Exploring the impacts of workday time use behavior on holiday time use behavior based on a MDCEV model: A comparison between urban and rural cities in Japan

Hajime WATANABE, Yoshihiro SATO, Makoto CHIKARAISHI, Eiji HATO, and Takuya MARUYAMA

Time-use behaviour on holidays is one of the crucial parameters to understand the characteristics of urban and rural city dwellers' activity-travel patterns. There are various factors affecting time-use behaviour on holidays, including individual attributes, quality of leisure facilities, and accessibility to these leisure facilities. This study particularly focuses on the effects of workday time use behaviour on holiday time use behaviour. In general, workers who work long hours during workdays spend more time on leisure activities during holidays. On the other hand, such effects may vary from one city to another due to differences in transport services and urban settings such as commuting time, congestion level, and distribution of leisure facilities. Understanding these effects is crucial to evaluate the impacts of transportation and land use policies on activity-travel patterns.

In this study, we examine how time-use behaviour on workdays affects the time-use behaviour on holidays of inhabitants in two cities in Japan: (1) Yokohama, which is highly urbanized and located in the Tokyo Metropolitan Area, and (2) Matsuyama, which is one of the rural cities located in West Japan and less urbanized compared to Yokohama. Even though the land areas are approximately equal for the two cities, the population sizes are different. There are around 4 million and 0.5 million inhabitants in Yokohama and Matsuyama, respectively. By applying a multiple discrete-continuous extreme value (MDCEV) model proposed by Bhat (2005&2008), we explore the differences in the impacts of workday time use behaviour on holiday time use behaviour between two cities, as well as the differences in the impacts of regional characteristics on time use behaviour.

Many time-use studies have been carried out over the years under activity-based approach by using traditional travel diary and time use survey data. However, most of them focus on time-use behaviour on one day or a few days mainly due to the limitation of data, which is not possible to capture weekly rhythms of time use behaviour. In this study, we use data collected through a long-term global positioning system (GPS)-based survey (called as Probe Person (PP) survey) to explore the weekly rhythms of time-use behaviour of inhabitants in Yokohama and Matsuyama. The data were collected in Yokohama from October to November 2009 (5 weeks) and in Matsuyama from February to March 2007 (5 weeks). The valid sample sizes for this analysis are 21 and 50 individuals for Yokohama and Matsuyama, respectively.

In the PP survey, the participants installed and activated the PP survey application on their own GPS-enabled mobile phones; In addition to automatic recording of activity timing and location through GPS, participants were required to input their travel mode and trip purpose in a supplemental web-

based questionnaire. The PP survey offers the following advantages over activity diary survey: (1) The departure/arrival time and activity location of each trip can be accurately recorded; (2) Both holiday and workday data can be collected over long periods; and (3) The habitual and non-habitual behaviours of the participants over the course of one month can be examined.

Next, we use the MDCEV model to represent time use behaviour which involves decisions on (1) the choice of leisure activity type and (2) the duration for the chosen leisure activity type. The leisure activity type considered in this study includes (1) recreation, (2) eating out, and (3) shopping. In empirical analysis, time use for other activities is considered as 'outside good'.

By using the MDCEV model, we have successfully determined a number of influential factors that are statistically significant (Table 1 and Table 2). We have also determined the statistically significant relationships between the time-use behaviour on workdays and the time-use behaviour on holidays of the workers. The key findings are summarized as follows: (1) Recreation time on workdays has a negative effect on recreation time on holidays for inhabitants in Yokohama whereas it has a positive effect on recreation time on holidays in Matsuyama; (2) Likewise, shopping time on workdays has a negative effect on shopping time on holidays in Yokohama whereas it has a positive effect on shopping time on holidays in Matsuyama; (3) Eating-out time on workdays in two cities are not statistically significant and it may have little effect on the holiday activities.

In addition, we found that work-related characteristics affect time-use behaviour on holidays. In Yokohama, workers with long commuting time on workdays tend to refrain from spending their time on eating out during the holidays. However, in Matsuyama, a different trend is observed: workers in Matsuyama tend to spend more time on eating out during holidays. In Yokohama, workers with long working hours tend to spend their time on shopping during holidays and hence, we can conclude that these workers may have insufficient time for shopping on workdays. In the presentation, we will also show the model estimation results which take into account the panel nature of data, by introducing the individual-level random term into the conventional MDCEV model.

References

1. Bhat, C.R., 2005. A multiple discrete-continuous extreme value model: formulation and application to discretionary time-use decisions. Transportation Research Part B 39, 679-707.
2. Bhat, C.R., 2008. The multiple discrete-continuous extreme value (MDCEV) model: Role of utility function parameters, identification considerations, and model extensions. Transportation Research Part B 42, 274-303.

Table 1 Estimation results of time use model on holiday in Matsuyama

Variable	Parameter	*t*-value	
Recreation (holidays)			
Constant	-5.99	-7.69	***
Average number of trips (workdays)	-0.31	-3.65	***
Age	-0.03	-1.36	
Female dummy	-0.87	-2.60	***
Recreation time (workdays)	1.15	1.89	*
Satiation parameter	105.64	3.09	***
Eating out (holidays)			
Constant	-7.07	-11.56	***
Average commuting time	0.55	2.49	**
Transfer counts in commuting	0.50	1.15	
Age	-0.04	-2.53	**
Recreation time (workdays)	-1.20	-1.85	*
Eating-out time (workdays)	0.40	0.65	
Satiation parameter	50.43	3.78	***
Shopping (holidays)			
Constant	-8.69	-13.58	***
Average working time	0.04	1.14	
Age	0.04	2.95	***
Female dummy	0.57	2.67	***
Shopping time (workdays)	0.79	2.27	**
Satiation parameter	10.84	6.25	***
Sample size, *N*		298	
Initial likelihood		-2576.08	
Final likelihood		-2536.20	

Table 2 Estimation results of time use model on holiday in Yokohama

Variable	Parameter	*t*-value	
Recreation (holidays)			
Constant	-9.22	-9.92	***
Average number of trips (workdays)	0.24	0.79	
Recreation time (workdays)	-4.21	-2.75	***
Eating-out time (workdays)	-6.44	-1.91	*
Shopping time (workdays)	4.05	3.41	***
Satiation parameter	80.80	2.22	**
Eating out (holidays)			
Constant	-9.89	-8.03	***
Average commuting time	-0.72	-1.73	*
Age	0.07	2.20	**
Eating-out time (workdays)	2.53	1.18	
Satiation parameter	36.56	2.92	***
Shopping (holidays)			
Constant	-8.56	-10.81	***
Average working time	0.21	2.44	**
Female dummy	2.25	2.59	***
Eating-out time (workdays)	8.45	3.87	***
Shopping time (workdays)	-2.53	-3.49	***
Satiation parameter	18.46	3.80	***
Sample size, *N*		122	
Initial likelihood		-1178.50	
Final likelihood		-1151.75	