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Research Article

Departure Time Choice (DTC) Behavior for Intercity Travel during a Long-Holiday in Bangkok, Thailand

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Time-of-day (TOD) or departure time choice (DTC) has become an interesting issue over two decades. Many researches have intensely focused on time-of-day or departure time choice study, especially workday departures. However, the travel behavior during long-holiday/intercity travel has received relatively little attention in previous studies. This paper shows the characteristics of long-holiday intercity travel patterns based on 2012 New Year data collected in Thailand with a specific focus on departure time choice of car commuters due to traffic congestion occurring during the beginning of festivals. 590 interview data were analyzed to provide more understanding of general characteristics of DTC behavior for intercity travel at the beginning of a Bangkok long-holiday. Moreover, the Multinomial Logit Model (MNL) was used to find the car-based DTC model. The results showed that travelers tend to travel at the peak period when the parameters of personal and household are not so significant, in contrast to the trip-related characteristics and holiday variables that play important roles in traveler decision on departure time choice. Finally, some policies to distribute travel demand and reduce the repeatable traffic congestion at the beginning of festivals are recommended.

1. Introduction

Bangkok is the primary city of Thailand which has registered and nonregistered populations of approximately 5.69 million [1] and 2.37 million, respectively [2]. Like all other capital cities in developing countries, the large number of non-registered populations evidently demonstrates the domestic migration and resettlement of people who leave rural areas to find better opportunities for jobs or/and education. Specific to domestic migration to and resettlement of people in Bangkok, this change causes many urban transportation problems in the city such as traffic congestion. In 2016, Bangkok ranked as the 11th most congested city in the world, and travelers spent 64.1 peak hours per year on the road [3].

Thailand is also well known as a festive kingdom celebrating numerous regional and national holidays. Every year, the government declares 19 national holidays and most of them adjoin weekend days. Moreover, 5 of the 19 holidays were 3 days or more, such as Songkran Festival (13-15 April) and Royal Ploughing Ceremony Day (12-14 May). Consequently, during festive or special-event periods, intercity travel demands to move out of (at the beginning) and move into Bangkok (at the ending) generally take place along the main routes between Bangkok and other regions. When comparing trip purpose between Songkran and New Year's Eve travels, most people usually go for meeting remote family (77.5%, 54.6%), recreational/leisure (8.2%, 26.2%), work (11.1%, 8.5%), shopping trips (1.7%, 7.3%), chauffeur (1.0%, 2.3%), and other (0.6, 1.1%) [4].

Based on travel evidences at the beginning of long-holidays or festivals in Thailand, the severity of traffic congestion usually occurs along the main routes from Bangkok Metropolitan Area (BMA) to other cities. In 2018, Department of Highways (DOH) reported average traffic volume on major highways from Bangkok to all regions during Songkran festivals in 2017 and 2017 increased by 12% and 19% compared to normal off-peak periods. Furthermore, average traffic volumes were up 19% during New Year's Eve, 2017 [5].

Hence, severe traffic congestion during these periods appears to occur along the main routes. Moreover, the dramatic increase in travel demand during festivals that relies on the road transportation also leads to many other following impacts such as loss of production time, the high potential of traffic accidents, GHG-emissions, and the waste of energy consumption.

According to these repeatable events, transportation policymakers try to experiment with some policies to reduce impacts and optimize the efficiency of the overall network system in terms of both mobility and safety [6, 7]. However, most of the present travel behavior studies concentrate only on urban travel behavior on normal periods, especially on workdays. Therefore, they cannot be used for describing travel behavior in other periods especially during long-holidays, when most people decide to travel long distance to join activities outside the city for social and recreational purposes.

In transportation planning views, there are many challenging issues from these occasional evidences such as long distance travel demand forecasting, travel behaviors (i.e., frequency, location, mode, route, and departure time), and special traffic management during festivals, etc. Hence, with the focus on traffic congestion appearing at the beginning in every festival, the specific interest of this research arises from the inherent concept that a traveler makes a rational decision [8, 9] and selects a suitable departure time to avoid traffic congestion. With this intention, this paper is aimed at studying departure time choice behavior for car-based commutes at the beginning of long-holidays for Bangkok Metropolitan Area (BMA), Thailand, by using the travel data of the New Year 2012 festival for Bangkok Metropolitan Area (BMA), Thailand.

2. Literature Review

Many previous studies developed a lot of knowledge on departure time and time-of-day choice. However, most of them only focused on short distances of urban travel which can be classified into 2 main groups: (1) urban-work related departure time choice (DTC) such as Chin's study on morning DTC for Singapore commuters [10], Zeid et al.'s study on time-of-day choice modeling using the tour- and activity-based travel model for San Francisco County, California [11], and Holyaok's examination of departure time choice behavior of car-based commuters by an Internet survey which combined RP- and SP-type surveys for a home-based car commute for a.m. and p.m. peaks in Sydney and Adelaide [12], etc., and (2) urban-nonwork DTC such as Bhat's examination of the mode and departure time choice for urban shopping trips using 1990 San Francisco Bay area travel survey data [13], Steed and Bhat's realization of the effect of various variables on individual departure time choice for home-based social recreational trips and shopping trips using discrete choice models [14], Okala's study of departure time choice studies of recreational activities by elderly persons [15], Yang et al.'s study on the time-of-day (TOD) choice behavior for weekends employing a tour-based approach using Atlanta household survey data [16], Thorhauge et al.'s derivation of psychological factors and DTC for car commuters to the city center of Copenhagen [17], etc. In contrast to the DTC of intercity or long distance travel, there were few studies such as Jin's study on the time-of-day choice behavior for long distance trips which are defined as 50 miles (approx. 80.5 kilometers) or longer in distance or 60 minutes or longer in one-way travel time [18] and Jin et al.'s examination of time-of-day choice behavior for long distance trips and a test of the possible spatial transferability of the behavior findings and models [19]. However, most of the studies ignored the study of DTC behavior of long distance travel during holidays [20].

In general, the study of travel behavior on intercity travel and departure time is a lot more complicated and costly due to the problem of sparse data [21, 22]. In order to examine individual departure time choice behavior of intercity travel at the beginning of a long-holiday, a study needs to find potential ways for collecting trip, personality, and household structure information. The best way is to collect whole information and real-time data or using travel diary data collection. However, it is not convenient to use these methods for extended-period data collection [23, 24]. Hence, this research proposes using the most common method, which is a home interview survey (HIS) for the long distance travel behavior of Bangkok residents for the departure time choice analysis.

3. Methodology

3.1. Data Descriptions. According to the research of long distance travel behavior of Bangkok residents in 2012 [25], the revealed preference data collection began on Saturday, 7 January, and finished on Sunday, 26 February 2012. 875 households throughout 50 districts of BMA were stratified random sampling and interviewed. According to the data, 590 of 1245 data items were travel data during the New Year 2012 festival period. Hence, these data were suitable for analysis in order to find the behavior of long-holiday travel. Figure 1 shows the distribution and general characteristics of the samples.

3.2. Departure Time Definition. According to the report of Department of Disaster Prevention and Mitigation (DDPM) [7], at the beginning peak of the festival, the movement of people out of the city to participate in activities can be separated into 2 periods. The first peak period usually occurs from evening to midnight of the last working day called "Evening Peak: EVP" (16:00-22:00) and the second period begins from morning till noon of the starting date of the festival and defined as "morning peak: MNP" (08:00-12:00).

Therefore, in this study, there are 3 off-peak periods as follows:

(1) Early departure (ED): the traveler chose the starting time before the beginning of the evening peak of the last working day.

(2) After evening peak departure (AEP): the traveler chose the departure time between 22:01 on 30 Dec 2011 and 07:59 on 31 Dec 2011.

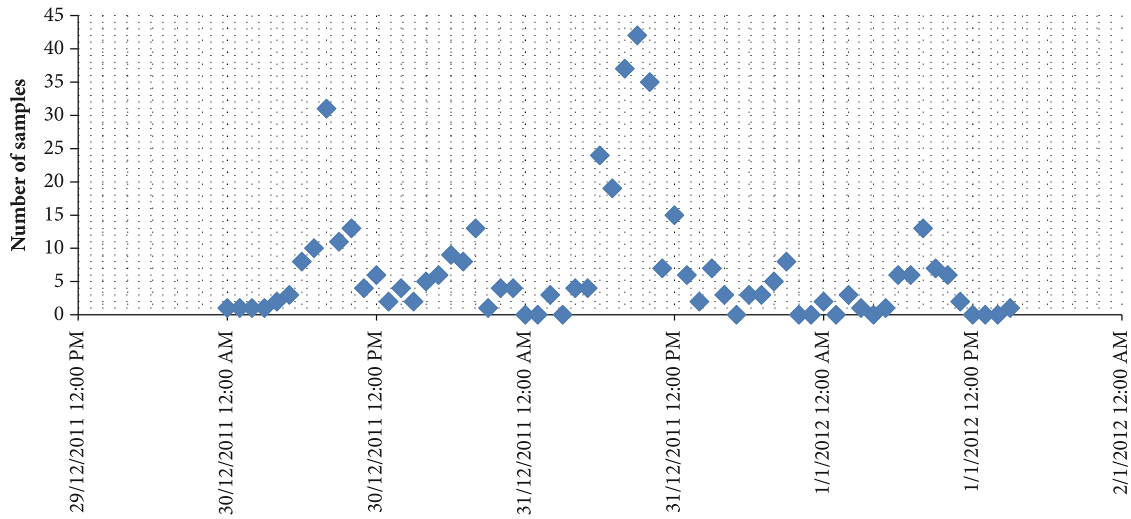


FIGURE 1: Departure date and time choice for intercity travel in New Year 2012.

(3) Late departure (LD): the traveler chose to stay at home during the peaks and departed after the ending of the morning peak to avoid traffic congestion.

Hence, the departure time choice set during the festival can be divided into 5 time spans: (1) depart before evening peak (early departure, ED), (2) depart on the first peak (depart at evening peak, EVP), (3) depart after evening peak, AEP), (4) depart on the second peak (depart at morning peak, MNP), and (5) depart after morning peaks (late departure, LD), as shown in Figure 2.

3.3. Factors in Data Collection. There are many studies that indicated the influencing factors related to departure time choice such as Chin's [10] model of morning departure time choice for Singapore commuters using MNL and NL models. The results showed that departure time choice was influenced by journey time (with longer journeys requiring earlier start times, as anticipated) and that occupation and income affected one's propensity for switching departure times. O'Fallen and Sullivan [26] conducted a weekend travel study in New Zealand in order to assess policy tools for decision-makers to manage weekend traffic congestion and found that they are influenced by a number of demographic and personal characteristics: age, gender, ethnicity, household type, number of people in a household, and personal and household income. Moreover, they have observed that auto ownership explains personal and household income and some of the variation in mode share and mode shift between weekdays and weekends. Yang et al. [16] explored the effects of various factors on weekend TOD choice and found that tour purpose, tour duration, and party size were the most powerful variables in the TOD choice-making for weekend travel. Income, education level, and household size were found not significantly contributing to the TOD choices, while other social demographics such as age, gender, household vehicles, presence of children, and work status all revealed significant impacts. Travel mode also showed significant contributions to the TOD model [16]. Holyaok examined the departure time choice behavior for car-based commuters in Sydney and Adelaide. Only 8 variables consisting of departure time change, travel time change, journey travel time, household children, household residents, household full-time workers, household cars, and personal income are included in the model [12].

According to the literature review, all parameters/factors related to the travel choice for making a long-holiday travel were retained into the analysis. These factors were classified into 3 main groups: (1) individual or personal characteristics and preferences, (2) household characteristics, and (3) trip-related characteristics. After that, all of the DTC-related factors have been reviewed for analysis as shown in Table 1.

Moreover, in this study, there is an attempt to find the best model using mixed or interaction variables and dummy variables such as the cost per income variable, low income group variable, high education group variable, more than 3 holidays variable, etc.

3.4. Model Specification. According to past studies, most of the past researches focused on departure time choice were relied on discrete time choice using Multinomial Logit Model (MNL) such as Small [8, 27], Hendrickson and Plank [28], Chin [10], Polak and Jones (1994), Okola [15], Holyoak [12], and Yang et al. [16] etc. However, there are other types of discrete and/or continuous time choice model such as Nested Logit Model (NL), ordered generalized extreme value (OGEV), EClogit, Ordered Probit Model, Duration model, and Deterministic Model [29].

For this study, the discrete choice model is the suitable technique based on the assumption that travelers are trying to maximize the utility of their choices (departure time choices) and therefore choose that alternative which is likely to offer them the highest utility out of all possible choices [9]. Moreover, Multinomial Logit Model (MNL) is selected due to the simplest and most popular methodological discrete choice model [30]. Furthermore, the sample size of this

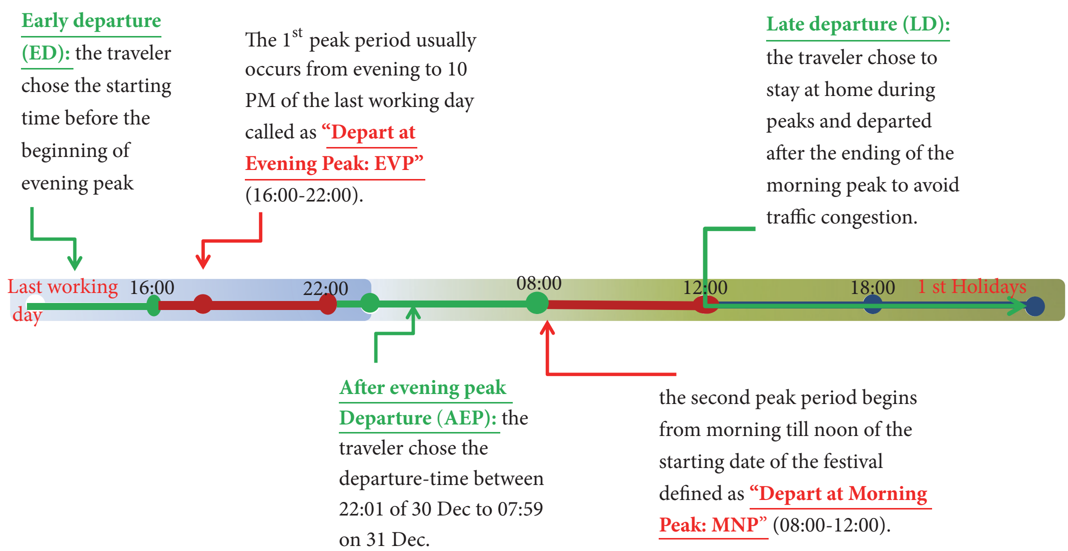


Figure 2: Definition of five alternatives of departure time.

study is not so much; hence, the advanced models are not appropriate according to the data consuming themselves.

It can be expressed under the assumption that the error terms are Gumbel distribution and identically and independently distributed (IID) as

$$P_{in} = \frac{e^{V_{in}}}{\sum_{A_j \in A_{(J)}} e^{V_{in}}} \quad (1)$$

where the term $V_{in} = \mathrm{f}(\beta, \mathrm{x}_{\mathrm{in}})$ is the deterministic part of the utility of the alternative $\mathrm{i} \in \mathrm{C}_{\mathrm{j}}$, C_{j}: choice set is available to decision-maker n, x_{in} is a vector representing the attributes of an alternative i as well as the socioeconomic characteristics of the decision-maker n, and β is vector of coefficients which needs to be estimated from the data. Hence, the deterministic part of the utility of the alternative i for individual n of this study is as follows:

$$\mathrm{V}_{\mathrm{edn}} = \mathrm{asc}_{\mathrm{a}} + \beta_{\mathrm{a}} * \mathrm{x}_{\mathrm{an}} \quad (2)$$

$$\mathrm{V}_{\mathrm{evpn}} = \mathrm{asc}_{\mathrm{b}} + \beta_{\mathrm{b}} * \mathrm{x}_{\mathrm{bn}} \quad (3)$$

$$\mathrm{V}_{\mathrm{aepn}} = \mathrm{asc}_{\mathrm{c}} + \beta_{\mathrm{c}} * \mathrm{x}_{\mathrm{cn}} \quad (4)$$

$$\mathrm{V}_{\mathrm{mnpn}} = \mathrm{asc}_{\mathrm{d}} + \beta_{\mathrm{d}} * \mathrm{x}_{\mathrm{dn}} \quad (5)$$

$$\mathrm{V}_{\mathrm{ldn}} = \mathrm{asc}_{\mathrm{e}} + \beta_{\mathrm{e}} * \mathrm{x}_{\mathrm{en}} \quad (6)$$

Therefore, the probability to select departure time (i) for each individual (n) can be described as (1). In this study, the coefficients of utility functions were estimated using NLOGIT4.0. Then, the t-statistics that have an absolute greater than 1.96 (p-value of 0.05) are selected due to the hypothesis that the estimate's difference from zero. Moreover, all coefficients in every utility functions must have the correct and explanation sign. Then the Pseudo R^2 (ρ^2) of the model will determine the goodness of the fit of the model comparing to the based model [31, 32].

$$\rho^2 = 1 - \left(\frac{LL_{Estimated\ model}}{LL_{Base\ model}} \right) \quad (7)$$

where $LL_{Base\ model}$ is log-likelihood for the zeros for all coefficients and $LL_{Estimated\ model}$ is log-likelihood with estimated coefficients.

4. Results

4.1. General Characteristics of Data

4.1.1. Traveler Characteristics. General characteristics of 590 samples who did intercity travel during the 2012 New Year festival are as shown in Table 2.

According to the frequency analysis, it is also found that most of the travelers were male (51.5%) with the age between 21 and 30 years (48.8%), the working status of the samples are employee and student/unemployed (37.1 and 34.9%), and the majority income ranged between 5,000 and 15,000 Baht/month (47.6%). For the household characteristics, most families contained 4 members (25.2%). It was also found that the most of the households had full-time workers/students (85.5%) and owned at least one vehicle (58.3%). For the holiday characteristics, most of the respondents had 4 consecutive days of holiday, and most started their trips on 31 Dec (74.2 %), followed by 30 Dec (14.1%) and 29 Dec (4.8%).

Aiming at trip characteristics, most of the respondents went traveling for leisure/recreation followed by returning home purpose (44.1% and 42.9%, respectively). Most of the respondents used a passenger car (47.6%), following by intercity bus and van (18.0% and 16.1%, respectively). Distance of travels mostly ranged between 101 and 200 km. (25.6%), followed by 201-400 and 601-800 km. (23.7% and 15.6%, respectively). For public transportation users, the

Table 1: Definition and parameter abbreviation of each variable.

Variable	Sub-variable	Parameter	Details
1. Individual characteristics			
1.1 Gender	GEN	βgen	= 1 if Male; else = 0
1.2 Age	Age1	βage1	= 1 if Traveler age is less than 20 Yrs. Old; else = 0
	Age2	βage2	= 1 if Traveler age is between 20-30 Yrs. Old; else = 0
	Age3	βage3	= 1 if Traveler age is between 30-40 Yrs. Old; else = 0
	Age4	βage4	= 1 if Traveler age is between 40-50 Yrs. Old; else = 0
	Age5	βage5	= 1 if Traveler age is between 50-60 Yrs. Old; else = 0
	Age6	βage6	= 1 if Traveler Age is more than 60 Yrs. Old; else = 0
1.3 Income	INC1	βinc1	= 1 if less than 5,000 Baht; else = 0
	INC2	βinc2	= 1 if between 5,000- 10,000 Baht; else = 0
	INC3	βinc3	= 1 if between 10,001-15,000 Baht; else = 0
	INC4	βinc4	= 1 if between 15,001-20,000 Baht; else = 0
	INC5	βinc5	= 1 if between 20,001-30,000 Baht; else = 0
	INC6	βinc6	= 1 if between 30,001-50,000 Baht; else = 0
	INC7	βinc7	= 1 if between 50,001-75,0000 Baht; else = 0
	INC8	βinc8	= 1 if between 75,001-100,000 Baht; else = 0
	INC9	βinc9	= 1 if more than 100,000 Baht; else = 0
1.4 Education level	EDU1	βedu1	= 1 if Lower than Grade 1; else = 0
	EDU2	βedu2	= 1 if between Grade 1-6; else = 0
	EDU3	βedu3	= 1 if between Grade 7-12; else = 0
	EDU4	βedu4	= 1 if between Undergraduate; else = 0
	EDU5	βedu5	= 1 if Bachelor Degree; else = 0
	EDU6	βedu6	= 1 if Above Bachelor; else = 0
1.5 Occupation	OC1	βocl	Professional/Academic = 1, else = 0
	OC2	βoc2	Student = 1, else = 0
	OC3	βoc3	Management = 1, else = 0
	OC4	βoc4	Government = 1, else = 0
	OC5	βoc5	Private sector = 1, else = 0
	OC6	βoc6	State enterprise = 1, else = 0
	OC7	βoc7	Driver = 1, else = 0
	OC8	βoc8	Engineering/Production = 1, else = 0
	OC9	βoc9	Live Stock = 1, else = 0
	OC10	βocl0	Agriculture = 1, else = 0
	OC11	βocl1	For hire = 1, else = 0
	OC12	βocl2	Services = 1, else = 0
	OC13	βocl3	Trader = 1, else = 0
	OC14	βocl4	Self-employed = 1, else = 0
	OC15	βocl5	Other = 1, else = 0
2. Household interaction			
2.1 No. of Household member Work/Study (full-time)	FTMem0	βftmem0	= 1 if equal to 0; else = 0
	FTMem1	βftmem1	= 1 if equal to 1; else = 0
	FTMem2	βftmem2	= 1 if equal to 2; else = 0
	FTMem3	βftmem3	= 1 if equal to 3; else = 0
	FTMem4	βftmem4	= 1 if equal to 4; else = 0
	FTMem5	βftmem5	= 1 if More than 4; else = 0
2.2 Children under 4 yrs. in HH	CHILD4	βhhchd4	= 1 if ≥ one person; else = 0
2.3 Children under 13 yrs. in HH	CHILD13	βhhchd13	= 1 if ≥ one person; else = 0
2.4 No. of elderly over 65 yrs.	ELDAPP	βhhld	= 1 if ≥ one person; else = 0

Table 1: Continued.

Variable	Sub-variable	Parameter	Details
2.5 Household income group	HHINC1	βhhinc1	= 1 if less than 5,000 Baht; else = 0
	HHINC2	βhhinc2	= 1 if between 5,000- 10,000 Baht;else = 0
	HHINC3	βhhinc3	= 1 if between 10,001-15,000 Baht;else = 0
	HHINC4	βhhinc4	= 1 if between 15,001-20,000 Baht;else = 0
	HHINC5	βhhinc5	= 1 if between 20,001-30,000 Baht;else = 0
	HHINC6	βhhinc6	= 1 if between 30,001-50,000 Baht;else = 0
	HHINC7	βhhinc7	= 1 if between 50,001-75,0000 Baht;else = 0
	HHINC8	βhhinc8	= 1 if between 75,001-100,000 Baht;else = 0
	HHINC9	βhhinc9	= 1 if more than 100,000 Baht;else = 0
3. Long-holiday trip characteristics			
3.1 Trip purpose	TP1	βtp1	Return home = 1, else = 0
	TP2	βtp2	Leisure/Recreation = 1, else = 0
	TP3	βtp3	Other = 1, else = 0
3.2 Travel cost per head	TC_Head	βtc	Travel cost per head (Baht/head)
3.3 Travel time	TTall	βtt	Total travel time (Minute)
3.4 In-vehicle Travel time	IVT	βivt	In-vehicle Travel time (Minute)
3.5 Waiting time	WT	βwt	Total waiting time (Minute)
3.6 Number of transfers	NOFTRANS1	βntran1	= 1 if ≤ 2 times; else = 0
	NOFTRANS2	βntran2	= 1 if more than 2 times; else = 0
3.7 Full-time passenger Appearance	FTAPP	βftapp	= 1 if YES; else = 0
3.8 Number of passenger in trip	NPASS0	βnpass1	= 1 if equal to 0 (Drive alone); else = 0
	NPASS1	βnpass1	= 1 if equal to 1; else = 0
	NPASS2	βnpass2	= 1 if equal to 2; else = 0
	NPASS3	βnpass3	= 1 if equal to 3; else = 0
	NPASS4	βnpass4	= 1 if ≥ 4; else = 0
3.9 Children under 13 yrs appearance in trip	U13_tri	βu13	= 1 if ≥ one person; else = 0
3.10 Elderly passenger appearance in trip	ELD_tr	βeldtr	= 1 if ≥ one person; else = 0
3.11 Destination Preference	Destprf	βdestprf	= 1 if YES; else = 0
3.12 Length of stay at destination	Nostay1	βnstay1	= 1 if equal to 1 day; else = 0
	Nostay2	βnstay2	= 1 if equal to 2 days; else = 0
	Nostay3	βnstay3	= 1 if equal to 3 days; else = 0
	Nostay4	βnstay4	= 1 if equal to 4 days; else = 0
	Nostay5	βnstay5	= 1 if more than 4 days; else = 0
3.13 Type of payment	Payby1	βpayby1	= 1 if pay by yourself; else = 0
	Payby2	βpayby2	= 1 if pay by family; else = 0
	Payby3	βpayby3	= 1 if pay by other (sponsor); else = 0
3.14 Distance	Dist	βdist	travel distance (km)
	Sdist	βsdist	= 1 if less than 200 km; else = 0
	S400	βs400	= 1 if less than 400 km; else = 0
	S401	βs401	= 1 if more than 400 km; else = 0
	Mdist	βmdist	= 1 if between 200-600 km; else = 0
	Ldist	βldist	= 1 if more than 600 km; else = 0

majority of people transferred 3 times (37.3%), following by 2 times and 4 times (36.9% and 12.7%, respectively). Most of the respondents traveled between 2 and 4 hrs. (33.2%) and paid less than 200 baht/head (38.3%) following by 201-400 baht/head and 401-600 baht/head (24.7% and 11.9%, respectively). Children under 13 years old and elderly travelers (8.3% and 4.4%, respectively) were found in the trips. Most people traveled alone (35.9%), followed by the inclusion of 1 passenger and 2 passengers (24.2% and 19.7%, respectively). While most people left Bangkok on 31 Dec (42.9%), followed by 30 Dec (last working day) and 29-Dec (27.1% and 10.17%, respectively), travelers chose to depart their destination during 8:00-10:00 a.m. on 31/12/2011 (22.2%).

4.2. The Relationship of Socioeconomic Characteristics Variables on DTC. In order to know the relationship of each socioeconomic characteristic on DTC, the crosstab technique was applied for behavior analysis of intercity travel in New Year 2012. The results found that personal and household characteristics such as gender, age, income, and education level had no precise relationship with DTC. In contrast to trip characteristics, the distance and total travel time variables show a clear relationship with DTC. According to Figure 3, the analysis results indicated that, for group of travel time less than 4 hours, travelers tended to depart in the morning peak (MNP). However, for longer distance trips, it seemed to be increased to early departure (ED) and departures in the evening of the last working day (EVP).

Table 2: General characteristics of samples.

Variable	*Frequency analysis*			
	Mean	S.D.	Min	Max
1. Individual and household socio-economics characteristics				
Age (yrs.)	30.59	11.09	14.00	69.00
Income (Baht)*	18,553.22	15,610.00	0.00	120,000.00
Number of holidays (day)	4.49	1.55	2.00	28.00
Household income	45,729.09	32,051.93	0.00	350,000.00
Household member	3.09	1.67	0.00	10.00
2. Trip characteristics				
Distance (km.)	356.89	252.40	29.00	1250.00
Travel cost per head (Baht)	495.49	536.97	22.50	3,000.00
Total travel time (min)	319.36	229.64	45.00	1,520.00
No. of other passengers in trip (person)	1.37	1.41	0	8

Remark: *1 US Dollar = 31.5950 Thai Baht on 12/31/2011.

4.3. Departure Time Choice Model. Because of the focuses on solving the problem of road traffic congestion on the main routes at the beginning of festivals to examine the specify actual what for travel behavior, 290 data are the car-based commutes during 30 Dec 2011-2 Jan 2012. In order to know the DTC model, MNL is applied to find the most suitable model compared to the based model. However, the difficulty of the analysis is to identify the different travel time and travel cost among each alternative. Because of the revealed preference (RP) data, travelers are lacking the full information in other choices. Hence, the assumption of total travel time in the other periods is set as follows: the ratio of travel time of evening peak and morning peak is assumed to be 2 and 1.5 times of the nonpeak period. However, for the peak trip, the total travel time of the peak is the same as revealed but the nonpeak travel time is assumed to be the average travel time in a normal situation. Moreover, in order to know the value of time (VOT) during festive holidays, the travel time and cost are assumed as the main variables.

Then, all variables in Table 1 and many new created parameters were selected and modeled for finding the explainable car-based MNL-DTC model. The criteria of consideration are all variables in every utility function, are of significance level at 95% confidence interval ($|t-stat| > 1.96$), have the correct and reasonable sign of coefficient value, and have the highest pseudo R^2 (ρ^2).

The coefficients of utility functions are estimated using NLOGIT 4.0. Finally, the explainable MNL-DTC model was modeled and the utility function for each alternative is shown in (8)-(12).

(i) The utility function of early departure (ED)

$$V_{car,ED} = ASC_{ED} + \beta_{TT} * TT_{ED} + \beta_{TC} * TC + \beta_{HHOLNP} * HHOL \quad (8)$$

(ii) The utility function of departure at evening peak (EVP)

$$V_{car,EVP} = ASC_{EVP} + \beta_{TT} * TT_{EVP} + \beta_{TC} * TC + \beta_{S400EVP} * S400_{EVP} \quad (9)$$

(iii) The utility function of departure after evening peak (AEP)

$$V_{car,AEP} = ASC_{AEP} + \beta_{TT} * TT_{AEP} + \beta_{TC} * TC + \beta_{stayAEP} * STAY45_{AEP} + \beta_{S401AEP} * S401_{AEP} + \beta_{HHOLNP} * HHOL \quad (10)$$

(iv) The utility function of departure at morning peak (MNP)

$$V_{car,MNP} = ASC_{MNP} + \beta_{TT} * TT_{MNP} + \beta_{TC} * TC + \beta_{U13MNP} * U13\_TRP_{MNP} + \beta_{S401MNP} * S401_{MNP} \quad (11)$$

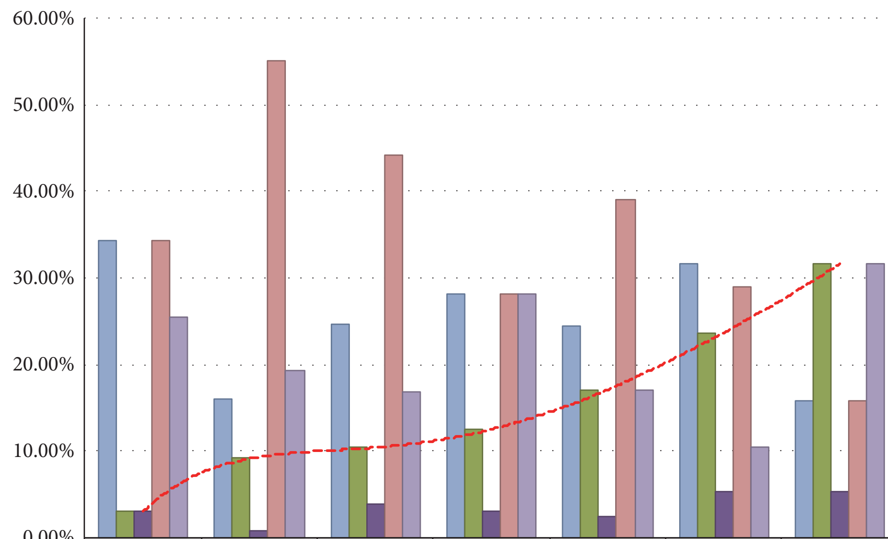
(v) The utility function of late departure (LD)

$$V_{car,LD} = \beta_{TT} * TT_{LD} + \beta_{TC} * TC + \beta_{LDISTLD} * LDIST_{LD} + \beta_{HHOLNP} * HHOL \quad (12)$$

Moreover, the estimated results are shown in Table 3.

According to the analysis in Table 3, the personal and household characteristic variables were found to be of no significance to the DTC of a traveler. This is in contrast to the trip-related characteristics variables such as travel time and travel cost, travel distance, number of holidays that are more than 3 days, time spent at destination exceeding 3 days, and appearance of children under 13 in trips which are significant in the DTC of car commuters. The estimated results are shown in Table 3. All of the parameters except the Alternative Specific Constant of early departure (ASC_{ED}) are significant at the confidence interval of 0.05 (95%).

Moreover, the value of Alternative Specific Constants (ASCs) indicates that travelers prefer to choose to travel in the peaks (EVP and MNP), while the "after evening peak" departure is less preferable. Additionally, the dummy variables of "Distance" appear in the EVP, AEP. MNP, and LD utility functions. Furthermore, the value of time (VOT)



	< 1 hrs	1-2 hrs	2-4 hrs	4-6 hrs	6-8 hrs	8-10 hrs	> 10hrs
ED	34.30%	15.90%	24.70%	28.10%	24.40%	31.60%	15.80%
EVP	3.00%	9.30%	10.40%	12.50%	17.10%	23.70%	31.60%
AEP	3.00%	0.70%	3.90%	3.10%	2.40%	5.30%	5.30%
MNP	34.30%	55.00%	44.20%	28.10%	39.00%	28.90%	15.80%
LD	25.40%	19.20%	16.90%	28.10%	17.10%	10.50%	31.60%

Figure 3: Crosstab of total travel time and departure time choice.

during the New Year 2012 festival period is implicit in the form of β_{TT}/β_{TC} = 13.349 baht/hr. (in 2012); that is 17.80% of the value of car-based commutes in normal periods (short distance-work trip) in the Extended Bangkok Urban Model (EBUM) (75.00 baht/hr. in 2012) [33]. The log-likelihood of the base model is -476.1808 and the log-likelihood of the most suitable model is -426.5139. Even the pseudo R^2 (ρ^2) representing the goodness of fit of the model is only 0.10430 indicating the model fit is "fair" at best, but the results give better understanding of the DTC behavior during a festive event in Thailand.

In order to add more understand about the impact of variables to travelers, the sensitivity analysis of all generic variables is determined. Table 4 shows the example of the change in percent share of each scenario due to the change in travel time variables.

From Table 4, the scenarios are ranged between -50 and +50 percent change in total travel time (TT). The probability of the estimates shows that the 50 percent increase in TT results in traveler decision to rescheduled to a nonpeak departure. Contrastingly, the change in travel cost per head (TC) does not make any effect to the change in rescheduling.

5. Conclusion and Discussion

Nowadays, humans travel more and longer due to transportation technology advancement [34]. The increase in demand for long distance travel during festivals leads to various transportation impacts, especially traffic congestion. As the evidence at the beginning of every long-holiday or festival in Thailand shows that the severity of traffic congestion usually occurs along main routes among Bangkok Metropolitan Area (BMA) and other regions, this repeatable problem causes adverse impacts such as increased fuel consumption, air pollution, and road accidents.

Because the nature of intercity travel in festival is a rare event, it is quite hard for researchers to find samples. This paper attempts to examine the departure time choice (DTC) behavior of travelers especially for intercity travel during New Year 2012 in Bangkok, Thailand. 590 household interview data were analyzed to provide an understanding of the general characteristics related to DTC behavior for intercity travel at the beginning of this long-holiday for Bangkok Metropolitan Area (BMA), Thailand. According to the frequency analysis, most of the travelers are aged between 21-30 years old (48.8%), and 85.5% of households have full-time workers/students. For the trip characteristics, most of the respondents went traveling for leisure/recreation followed by returning home purpose (44.1% and 42.9%, respectively). Most of the respondents used a passenger car (47.6%), traveled between 101 and 400 km. (49.3%), 2-4 hrs. (33.2%), and paid less than 400 baht/head (63.0%) in travel expenses. Children under 13 years old and elderly were found in trips (8.3% and 4.4%, respectively). Most people traveled alone (35.9%), followed by the accompaniment of one and two passengers (24.2 and 19.7%, respectively). While most people left Bangkok on 31 Dec (42.9%), followed by 30 Dec (last working day) and 29 Dec (27.1 and 10.17%, respectively), 22.2% of travelers chose to depart for their destination during 8:00-10:00 a.m. on 31/12/2011.

Table 3: Estimation results of the MNL-DTC model.

Coefficients	Variable	Coefficient Value	Standard Error	t-stat
ASC_{ED}	Alternative Specific Constant of early departure	-0.40009538	0.23942316	-1.671
β_{TT}	Total travel time	-0.00332691	0.00055665	-5.977
β_{TC}	Travel cost per head	-0.00074018	0.00017925	-4.129
β_{HHOLNP}	Dummy Variable-Holidays ≥ 4 days for non-peak time	1.38938468	0.27527893	5.047
ASC_{EVP}	Alternative Specific Constant for evening peak departure	2.22386548	0.44238680	5.027
$\beta_{S400EVP}$—	Dummy Variable-Distance ≤ 400 km for EVP	-1.46755623	0.40592287	-3.615
ASC_{AEP}	Alternative Specific Constant for after evening peak departure for AEP	-1.23626739	0.32142725	-3.846
$\beta_{STAYAEP}$	Dummy Variable-Stay at destination > 3 days for AEP	1.48531417	0.38463014	3.862
$\beta_{S401AEP}$	Dummy Variable-Distance > 400 km for AEP	1.54582231	0.42543065	3.634
ASC_{MNP}	Alternative Specific Constant for morning peak departure	1.12731756	0.28741855	3.922
β_{U13MNP}	Dummy Variable-child under 13 yrs. in trip for MNP	1.47982853	0.57837436	2.559
$\beta_{S401MNP}$	Dummy Variable-Distance > 400 km for MNP	1.12276673	0.39668703	2.830
$\beta_{LDISTLD}$—	Dummy Variable-Distance > 600 km for LD	1.79863542	0.58284880	3.086
LL_{Base}	Log likelihood of base model	-476.1808		
LL_{Model}	Log likelihood of estimated model	-426.5139		
ρ^2	pseudo R^2	0.10430		
ρ^2 (adjusted)	Adjusted-pseudo R^2	0.09556		

Table 4: Sensitivity analysis of the MNL-DTC model due to total travel time variable.

DTC	%Share due to change in Total travel time variable (Percent)						
	-50	-40	-20	Based Scenario	20	40	50
ED	15.395	15.600	15.986	16.342	16.670	16.972	17.114
EVP	13.992	13.294	12.064	11.023	10.140	9.387	9.052
AEP	20.241	20.576	21.186	21.722	22.194	22.609	22.799
MNP	24.592	24.406	24.005	23.577	23.136	22.694	22.474
LD	25.780	26.123	26.759	27.335	27.860	28.338	28.561

Moreover, based on the MNL-DTC model, travelers chose their departure time by considering trip-related characteristics such as travel time and travel cost, travel distance, number of holidays, time spent at destination, and under-13 children's appearance in trips, all of which are significant in DTC. According to the results, the value of time (VOT) during a festival period is only one-fifth compared to the normal period. Hence, it is not surprising that travelers still chose to depart at the peak periods, both "evening peak" and "morning peak". The time-savings during festivals by selection of the nonpeak departure time are continually considered negligible by travelers. The modeling result shows the goodness of fit is 0.10430. This may be because of the nature of the travelers' DTC that is sophisticated and so easy to apprehend. In addition, future studies will need to collect more data to better analyze and explain the behavior of departure time choice during festivals.

Furthermore, the Thailand government frequently announces additional public holidays such as during New Year's Eve 2014, which has increased the New Year holidays in order to benefit the economic and tourism sectors [35]. So, according to the value of the dummy variable-Holidays ≥4 days for nonpeak time: β_{HHOLNP}, this policy can also help to distribute travel demand from the peaks to nonpeak periods.

Moreover, according to the dummy variables of "Distance" appearing in the EVP, AEP, MNP, and LD utility functions, there are 3 more suggestions to alleviate the traffic congestion during New Year period including the following: (1) The negative value of Dummy Variable-Distance ≤ 400 km for EVP, $\beta_{S400EVP}$, this indicates that travelers who travel less than 400 km tend to avoid the congestion in evening peak. Thus, the government agencies should be strongly promoting people who travel less than 400 km to avoid the congestion in evening peak and depart early. (2) The coefficient values of Dummy Variable-Distance > 400 km for AEP ($\beta_{S401AEP}$) and MNP ($\beta_{S401MNP}$) are 1.54582231 and 1.12276673. Hence, the government agencies can be reduced the morning peak travel demand by convincing the people who travel longer than 400 km to make after evening peak departure rather than Morning Peak departure. (3) The coefficient value of Dummy Variable-Distance > 600 km for LD ($\beta_{LDISTLD}$) is 1.79863542. Hence, the government agencies can be reduced the peak travel demand by convincing the people who travel longer than 600 km to make late departure.

In addition, according to the sensitivity analysis, the increase in total travel time (TT) results in the more of traveler decision to reschedule to a nonpeak departure. Hence, the government agencies should give the information about the increase in travel time due to congestion during the peaks (EVP and MNP) in New Year festival. Then travelers tend to plan and change their departure to the nonpeak period (ED, EVP, and LD).

Lastly, since all of the results came from a specific holiday, hence, it is completely not recommending to directly apply the resulting model and coefficients to other long-holiday journeys without getting brand new interview data to calibrate and validate the model. As reported by DOH [4], differences in festivals would engender different travel purposes. In Songkran, Thailand New Year Festival, 77.5% of travelers make a mandatory journey (away from main cities like Bangkok) to and from their home provinces. Moreover, the more data on other festivals are preferable in order to provide better understanding on travelers' behavior such as a comparing of the short and long distance travel behavior during festivals, studying on the characteristics of each travel purpose. Therefore, this would be an interesting issue for further study.

Data Availability

Data used in this article consist of 590 home interviews of travel data during the New Year 2012 festival period in Bangkok Metropolitans Area (BMA). These data are a part of the research of long distance travel behavior of Bangkok residents in 2012 and will be expected to use for the future works of the KBU, which is the supporting organization. Request for academic purpose access is available by contacting with the corresponding author.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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References

[1] Bureau of Registration Administration (BORA), *Official Statistics Registration Systems*, 2017, http://stat.bora.dopa.go.th/stat/y_stat59.htm.

[2] National Statistics Office, *Latent Population in Thailand*, Statistical Forecasting Division, Bangkok, Thailand, 2017.

[3] INRIX, *Global Trafic Scorecard*, 2018, http://inrix.com/scorecard/.

[4] Department of Highways, *Motorway Safety Campaign Project in Songkran 2006 and Newyear 2007*, 2007.

[5] Bureau of Highway Safety, *Bureau of Highway Safety, Department of Highways*, 2018, http://bhs.doh.go.th/en/infographics.

[6] Department of disaster prevention and mitigation, *Integrated Plan for Road Accident Prevention and Reduction during Songkran Festival and New Year Festival (In Thai)*, 2011.

[7] Department of disaster prevention and mitigation, *The Study for Sustainably Solving Road Traffic Congestion (outbound and inbound to Bangkok) during festivals Project*, 2007.

[8] K. A. Small, "A discrete choice model for ordered alternatives," *Econometrica*, vol. 55, no. 2, pp. 409–424, 1987.

[9] M. Ben Akiva and S. R. Lerman, *Discrete Choice Analysis: Theory and Application to Travel Demand*, MIT Press, Cambridge, UK, 1985.

[10] A. T. H. Chin, "Influences on commuter trip departure time decisions in Singapore," *Transportation Research Part A: General*, vol. 24, no. 5, pp. 321–333, 1990.

[11] M. Zeid, T. Rossi, and B. Gardner, "Modeling Time of Day Choice in the Context of Tour and Activity Based Models," in *Proceedings of the 85th Annual Meeting of the Transportation Research Board*, Washington, DC, USA, 2006.

[12] N. Holyoak, "Departure time choice for the car-based commute," in *Proceedings of the 31st Australasian Transport Research Forum, ATRF 2008*, pp. 429–442, Australia, October 2008.

[13] C. R. Bhat, "Analysis of travel mode and departure time choice for urban shopping trips," *Transportation Research Part B: Methodological*, vol. 32, no. 6, pp. 361–371, 1998.

[14] J. L. Steed and C. R. Bhat, "On modeling departure-time choice for home-based social/recreational and shopping trips," *Transportation Research Record*, vol. 1706, pp. 152–159, 2000.

[15] A. Okola, "Departure time choice for recreational activities by elderly nonworkers," *Transportation Research Record*, vol. 1848, pp. 86–93, 2003.

[16] F. Yang, X. Jin, and R. Liu, "Tour-Based Time-of-Day Choices for Weekend Non-work Activities," in *Proceedings of the 87th Annual Meeting of the Transportation Research Board*, Washington, DC, USA, 2008.

[17] M. Thorhauge, S. Haustein, and E. Cherchi, "Accounting for the theory of planned behaviour in departure time choice," *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 38, pp. 94–105, 2016.

[18] X. Jin, *toward Time-Of-Day Modeling for Long-Distance Trips*, 2007.

[19] X. Jin, J. Wu, and A. Horowitz, "Transferability of Time-of-Day Choice Modeling for Long-Distance Trips," in *Proceedings of the 88th Annual Meeting of the Transportation Research Board*, Washington, DC, USA, 2009.

[20] X. Jin and K. Chiao, "A Synthesis of Time-of-Day Modeling Research," in *Proceedings of the 87th Annual Meeting of the Transportation Research Board*, Washington, DC, USA, 2008.

[21] A. Monzón and A. Rodríguez-Dapena, "Choice of mode of transport for long-distance trips: Solving the problem of sparse data," *Transportation Research Part A: Policy and Practice*, vol. 40, no. 7, pp. 587–601, 2006.

[22] A. Frei, T. Kuhnimhof, and K. Axhausen, "Long Distance Travel in Europe Today: Experiences with A New Survey," in *Proceedings of the 89th Annual Meeting of the Transportation Research Board*, Washington, DC, USA, 2010.

[23] J.-L. Madre, K. W. Axhausen, and W. Brög, "Immobility in travel diary surveys," *Transportation*, vol. 34, no. 1, pp. 107–128, 2007.

[24] A. Frei, "Survey Issues in Long-Distance Travel," in *Proceedings of the 8th Swiss Transport Research Conference*, Ascona, Switzerland, 2008.

[25] B. Chaichannawatik and T. Limanond, "Long distance travel behavior of bangkok resident: a study on mode choice (in Thai)," *Kasem Bundit Engineering Journal*, vol. 3, no. 2, pp. 57–72, 2013.

[26] C. O'Fallon and C. Sullivan, "Understanding and Managing Weekend Traffic Congestion," in *Proceedings of the 26th Australasian Transport Research Forum*, Wellington, New Zealand, 2003.

[27] K. A. Small, "The scheduling of consumer activities: work trips," *The American Economic Review*, vol. 72, no. 3, pp. 467–479, 1982.

[28] C. Hendrickson and E. Plank, "The flexibility of departure times for work trips," *Transportation Research Part A: General*, vol. 18, no. 1, pp. 25–36, 1984.

[29] G. de Jong, A. Daly, M. Pieters, C. Vellay, M. Bradley, and F. Hofman, "A model for time of day and mode choice using error components logit," *Transportation Research Part E: Logistics and Transportation Review*, vol. 39, no. 3, pp. 245–268, 2003.

[30] J. Ortuzar and L. Willumsen, *Modeling Transport*, John Wiley & Sons Ltd, 1990.

[31] D. A. Hensher, J. M. Rose, and W. H. Greene, *Applied choice analysis*, Cambridge University Press, New York, NY, USA, 2005.

[32] W. Green, *NLOGIT 4.0: User's guide*, Econometric Software, Inc, 2007.

[33] Office of transport and traffic policy and planning (OTP), *Final Report, Transport Data and Model Integrated with Multimodal Transport and Logistics (TDL) Project*, Ministry of Transport, Bangkok, Thailand, 2015.

[34] J. LaMondia, C. R. Bhat, and D. A. Hensher, "An annual time use model for domestic vacation travel," *Journal of Choice Modelling*, vol. 1, no. 1, pp. 70–97, 2008.

[35] The Cabinet Secretariat, "Cabinet Resolutions dated October 15, 2013 on regarding the determination of adding special public holiday for 2013 and 2014," 2013.