways due to the implementation of number coding scheme (MMDA, 2011) but no existing study that really proves this claim. Hence, this study is hoping to take the first and initial step to explore the possible effects of the scheme on travel patterns. It is, therefore, the main objective of this paper to investigate the effects number coding scheme on travel patterns.

Figure 2. Vehicles with plate number that ends with 3 are banned on Tuesdays

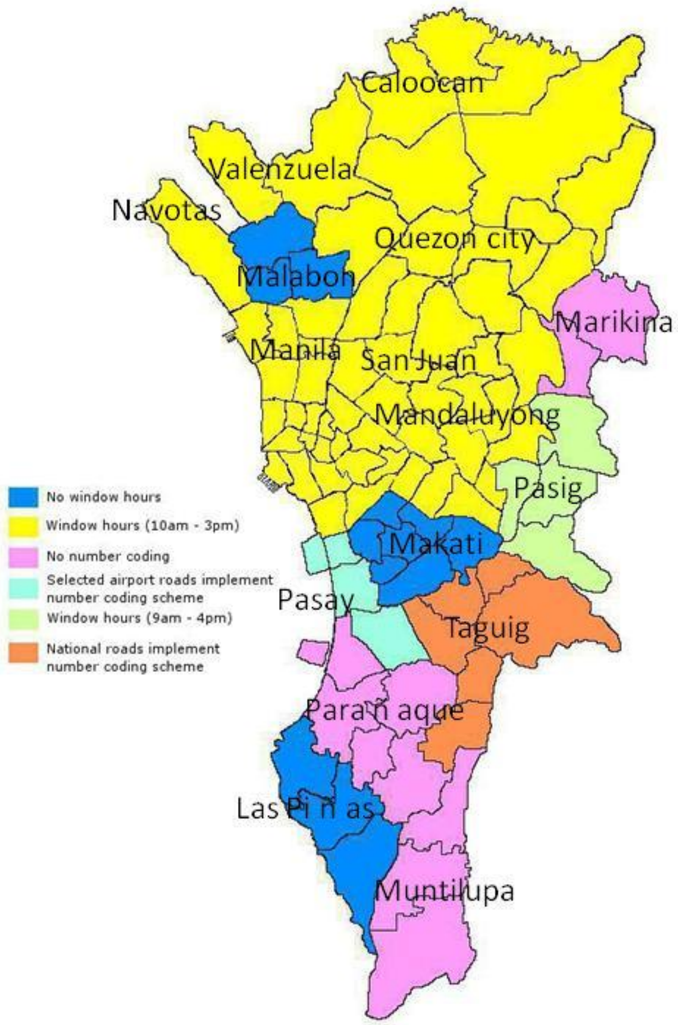

Figure 3. A thematic map of the number coding scheme in Metro Manila

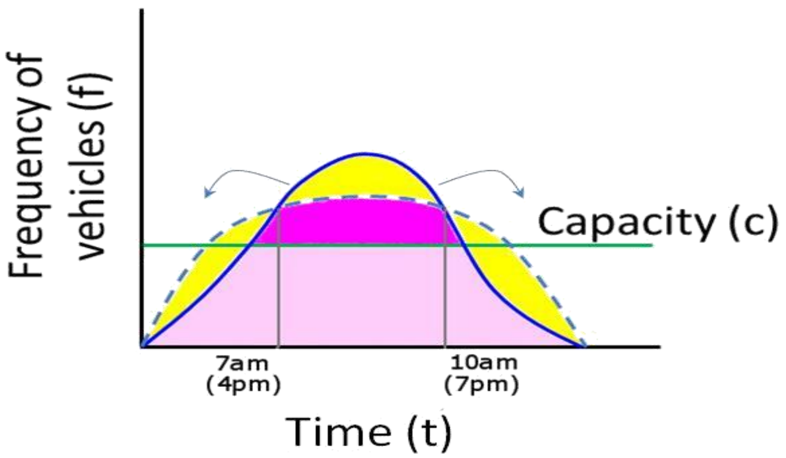

Figure 4. Hypothetical diagram by avoiding number coding scheme time frame

We hypothesized that due to the implementation of number coding scheme commuters would likely to: 1.) use public transport, and 2.) travel early for work and be late for home. Whenever commuter cannot use their car during the number coding day, commuting by the available public transport will likely be the option on their way to work. According to the study in (De Langen et al., 2004), 41% of the Metro Rail Transit (MRT) users report that their household owns a car. On the other hand, when the commuters opted not to use public transport, instead, use their car to travel for work early and be home late. As Hine and Scott (2000), revealed that at great duration both in origin and destination stages, public transport systems become increasingly unattractive, which may due to reasons of comfort and quality services. Figure 4 illustrates commuters who drive their car even during the number coding day, and that is they go to office early (before 7am) and go home late (after 7pm) in the evening .

The remainder of this paper is structured as follows. Section 2 reviews some literatures related to travel demand management measures. Section 3 explains the survey, research method and some descriptive statistics of the sample as well as the model specification. Section 4 discusses the key findings of the empirical model. Finally, Section 5 presents the conclusion and recommendations.

2. LITERATURE REVIEW

The travel demand management (TDM) strategy was designed to control demand for transportation system resources (Bhattacharjee et al, 1997; Nozick et al, 1998). TDM strategies include but not limited to car use reduction, road and parking pricing, congestion pricing, ride sharing, telecommuting and alternative work schedules. Car use reduction employed as a TDM measure found to change trip chaining as well as travel mode (Eriksson, et al., 2010). In addition, a study done by Garling et al (2000) that the household choice of car use reduction is more likely to be shopping at nearby shops and leisure trips however men tend to change to public transport mode and trip chaining than women. On the other hand, park-and-ride systems aim to minimize both congestion and parking requirements in urban centers (Parkhurst, 1995; 2000). In addition, congestion charging is becoming popular as an effective measure in reducing high levels of traffic congestion (Hensher and Puckett, 2007). Aside from minimizing congestion, it also helps drivers to switch other transport modes. Ride sharing mechanism was realized through the cooperation of the employers examples are: CARAVAN in Boston area, RIDES in San Francisco, and RIDESHARE in Los Angeles (Meyer, 1999).

Flexible work schedule is also one of the TDM strategies that enable to divert a chunk of travel demand to other times of the day. As suggested in (Brewer, 1998; Tanaboriboon, 1994; Giuliano and Golob, 1990) that peak period diversions shift travel times through staggered office hours and flexible work arrangements. Some people would also have the extended working hours which compress the number of workdays (Hung, 1996; Gannon, 1974).

On the other hand, TDM measures such as extended working hours and compressed number of workdays which was discussed in the study of Sundo and Fujii (2005) that randomly selected government employees in the university to examine compressed working week-related activity time patterns. Their results reveal that commuting times significantly declined during the compressed working week. In addition, the technology-oriented telecommuting is often suggested to be one of a series of policy measures to reduce travel demand; for example in (Mokhtarian and Salomon, 1997). In the recent study of (Padayhag et al., 2011) reveals that those who are doing much telecommuting reduces work trips while increases other types of trip (e.g., leisure or shopping trips).

Further, the city of Surabaya in Indonesia adopted and implemented the odd- even scheme as TDM measure for short term strategy, which is quite similar scheme in Metro Manila. The implementation is aimed to restrain traffic volume in some arterial roads with high vehicle density (SCG, 2001).

3. SURVEY METHOD

3.1 Overview

The dramatic increase of traffic in the streets of Metro Manila has some serious effects on air pollution, energy conservation and vehicular congestion. To minimize these adverse effects, TDM measures are implemented such as number coding scheme, which is now implemented that mainly aims to reduce the vehicular traffic plying through the thoroughfares. For this reason, a survey was carried out specifically in the cities where number coding scheme is strictly observed. At present, only three cities in Metro Manila that do not implement the number coding scheme and those participants that come from these cities were automatically filtered in the total sample.

3.2 Participants

To verify the hypothesis, a survey was conducted in the universities within Metro Manila, Philippines in March 2011. The main goal of the study is to gain information on the effects of number coding scheme by randomly selected participants who are experiencing NCS. The random selection of participants were made sure that they belong to a working class where NCS is observed, especially those who work in the business districts where NCS is strictly kept though some participants are usually a familiar contact of the surveyors. A survey was conducted and a total 350 survey sheets were disseminated to all possible contact persons in Metro Manila. During the distribution of survey questionnaires, the survey faced two challenges. First, there was a challenge of getting ample number of participants since most of them are hesitant to answer the survey questionnaire. The main reason is due to security purposes since questions in the survey like, the day the car is used, the time to leave home for work and time to leave the office for home made them skeptical to answer the survey. Second, Metro Manila has only 21% who are private car users and 79% are public transport users (LTO, 2011), which obviously means that to get an ample number of participants from one-fifth is scarce. In spite of the challenge of having ample number of survey returns, there were around 123 samples returned from the 350 survey questionnaires distributed. Subsequently, the data samples were reduced to 116, which are considered usable for analysis.

3.2 Questionnaire Design

The designed survey questionnaire was split into three sections: (1) socio-demographic attributes, (2) number coding scheme information, and (3) and patterns of travel behavior. The first part of the survey draws information on socio-demographic characteristics; for example, age, gender, civil status, number of household members, car ownership, occupation, and monthly income. The second part elicits information of NCS; like, number coding day, the use of car to go for work albeit it is banned to run on the streets due to number coding day, the time to go to work and time to go home on the day their car is banned (again, due to NCS), total distance travelled during from home to work (using their car or using public transport). The third and last part of the questionnaire is all about the patterns of travel of the participants; for example, the total frequency of daily trips per day whether on regular (meaning car is not on a coding day) or on number coding day, cost of travel using car on a regular day, cost of travel using public transport on a coding day, commute time (whether using car or public transport), and the use of public transport as alternative mode. Finally, the data were coded then cleaned and analyzed.

In the collected survey sample, approximately 72% are male, as shown in Table 1. This result is expected since male are usually dominating in numbers in terms of driving passenger cars. Further, the sample were categorized according to age group : <20, 21-29, 30-39, > 40 years old. The biggest age group is 21-29, which is about 38%, and the smallest is ages less than 20 years old (14%). Mostly, the participants are single which comprise of about 59%. The average of household size of each respondent has about 5.2 family members. Among the participants of the samples 20% are employed in the education and research sector, 53% are in the engineering and construction sector while the rest are in the business and management sector. The samples are categorized into three income groups. The last income group, which is the high income group, has the bigger frequency in the sample for about 56% of the total sample. Moreover, the collected sample has an average car ownership of 1.91 cars (with standard deviation of 1.33). The participants were also asked on the type of fuel they used and approximately 72% of the samples are using gasoline as car fuel.

As illustrated in Table 2, daily trips are grouped into three: 2 or less, 3, and 4 or more trips. Those who are making 4 or more trips comprise nearly 30% of the sample.

Table 1. Descriptive result of socio-demographic characteristics of participants (N= 116)

Socio-demographic characteristics	Frequency	Percentage (%)
Gender (male = 1)	84	72.4
Age		
Age (<20)	16	13.8
Age (21-29)	44	37.9
Age (30-39)	37	31.9
Age (>40)	19	16.4
Civil Status (single = 1, otherwise =0)	68	58.6
Household size	5.2 (M)	2.18(S.D.)
Occupation		
Education and research	23	19.83
Engineering and construction	61	52.59
Business management and others	32	27.59
Income (PhP)		
<10,000	25	21.6
10,000-29,000	26	22.4
>30,000	65	56.0
Car ownership	1.91 (M)	1.33 (S.D)
Car fuel		
Gasoline	84	72.41
Diesel	32	27.59

Note: M: mean S.D.: standard deviation

Table 2. Number coding scheme and travel information

Item	Frequency	Percentage (%)
Daily trips		
2 or less	70	60.34
3	15	12.93
4 or more	31	26.72
Number coding day		
Coding on Mondays	25	21.6
Coding on Tuesdays	20	17.2
Coding on Wednesdays	33	28.4
Coding on Thursdays	19	16.4
Coding on Fridays	19	16.4
Schedule pattern on number coding day		
Early for work –Early for home (EWEH)	6	5.2
Early for work – Late for home (EWLH)	75	64.7
Late for work – early for home (LWEH)	4	3.4
Late for work – late for home (LWLH)	31	26.7
Uses car during coding day (yes = 1)	90	77.6
Public transport captive user (public transport, PT = 1)	74	63.8
Commute time (minutes)	39.4(M)	25.77(S.D.)
Fuel cost (PhP)	240.12 (M)	355.14 (S.D.)

Note: M = mean, S.D. = standard deviation

Participants of the survey were asked about the day their car is banned for NCS in Metro Manila. Approximately 22% said that their car is banned from running the streets of Metro Manila on Mondays, 17% said their car is banned on Tuesdays, 28% on Wednesdays and 16% for both Thursdays and Fridays. In addition, according to time frame schedule of commuters, participants also reveal the time they usually go to work early as well as the time they usually go home late during NCS day when their car is banned, and it comprise of 65% who said that they travel to work early and travel home late (EWEH) when their car is on coding day. Perhaps they want to avoid getting apprehended they travel away from the time frame of NCS. A bigger percentage of 78% of the sample that said they use car during number coding day at any time of day – meaning, not only during early and late hours, most probably they used their cars during window hours especially for some cities implement NCS with window hours. About 64% of the sample indeed uses public transport (PT) as alternative mode, just in case their cars are out of service or in use for other purposes. This result will give us a perception that some commuters choose PT as their alternative mode to private car use. The average commute time for work of the sample is about 39minutes with average fuel cost of 240PhP per day (approximately 5.6US $ per day). As depicted in Figure 5, the fuel pump price (gasoline) has drastically increased from 1999 (0.40US$) up to 2004 (0.52US$ per liter), and even the fuel had increased, the number of passenger car dramatically increased in Metro Manila particularly during the 1999 – 2004 period.

For the time being, the analysis for fuel consumption is preliminary done by cross-tabulation analysis. In the Table 3, the pattern of daily travel to work is categorized and classified with the fuel consumption categories as well as with the frequency of daily trips. By doing this, it wishes to capture the change in travel pattern through change of commute time. The daily travel pattern from home to home is categorized according to: early to work- early to home (EWEH), early to work –late to home (EWLH), late to work –early to home (LWEH), and late to work-late to work (LWLH). The results revealed that those samples in the

EWLH that 57% consumed fuel greater than 10L/km. While sample in the "late to work –late to home" (LWLH) category, there are 58% that only consumed fuel <10L/km. In other words, those who opted to go to work late and be home late, which obviously avoids the NCS time frame, are likely to reduce their fuel consumption. However, this has yet to be confirmed for a more in-depth analysis.

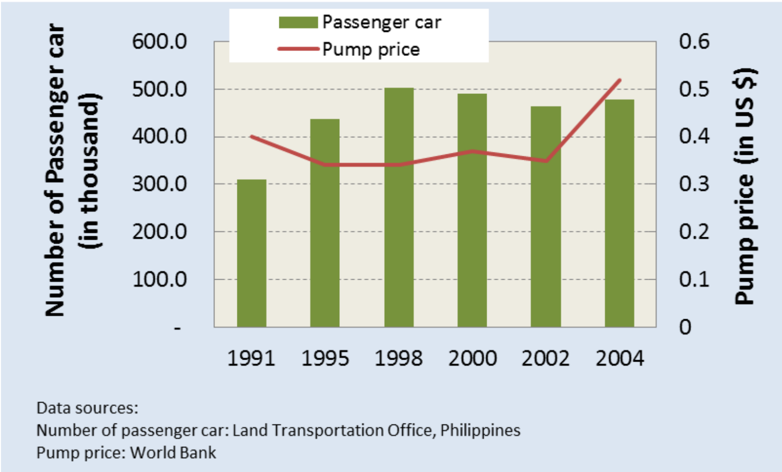

Figure 5. Passenger car versus Pump price (gasoline) in Metro Manila

Table 3. Crosstabulation Analysis

Commute schedule pattern	Fuel consumption (Liter/km)		Frequency of daily trips by category				Total
	<10	>10	1	2.00	3.00	4.00	
Early to work - Early to home	1	5	0	1	3	2	6
Early to work - Late to home	32	43	15	31	6	23	75
Late to work - Early to home	0	4	0	3	0	1	4
Late to work - Late to home	18	13	6	14	6	5	31
Total	51	65	21	49	15	31	116

Table 4. Cross-tabulation Analysis of Daily trips and Fuel consumption

		Fuel consumption (Liter/km)		Total
		<10	>10	
Daily trips by category	1.00	7	14	21
	2.00	26	23	49
	3.00	6	9	15
	4.00	12	19	31
Total		51	65	116

With reference again to Table 3, where daily travel pattern from home to work are categorized according to: early to work- early to home (EWEH), early to work –late to home (EWLH), late to work –early to home (LWEH), and late to work-late to work (LWLH). Results revealed that activity time frame of most commuters is elongated during the day when their car is banned from running due the NCS, i.e. participants avoid the time frame of NCS and that they extend their activity time by going to work early and going home late. Early for work means traveling and reaching the workplace before 7am and late to be home means leaving workplace after 7pm when NCS is already lifted.

And of the 116 sample, 65% belonged to EWLH of which 31% have at least an average of two trips in a day. This would also mean, this group of sample tend make at least two trips by making EWLH travel pattern, to avoid the NCS.

In similar cross-tabulation analysis, Table 4 suggests that more portion of the survey sample consumes fuel greater than 10lites per km. Only in the 2.00-trip category shows that more samples have consumed fuel less than 10lites per km. While, this is just a preliminary investigation and therefore, other factors should be under consideration that might also affect the fuel consumption like the type of car, age of car and the likes.

3.2 Ordered Probit Analysis

The study opted to employ ordered probit regression. This analysis found to more fitting for modeling with a dependent variable that takes more than two values, where these values have a natural ordering. In the ordered probit model, the dependent variable is latent (i.e., unobserved variables) and expressed as:

$$y_i^* = \mathbf{x}_i \boldsymbol{\beta} + \varepsilon_i ,$$

where y_i^* is a latent variable measuring the number of daily trips (from Monday to Friday only) by the commuter i (i = 1,..., N) and N is the sample size; $\boldsymbol{x}_i$ is a ($k \times 1$) vector of independent (observed) nonrandom explanatory variables; $\boldsymbol{\beta}$ is a ($k \times 1$) vector of unknown (coefficients) parameters; ε_i is the random error term, which is assumed to be normally distributed with zero mean and unit variance.

Let y_i be the number of trips made in a day. To convert the continuous latent variable y_i^* into the discrete observed frequency of daily trips, a set of $\boldsymbol{\mu}$ ($n \times 1$) is considered where n denotes the frequency of daily trip categories as shown below:

$$y_i = \begin{cases} 2 & \text{if } -\infty \le y_i^* \le \mu_1 \\ 3 & \text{if } \mu_1 \le y_i^* \le \mu_2 \\ 4 & \text{if } \mu_2 \le y_i^* \le \mu_3 \\ & \cdots \\ n+1 & \text{if } \mu_n \le y_i^* \le \infty, \end{cases}$$

where the vector of threshold values $\boldsymbol{\mu}$ are unknown parameters to be estimated along with the parameter vector $\boldsymbol{\beta}$.

The parameters are to be estimated so that y_i* is expected to change by β_k for a unit change in x_{ik}, holding all other variables constant. The maximum likelihood method is employed for the estimated parameter in the model (Long, 1997). The predicted probability of the frequency of daily trips m for given x_i is

$$\Pr(y_i = m | \mathbf{x}_i) = F(\mu_m - \mathbf{x}_i \boldsymbol{\beta}) - F(\mu_{m-1} - \mathbf{x}_i \boldsymbol{\beta}),$$

where F is the normal cumulative distribution function.

The log likelihood function is the sum of the individual log probabilities is given as

$$LL = \sum_{i=1}^{N} \sum_{j=0}^{n} Z_{ij} \log\left(F(\mu_j - \mathbf{x}_i \boldsymbol{\beta}) - F(\mu_{j-1} - \mathbf{x}_i \boldsymbol{\beta})\right),$$

where Z_{ij} is an indicator variable which equals 1 if $y_i = j$ and 0 for otherwise.

4. KEY FINDINGS AND DISCUSSION

The results of the empirical analysis by ordered probit analysis with the estimated parameter and its corresponding t-values are tabulated are presented in Table 3. The model employs the frequency of daily trips as the dependent variable while socio-demographic characteristics, NCS information and travel pattern attributes serve as the independent variables. We use daily trips simple because NCS is only implemented on these days, NCS is lifted on weekends.

The McFadden R^2 value is also presented, which is found to be small (0.164), but comparable to other applications of ordered probit analyses in transportation research with low R^2 value (Khattak et al, 1993; Quddus et al, 2002). For this reason, the discussion will focus mainly on most explanatory variables that exhibit significant *t*-values.

In the socio-demographic characteristics, male participants are unlikely to show significance of making trips where the t-value below 2 (1.07). Among the age group, participants with ages greater or equal to 40 years old found to be more likely to make trips than ages 20-39. This is also supported by correlation analysis of the interaction between civil status and age group versus trip frequency, it was found out that young and married couple (of age group 20-39) make less trips. The reason could be that young married couples tend to do more household chores thus reducing or cutting off their trip frequency. Participants who are single exhibit no significant result in the analysis, either with married participants. As expected, participants with higher income tend to make trips than those with lower income (less than 30,000 PhP). Car ownership is important factor for trip frequency however it did not exhibit any significance in the model having tried to do some separate dummies (by converting it to categorical variables). Hence, I opted to retain the continuous variable for car ownership (at 10% significance level with t-value of 1.34). There is an inclusion of the public transport captive user since it might some implications on who might or how much will make a shift from private modes to public transportation since the goal of NCS is to reduce car use in major streets of MM.

An increase of daily trips for participants who go early for work and be late for home (EWLH) – albeit their cars are banned to run the streets, than those who go for work late (LWEH/LH), with neither going home early or late. This result conforms to the second hypothesis that during the number coding day, when the vehicles are banned to run on the streets, commuters tend to go to work early and be home late to avoid the time frame of NCS

Table 5. Ordered probit model for frequency of daily trips

	Estimated parameter	t-value
Cut points (trips)		
1-2 daily trips	-1.70	-2.78
3 daily trips	-0.14	-0.24
4 + daily trips	0.31	0.52
Socio-demographic characteristics		
Gender (male = 1)	0.28	1.07
Age		
Age (<20)	-0.78	-1.39
Age (20-29)	-0.75	-1.67
Age (30-39)	-1.22**	-2.86
Age (>40) (reference)	---	---
Civil status (single = 1)	-0.29	-0.97
Income (PhP)		
Income (<10,000)	-0.29	-0.77
Income (20,000)	-0.57*	-1.96
Income (30,000) (reference)	---	---
Car ownership	0.14	1.34
Number coding scheme and travel attributes		
Schedule pattern on number coding day		
Early for work –Early for home	1.25*	2.10
Early for work – Late for home	0.55*	2.01
Late for work – Early for home	0.11	0.18
Late for work – Late for home (reference)	---	---
Uses car during coding day (yes = 1)	0.69*	2.54
Public transport captive user	-0.52	-1.89
Commute time (minutes)	-0.53*	-2.03
Fuel cost (PhP)	-.001	-1.45
Number of observations		116
-2 Log Likelihood Intercept only		292.49
-2 Log Likelihood Final		244.08
McFadden R^2		0.164

Note: 1PhP = 0.02 USD
* significance level at 0.05
**significance level at 0.01

where the vehicles are banned (also correspond to illustration Figure 4). This means that commuters are likely to shift their time frame schedules when their car is banned. Though, this does not necessarily mean that the scheme effectively facilitates the decongestion, it only means that demand of car use in terms of time of the day is distributed to some off-peak hours (during day and night). In addition, those who go to work early and be home early (EWEH) are also likely to make trips. This can be explained by speculating the nature of work the participants might have, working by the luxury of flexibility that enables to be home early where some cities allow banned vehicles to still run the streets through window hours (starts from 10am to 3pm).

Moreover, those who use private car (or another car for those participants who have more than 1 private car) all days of the week tend to make more trips, even if they have car that is banned for a day. However, a negative association to the frequency of daily trips when participants were asked about using public transport (PT) as an alternative mode for commute to work instead of using private cars. This result does not agree with the first hypothesis on the use of public transport in case car is not available or banned due to NCS. Even though Metro Manila is known to be a public transport dominated city, the use of public transport for car dependent participants is unlikely. The poor serviceability (i.e., security, safety, punctuality and reliability) and comfort (Susilo et al., 2010) of public transport might be the sound speculation.

Negative effects on daily trips for variables commute time and fuel cost. Interestingly, both results correspond to Rubite and Muromachi (2008), which revealed commute time is negatively associated with the frequency of trips. Their study is about public transport chains in Metro Manila using the Metro Manila Urban Transportation Integration Study (MMUTIS) 1996 data.

5. CONCLUSION AND RECOMMENDATIONS

Number coding scheme is introduced and considered as one of the TDM measures aimed to reduce the traffic volume and decongest the thoroughfares in Metro Manila. This research hopes to look at the effects of number coding scheme on daily trips of commuters. The empirical analysis selected the working class within Metro Manila as the participants of the survey for which the findings show interesting and enriching results.

Results revealed that commuters use private car, albeit it is banned for the day due the number coding scheme. Additionally, it was also found out that the use of public transport is less likely to be chosen as an alternative mode to travel for work, which can infer that participants are more car dependent. Moreover, the time frame schedule of commuters who used their private car for work even they are banned from running the streets is shifted from earlier (later for going home) than the usually time when traveling for work. By saying early for work means traveling and reaching the workplace before 7am and late to be home means leaving workplace after 7pm when number coding scheme is already lifted. The reason for this is that participants avoid the time frame of number coding scheme and that they extend their activity time by going to work early and going home late. In this sense, we openly can say that the number of private cars are not reduce in the streets during number coding scheme day but are distributed in earlier and/or later periods of time. More often than not, commute time and fuel costs have both negative effects on the frequency of daily trips in which this result is an expected output.

Importantly, number coding scheme implies that it could be a good venue to encourage people to use public transport mode. However, with poor quality and services of public transport, commuters still use their private cars even during number coding day in expense of changing their travel patterns by shifting their time frame schedule, i.e. waking up early and going home late. In addition, NCS have two sides of the coin on in the hope of reducing car use in Metro Manila. First, it distributes some volume of vehicles to earlier or later time. On the other side, it also encourages affluent households to own more cars.

Admittedly, the survey data is quite small and travel patterns for more participants may have experienced some changes however the knowledge gained in the analysis of the dataset serves as a good source of useful information acting as leverage for future research efforts and directions. It is acknowledged that the size of database plays a crucial role in the analysis. In fact, an ample additional data were recently gathered and it is underway for the analysis. Future directions include further exploration of number coding scheme and its influences on travel, i.e.by determining other key variables that may prove significant to the improvement of future modeling works will be sought after.

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