Empirical Analysis on Inter-regional Tourism Demand in Japan Considering Trip Generation

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Abstract: In Japan, Japan Tourism Agency is founded in 2008 in order to correspond to increase in tourism demand. In the tourism demand modeling, trip generation, destination choice (traffic distribution), modal choice and tourism duration choice should be considered in the model system. Further, the improvement on inter-regional transportation facilities enables to tour several destinations in two or three days, therefore, the model adequately represents the possibility in touring around the destination. This study estimates the tourism demand model considering trip generation and the passenger traffic distribution simultaneously. By using the disaggregated data sampled from all the regions with the augmentation coefficient, characteristics in tourism demand in Japan such as attractiveness of the tourism resource, the possibility to tour around the destination, and the influence of demographic characteristics of trip maker, are clarified. The effect of the improvement in level-of-service of expressway is simulated.

Key Words: Tourism, Trip Generation, Regional Tourism Resource

1. INTRODUCTION

1.1 Background and Conventional Studies

The economic growth in Asian developing countries stimulates the demand for international tourism (Lim, *et. al*, 2008; Chang, *et. al*, 2009). Also in Japan, domestic tourism is increased due to the increase in the retired generation. In order to facilitate the seamless transportation, comfort and attractive environment in tourism, Japan Tourism Agency (JTA) is founded in 2008. JTA is expected to integrate all the tourism policies relating to tourist, transportation and tourism resources, which were conventionally covered by the different sectors of the government.

The difficulty in the management of tourism industries stems from both supply and demand side in tourism market. In terms of supply side, the policies to preserve the local environment to keep the sustainability as the tourism resource should be carefully maintained due to the limitation of capacity in the number of visitors, especially in case for the national park or the

world heritage area (Cawley and Gillmor, 2007). It is widely recognized that a concentration of visitors that is too high within a short time period will not only harm the environment at the destination, but will also discourage the repeat tourist. In order to avoid "the tragedy of commons" in the limited tourism resource, the consistent regulation, incentive policies and cooperation among the stake-holders which include transportation, accommodation service, restaurant, souvenir retailers, and local communities are very important. Adequate management of resource in tourism is the one of key issues to sustain and develop the local tourism industries (Limtanakool, *et.al,* 2006, Dwyer, *et. al*, 2009). On the other hand, Weng and Yang (2007) theoretically analyzed the conditions to concentrate / or to diversify the destination of tourism. They formulated the monopolistic competition model for the two city system with the different types in tourism resources. The comparative statistics on the proposed model clarified that the scale economy about the investment of tourism industry is the source of the concentration, while the preference in variety consumption drives the tourists into rural area. Their study also implies that the concentration of tourism at the limited number of destinations occurs parallel to the diverged destinations, under the lower transportation cost.

Concerning to the characteristics of trip maker and transportation, vast number of researches have been accumulated, which focus on the modal choice, time allocation and routing at destination (e.g. Bohler, *et. al*, 2006, Edy and Molner, 2002, and Jara-Diaz, *et. al*, 2008). However, only a few studies focus on the trip generation or the preference on transportation mode by non-monetary factors. Graham (2006) discussed the important factors to determine the airline demand in tourism. This study reported that the motivation of the tourism largely depends on the demographic characteristics of the trip maker. The trip makers who could not fulfill their motivation by the ready-made package tour tend to make the frequent tourism trips with short duration. Anable and Gatersleben (2005) investigated the determinants on the modal preference focusing on the monetary cost and subjective evaluation (e.g. stress-freeness or relaxation). They reported that subjective evaluation of transportation mode is almost equally weighted with LOS in leisure trip.

Jara-Diaz, *et. al* (2008) empirically measured the value of leisure time. In this study, the time allocation model derived by the utility maximization of tourist under the income and time resource constraint is empirically calibrated. The calculated value of leisure time is significantly high from the wage rate in European cities, while it was indifferent in U.S. cities. Jara-Diaz *et. al* discussed the reasons for such difference that the Europeans more positively recognize the time consuming leisure rather than the Americans. About retirees' expectation for leisure and tourism, Nimrod (2008) conducted a semi-structured interview survey for the recently retired persons in Southern U.S. cities. This study pointed out that the retirees wanted to realize the life-long interest tend to pay more for transportation in order to shorten the travel time. Heung *et. al* (2001) were focused on the Japanese tourists stayed at Hongkong in order to clarify the purpose and motivation. By applying the factor analysis and ANOVA to the estimated factors from the questionnaire survey, they found that the trip purpose of Japanese is significantly different with that of the other countries. Further, the importance on exploring novelty and shopping or food is significantly different among gender or generations.

The inter-regional trip is characterized by low trip generation, and longer travel time with low frequent transportation service. In the tourism trip planning, the trip maker faces very complicated alternatives to determine the schedule. The set of destinations, the duration of the tour, transportation among the destination, and the location of accommodation should be simultaneously considered in. Hatzinger and Mazanec (2007) conducted a conjoint analysis to

choose the tour package. By using the generalized log-linear model modified from the Bradley and Terry's model, they compared the cases in business and tourism trip. As the result, the age of trip maker was most important factor to determine not only the transportation mode, but also the destinations, total cost of the tour, and the duration of stay at the destination. March and Woodside (2004) focused on the planned and the realized schedule of inter-regional tourism. The comparison among the schedule clarified that the realized expense and the duration of stay at the destination are both larger than that of the planned. They also pointed out that the type of accompanied person and the number of visits in the past strongly influences on the tourism behaviors. Nicolau and Mas (2008) studied the tourism destination choice by applying the sequential destination choice mechanism. Based on the stated preference survey and the estimation of random coefficient logit model, the sequential destination choice to bundle the similar type of destinations is supported. In terms of tourism duration choice, Alegre and Pou (2006) estimated the model about the duration of stay at the destination. This study clarified the socio demographic characteristics of trip maker, and the characteristic of destination were very important factors to determine the duration of stay.

1.2 Purpose of Our Study

The provided transportation service in Japan is greatly improved in recent years so that tourists can step at the multiple areas within a short duration. Such the convenience is mainly achieved by the provision in rapid inter-regional transportation services as the local airports or the expressways. Tsukai and Okumura (2006) devised the short-cut algorithm to calculate the round trip area (RTA) within a day and maximum stay time at destination (MST). The calculated MST of each OD was regressed on the number of inter-regional airline passengers on business purpose. Through the regression analysis, the calculated MST significantly influences on the number of passengers.

The important implication from Tsukai and Okumura (2006) is that the improvement of transportation service will not always cause the increase of passengers for all regions. Again, Weng and Yang (2007) already pointed out that lower transportation cost will accelerate both the attracting the passengers from larger area and the diverging the passenger into rural area. Okumura and Tsukai (2008) estimated the inter-regional tourism passenger model including MST and the amount of tourism facilities as the attraction index at the destination, and at the neighbors of the destination. The estimated model showed that the parameter of MST was positive, while some of parameters in tourism facilities located in the neighbor of the destination were negative. Therefore, the compliment effect and competitive effect in tourism resource with the neighbor areas were simultaneously observed. The data set used in Okumura and Tsukai (2008), however, was the aggregated number of passengers. Therefore the estimated model did not include any information about the demographic characteristics of tourists. Referring the conventional studies, the influence of demographic characteristics of tourists (e.g. gender and generation) should be incorporated in the model in order to consider the demographic changes in Japan.

This study purposes an empirical model to clarify the characteristics of inter-regional tourism demand between all the regions in Japan. In the following analysis, we focus on trip generation, the trip distribution, the modal choice and trip duration choice. In order to clarify the influence of demographic characteristics of the trip maker on the trip generation, the trip generation and the passenger demand between each OD are simultaneously modeled using the censored simultaneous regression analysis (Nelson, 1977). The trip generation/distribution model is estimated by the aggregated number of passengers among the regions, while the

modal choice and tourism duration choice model are estimated by the disaggregated data recorded with the demographic characteristics of trip maker. However, we do not make an analysis on the trip destination choice due to the limitation of data availability.

The sections in this paper are organized as follows. **Section 2** shows the formulation of the model. **Section 3** shows the summary of data. **Section 4** shows the result of the estimated model. **Section 5** shows the result of simulation analysis. **Section 6** shows the summary and conclusions.

2. MODEL SPECIFICATION

2.1 Censored Simultaneous Regression Models for Regional Trip Generation

If the trip generation recorded for each trip maker, the discrete choice model is applied to predict the probability of individual sample, and the aggregated number of passengers in population is calculated from the probabilities weighted by the augmentation coefficients. If the aggregated number of generated tourism trips is recorded for each OD pair, the data set often includes zero observations. However, such zero observations would not immediately indicate no trip generation of the OD, because the OD table is estimated from the limited number of observations under the limited survey period. Therefore, the passenger demand model estimated from the data set omitting all the zero observations, i.e.; including only the positive observations would be biased, because the zero observations actually indicate "small number of trip generation". For tackling this problem, Okumura and Tsukai (2008) proposed a model to incorporate zero observations into the passenger demand model, instead to discard the information by "zero" observations. In the proposed method, the "zero" observations were treated as being censored at lower bound of minimal observation criteria, then a tobit model was applied for the log-transformed gravity model. However, the above approach still had the limitation, that the factors to influence on the censoring were not clarified.

In order to clarify the factors about the trip generation (or non-missing observation), we use the censored regression model with unobserved thresholds proposed by Nelson (1977). Consider the following models consist of eq. (1) and eq. (2).

$$y_{1i} \begin{cases} = \sum_k \beta_k x_{ki} + \varepsilon_{1i} & (y_{1i} \geq y_{2i}) \\ = 0 & (y_{1i} < y_{2i}) \end{cases} \tag{1}$$

$$y_{2i} = \sum_l \gamma_l z_{li} + \varepsilon_{2i} \tag{2}$$

where, y_{1i} is the dependent variable with stochastic error term ε_{1i}, y_{2i} is the unobserved stochastic threshold which gives the lower bound of observation of y_{1i} with stochastic error term ε_{2i}. Shown in eq.(1), y_{1i} is censored by y_{2i}. x_{ki} and z_{li} are the observed variables to give the expected values of y_{2i} and y_{1i}, respectively, β_k and γ_l are parameters, and $i = 1,...,N$ indicates the samples. Assume that ε_{1i} and ε_{2i} follow a bivariate normal distribution with the covariance matrix.

$$\Sigma = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix} \tag{3}$$

Nelson (1977) showed the identification condition for eq.(1), (2) and (3) is to fulfill one of the following two conditions; as $\sigma_{12} = 0$, or at least one variable in x_{ki} is different from z_{li}.

In order to derive the likelihood function, the sample set is classified into two groups: y_{1i} is observed, and y_{1i} is not observed. For the first group, we know $\varepsilon_{1i} = y_{1i} - \sum_k \beta_k x_{ki}$ and $\varepsilon_{2i} \leq y_{1i} - \sum_l \gamma_l z_{li}$, while for the second group, we only know $\sum_k \beta_k x_{ki} + \varepsilon_{1i} < \sum_l \gamma_l z_{li} + \varepsilon_{2i}$, because both y_{1i} and y_{2i} are not observed. Note that $\varepsilon_{1i} - \varepsilon_{2i}$ follows normal distribution with mean 0 and variance $\sigma^2 = \sigma_1^2 + \sigma_2^2 - 2\sigma_{12}$. Therefore, the unobserved probability is obtained as eq.(4).

$$P(y_{1i} < y_{2i}) = \Phi\left(\frac{\sum_l \gamma_l z_{li} - \sum_k \beta_k x_{ki}}{\sigma^2}\right) \tag{4}$$

where, $\Phi(\cdot)$ indicates a normal distribution function. Let $f(\varepsilon_1, \varepsilon_2)$ be the joint density function of ε_1 and ε_2. The likelihood function is written in eq.(5).

$$L(\boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\Sigma}) = \prod_i \left[\prod_{y_1>0} \int_{-\infty}^{y_{1i} - \sum_l \gamma_l z_{li}} f(y_{1i} - \sum_k \beta_k x_{ki}, \varepsilon_2) d\varepsilon_2 \prod_{y_1=0} \Phi\left(\frac{\sum_l \gamma_l z_{li} - \sum_k \beta_k x_{ki}}{\sigma^2}\right) \right] \tag{5}$$

Note that ε_2 conditioned by ε_1 follows normal distribution with mean $(\sigma_{12}/\sigma_1^2)\varepsilon_1$ and variance $\sigma_{2/1}^2 = \sigma_2^2 - (\sigma_{12}/\sigma_1^2)$. For simplicity, we drop the subscript i to indicate each sample.

$$P(\varepsilon_2 < y_1 - \sum_l \gamma_l z_l \mid \varepsilon_1 = y_1 - \sum_k \beta_k x_k) = \Phi(W) \tag{6}$$

$$W = \frac{1}{\sigma_{2/1}^2}\left[y_1 - \sum_l \gamma_l z_l - \frac{\sigma_{12}}{\sigma_1^2}(y_1 - \sum_k \beta_k x_k) \right] \tag{7}$$

The log-likelihood function can be written as eq.(8).

$$\log L(\boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\Sigma}) = N_1 \log \sigma_1 - \frac{1}{2\sigma_1^2} \sum_{y_1>0}(y_{1i} - \sum_k \beta_k x_{ki})^2 + \sum_{y_1>0} \log \Phi(W) + \sum_{y_{1i}=0} \Phi\left(\frac{\sum_l \gamma_l z_{li} - \sum_k \beta_k x_{ki}}{\sigma^2}\right)$$
$$\tag{8}$$

where, N_1 is the number of observations which y_1 is observed, $\sum_{y_{1i}>0}$ denotes the summation over the N_1 observations, and $\sum_{y_{1i}=0}$ denotes the summation over the $N - N_1$ observations.

Following Okumura and Tsukai (2008), we consider y_1 is the number of tourism passengers in log transformed, x_k s are the explanatory variables included in gravity model (i.e. potential, attractiveness and impedance) in log transformed. z_l s are the explanatory variables, which are the additionally introduced in this study, to explain the occurrence of 0 observation (censored). In order to simplify the discussion, all the estimates of γ_l are multiplied by -1, so that we can interpret the variable with the positively estimated parameter increases the trip generation possibility, while the variable with the negatively estimated parameter decreases it.

2.2 Modal Choice Model and Tourism Duration Choice Model

The modal choice model and tourism duration choice model are formulated by multinomial logit model. Considering the choice mechanism in tourism, trip generation, modal choice and tourism duration choice would not be independent. The simultaneous model including all of the above choices becomes too complex to estimate. Further, no information about the order of decision making is available. Therefore, we separately estimate the modal choice, or the

tourism duration choice. In order to keep the consistency between the trip generation /distribution model estimated by using the aggregated trip generation for each OD and the model or tourism duration choice model, the samples are weighted by the augmentation coefficient. The estimated log-sum values of modal choice model and of tourism duration model are used as the explanatory variables of the trip generation /distribution model. The weighted log of likelihood function; $L(\lambda)$, and log-sum variable; LS_i, are shown in eq.(9), and eq.(10), respectively.

$$L(\lambda) = \sum_i w_i \sum_j P_{ij}(\lambda) \tag{9}$$

$$LS_i = \log \sum_j \exp(\hat{V}_{ij}) \tag{10}$$

where, w_i is the augmentation coefficient recorded for each sample i, $P_{ij}(\lambda)$ is the choice probability of sample i for alternative j, λ is the vector of the parameter of utility function, and $\hat{V}_{ij}$ is the expected value of utility function.

3. DATA

3.1 Inter-regional Net Passenger Traffic Survey

The inter-regional net passenger traffic survey of Japan started in 1990, and repeated in every 5 years, which covers car, railway, airline and ship passengers from all the regions in Japan. The objective of this survey is to provide the fundamental information to plan the inter-regional transportation infrastructure. The samples are collected by the questionnaire survey for each of modes. Each sample have the augmentation coefficient based on the gross passenger traffic at several control sections, and it is aggregated in the inter-regional OD tables by each of trip purposes, or each of transportation modes. The aggregated OD tables are available on the website of Ministry of land, transportation, infrastructure and tourism of Japan. The summary and report about the survey are also available (MLTIT, 2007). After the third survey in 2000, the disaggregated samples with the augmentation coefficient for each record are available. Inter-regional tourism passenger traffic data used in this study is car, rail and air passengers surveyed at holiday in 2005. We use the OD table aggregated for 207 areas which records the traffic from the residential area to the main destination. Note that this survey excludes the intra trips made in each prefecture, or the intra- regional trips in the three metropolitan areas around Tokyo, Nagoya and Osaka cities, in order to omit the short distance trips. We used 194 areas out of 207 areas, the excluded areas are remotely isolated islands.

Figure 1 shows the demographic characteristics of tourism passenger. Note that the sample is aggregated with the augmentation coefficient. The number of male passengers is larger than that of female, which may be happened because the representative respondent of the questionnaire survey tends to be male in Japan. **Figure 2** shows the cross aggregation between transportation modes and tourism durations. As shown in **figure 2**, the passengers of public transportation tend to take the schedule over two days, while over 80 % of car users finish the trip within a day. **Figure 3** shows the cross aggregation between transportation modes and trip distance. Car trip is dominant below the 300 km, the largest share of rail appears in 300 to 500 km with over 60%, while the large share of air is seen over 500 km with over 60%.
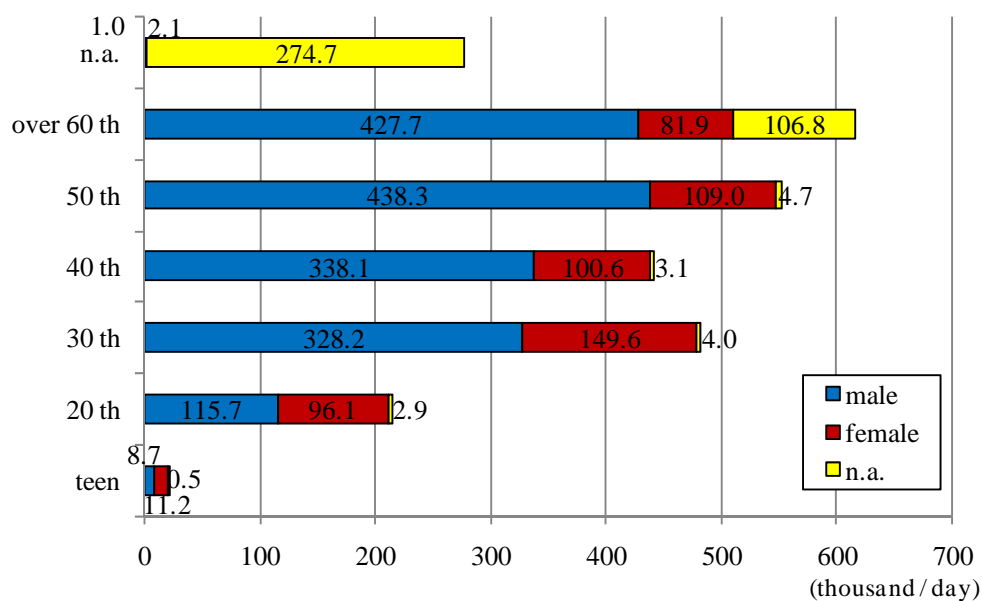
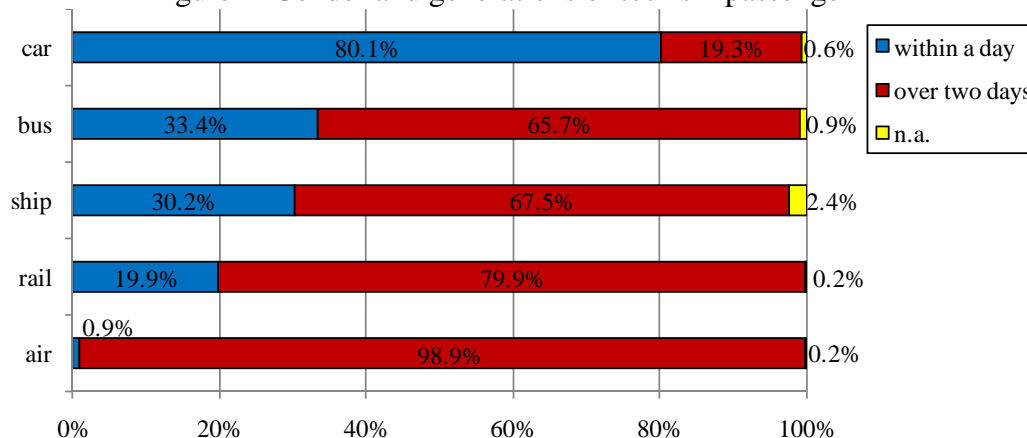Figure 1 Gender and generations of tourism passenger

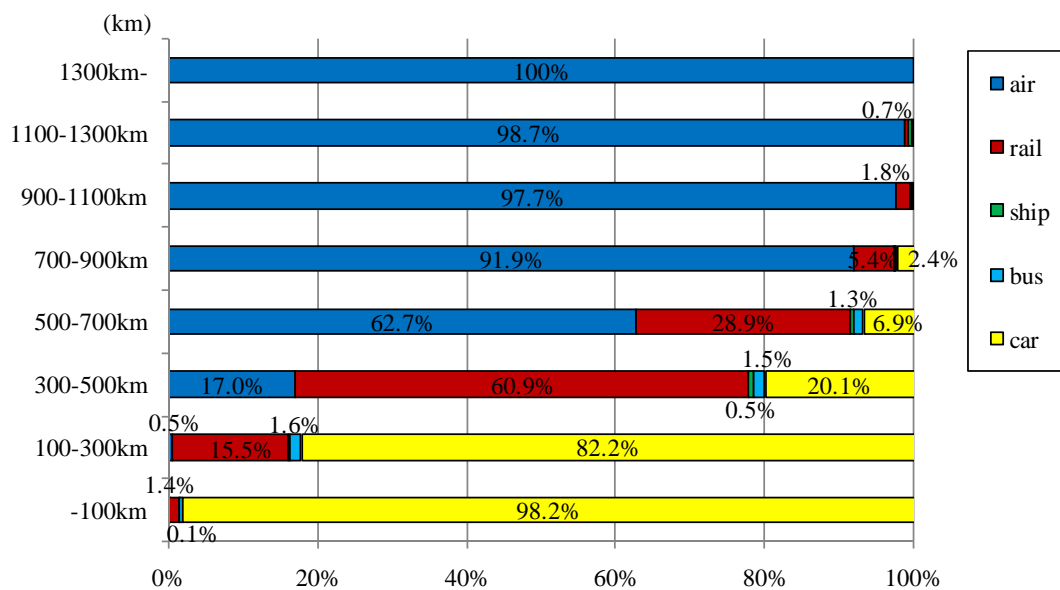Figure 2 Transportation modes and tourism duration

Figure 3 Transportation modes and trip distance

3.2 Calculation of Maximum Stay Time at Round Trip in a Day

Since the information about the level of service used in the modal choice model is not surveyed, we calculate it for each OD. Following the previous study, we take into account the influence of the round trip area (RTA) and the maximum stay time at the round trip in a day at the destination (MST). The RTA from an origin area consists of the destinations where MST is positive. The MST for each OD pair and RTA for each origin node are defined in eq.(11), eq.(12), respectively.

$$MST_{ij} = \overline{D}_{ji} - \overline{A}_{ij} \tag{11}$$

$$RTA_i = \{j \,|\, MST_{ij} > 0\} \tag{12}$$

where, $\overline{D}_{ji}$ and $\overline{A}_{ij}$ are the latest departure time at destination j to arrive at origin i up to 24:00, and the earliest arrival time at destination j departed after 6:00 at origin i. The difficulty occurs to calculate the exact MST because it requires the time table for trains, flights and ships including whole Japan. Tsukai and Okumura devised a short cut procedure to approximately calculate the MST for all OD pairs (2006).

In order to calculate MST and level-of-service for all ODs, inter-regional network database is made to keep the correspondence with the areas used in the inter-regional net passenger traffic survey. The dataset consists of 240 nodes with 501 links. Attributes of each link are travel time, frequency, and modal information (railway, airline, and access link). The frequency is recorded for each 3 hours, such as 6:00-9:00, 9:00-12:00,…, 21:00-24:00. Therefore, there are 6 durations for one direction, so then the frequency dataset for a link is 12 attributes. The level of service of the time table is made from a published time table in November in 2005. In this study, round trip area is defined as the set of returnable areas departing after 6:00 up to 24:00.

3.3 Regional Tourism Resource

The data base in regional resource of tourism, and demographic characteristics are made from the national statistics, or referred to the web site. The source of data is summarized on **Table 1**. The last column shows the categories of data source.

Table 1 Summary of regional database

Variables	Data source	Category
Population Gender and generations	National census	(1)
Forest / Developable area Number of museum	Statistics in city and town (ASAHI news paper company "Minryoku")	(2)
Famous hot spring	Ministry of the environment, bureau of national environment :annual report on hot spring http://www.env.go.jp/nature/(last visited at 2009.1)	(3)
World heritage National park Natural preserved area Disney land Hakkeijima Theme park Traditional area Traditional buildings	The data base for regional tourism resource http://www.kankouchidokuri.jp/(last visited at	(4)

4. Result of the Model Estimation

Table 2 shows the estimated parameters of the tourism modal choice model. The adjusted rho squared index is 0.525, so the fitness of the model is fairly good. As level-of-service variables, fare and travel time are negatively significant. Number of accompanied person is negatively significant in air, but positively significant in car.

Table 2 Tourism modal choice model

	explanatory variable	estimate		t-value
commmon	fare (thousand yen)	-0.072	**	-71.19
	travel time (min.)	-0.005	**	-102.33
air	number of accompanied pearson	-0.163	**	-88.71
car	number of accompanied pearson	0.005	*	2.44
rail	constant	-2.107	**	-191.24
	likelihood at initial	-126243.74		
	likelihood at convergence	-59902.75		
	Rho Squared, adjusted d.f.	0.525		
	number of samples	114912		

significant level +: 10%, *: 5%, **: 1%

Table 3 shows the estimated parameters of the tourism duration choice model. The adjusted rho squared index is 0.728, so the fitness of the model is quite good. In order to check the non-linear effect on utility, the dummy variables are defined for each MST categories. Most of the MST categories on the duration within a day are significant, but they are significantly negative up to 10 hours. Further, they are not monotonically increased as the increase of MST. The tourists come from the origin with the MST between four to six hours, will not choose such destination as a target area of tourism within a day. The parameters in gender and generations set at alternative specific variables of two days and of over three days are mostly significant. Since the number of respondents is small in the teen and twentieth generation, these two generations are unified. Concerning to the demographics, female from thirties to fifties and over the sixties prefer longer duration then the others. The parameters for trip destination area are mostly significant. Comparing the parameters for Tohoku, Hokuriku, Shikoku and Kyusyu have negative parameter, while Kanto, Kinki, and Chubu, which correspond to the area with large population, have positive parameters. Only Shikoku is the destination preferred over three days stay than two days stay.

All the variables about the tourism resource in this model are defined as the resource in the neighbor areas except the destination. The estimated parameters would clarify the contribution of the neighbor tourism resource on the tourism demand around the destination. In this analysis, the "neighbor" is defined as the areas where MST is over twelve hours from the recorded destination (not from the origin). The result showed that the destinations being the neighbor of famous hot spring, national park or natural preserved area, Hakkeijima in Yokohama area, and world heritage will attract the longer stay, while the destinations being the neighbor of Disney land will attract the shorter stay. The absolute difference in temperature and longitude significantly prolong on the touring duration as the differences increase, and they contribute more for over three days trip. Tourists prefer the longer stay if the difference in climate or geographical feature is large.

Table 4 shows the estimated parameters of the tourism trip generation/distribution model formulated as a sample selection model. Note that on this table, "O" and "D" denote the origin and the destination, respectively. The correlation coefficient for the trip generation is

Table 3 Tourism duration choice model

explanatory variables		Within a day			two days			over three days		
		estimate		t-value	estimate		t-value	estimate		t-value
MST below 2 hours		-1.077	**	-10.04						
MST from 2 to 4 hours		-1.939	**	-18.26						
MST from 4 to 6 hours		-2.163	**	-19.43						
MST from 6 to 8 hours		-1.370	**	-15.21						
MST from 8 to 10 hours		-0.835	**	-9.76						
MST from 10 to 12 hours		-0.030		-0.34						
MST over 12 hours		1.609	**	17.92						
teens and 20s	(1)				0.764	**	25.19	0.806	**	11.13
male from 30s to 50s	(1)				-0.704	**	-31.69	-0.709	**	-13.25
female from 30s to 50s	(1)				0.264	**	10.98	0.428	**	7.25
male over 60s	(1)				-0.632	**	-26.05	-0.049		-0.90
female over 60s	(1)				0.849	**	24.71	1.583	**	22.71
Hokkaido dummy					0.169	**	5.69	-0.321	**	-4.89
Tohoku dummy					-0.057	+	-1.69	-0.391	**	-7.70
Kanto dummy					0.610	**	20.61	0.347	**	8.66
Hokuriku dummy					-0.278	**	-5.89	-1.428	**	-15.72
Chubu dummy					0.339	**	10.49	0.052		1.19
Kinki dummy					0.479	**	14.21	0.400	**	7.74
Shikokudummy					-0.425	**	-6.58	-0.367	**	-3.28
Kyusyu dummy					-0.014		-0.46	-0.289	**	-5.32
number of museum at neig. of D	(2)				0.000	**	4.18	0.002	**	15.60
famus hot spring at neig. of D	(3)				0.749	**	40.03	0.503	**	10.25
world heritage dummy at neig. of D	(4)				0.178	**	9.14	0.018		0.52
national park / natural pres. area dummy at neig. of D	(4)				0.231	**	16.53	0.112	**	4.00
"Disney land" dummy at neig. of D	(4)				-0.094	**	-3.40	-0.346	**	-8.66
theme park dummy at neig. of D	(4)				0.115	**	4.82	0.503	**	11.79
traditional area dummy at neig. of D	(4)				0.017		0.68	-0.040		-0.89
traditional buid. dummyat neig. of D	(4)				-0.032	*	-2.05	0.059	*	2.28
"Hakkeijima" dummy at neig. of D	(4)				0.371	**	12.63	0.524	**	12.37
seaside dummy at neig. of D					0.585	**	45.14	0.619	**	35.84
difference in temp.|O-D|	(2)				0.028	**	6.97	0.027	**	5.73
difference in long.|O-D|					0.517	**	37.71	0.889	**	54.99
constant					-2.911	**	-29.65	-4.093	**	-31.68
likelihood at initial					-126243.74					
likelihood at convergence					-34298.57					
Rho Squared with adjusted d.f.					0.728					
number of samples					114912					

The marks with explanatory variable ((1) to (4)) correspond to the categories in table 1.

significant level +: 10%, *: 5%, **: 1%

not so high, while the coefficient for the gravity model is not so low. Again, the parameters in trip generation model are shown with multiplied by -1, therefore the variables with positively estimated parameter are the factor to cause trip generation, and *vice versa*. Covariance parameter is positive and significant but very small, therefore the factors to contribute the trip generation and number of tourism trip would be successfully identified. Among significant variables in the trip generation model, developable area at the origin, famous hot spring at origin, national park, natural preserved area, and traditional buildings are positive, while number of museum and world heritage area are negative. Fractions of the combination of gender and generations show that female are contributing to the trip generation, except the female in the fourteens. The parameter of the areal population is positively estimated.

Table 4 Tourism trip generation/distribution model

explanatory variables		trip generation model			gravity model		
		estimate		t-value	estimate		t-value
log sum in transportation					1.093	**	61.45
log sum in schedule					0.534	**	37.24
population at O	(1)	0.161	**	4.33	0.719	**	39.26
frac. of male in the 20s at O	(1)	0.452		1.08			
frac. of female in the 20s at O	(1)	1.653	**	3.41			
frac. of male in the 30s at O	(1)	-0.003		0.00			
frac. of female in the 30s at O	(1)	-0.163		-0.20			
frac. of male in the 40s at O	(1)	6.816	**	7.67			
frac. of female in the 40s at O	(1)	-5.513	**	-6.53			
frac. of male in the 50s at O	(1)	-7.841	**	-11.67			
frac. of female in the 50s at O	(1)	7.095	**	11.79			
frac. of male over 60s at O	(1)	-0.410		-0.64			
frac. of female over 60s at O	(1)	1.132	*	2.18			
forest area at O (km2)	(2)	-0.005		-0.62			
developable area at O (km2)	(2)	0.160	**	3.05			
number of museum at O	(2)	-0.091	+	-1.89			
famus hot spring dummy at O	(3)	0.176	**	3.19			
world helitage dummy at O	(4)	-0.099	+	-1.65			
national park dummy at O	(4)	0.112	*	2.34			
natural pres. area dummy at O	(4)	0.172	**	3.44			
theme park dummy at O	(4)	0.034		0.40			
traditional area dummy at O	(4)	0.161		1.30			
traditional buid. dummy at O	(4)	0.097	*	2.45			
Hokkaido dummy at D					1.722	**	20.14
Tohoku dummy at D					0.328	**	5.29
Kanto dummy at D					0.110	+	1.83
Hokuriku dummy at D					0.020		0.27
Chubu dummy at D					-0.170	**	-2.78
Kinki dummy at D					-0.225	**	-3.53
Shikokudummy at D					0.027		0.40
Kyusyu dummy at D					0.871	**	13.35
forest area at D (km2)	(2)				-0.085	**	-11.80
developable area at D (km2)	(2)				0.156	**	3.43
number of museum at D	(2)				0.606	**	14.57
famus hot spring dummy at D	(3)				0.395	**	8.43
world helitage dummy at D	(4)				0.155	**	2.80
national park dummy at D	(4)				0.362	**	9.14
natural pres. area dummy at D	(4)				0.129	**	3.11
"Disney land" dummy at D	(4)				2.068	**	9.96
theme park dummy at D	(4)				0.165	*	2.40
traditional area dummy at D	(4)				0.596	**	6.13
traditional buid. dummy at D	(4)				0.202	**	5.91
"Hakkeijima" dummy at D	(4)				1.022	**	5.52
seaside dummy at D					0.247	**	7.81
difference in temp.|O-D|	(2)				0.094	**	10.93
difference in long.|O-D|					-0.228	**	-13.71
constant		2.945		0.73	-8.477	**	-17.96
sigma in selection		1.897	**	18.64			
sigma in gravity					3.076	**	40.77
covariance					0.058	*	2.18
positive observation				12514			
number of sample				36346			
fraction of positive sample				0.344			
correlation coefficient			0.604			0.674	

The marks with explanatory variable ((1) to (4)) correspond to the categories in table 1.

significant level +: 10%, *: 5%, **: 1%

Considering the tendency of these signs of tourism resources, the tourism trip would tend to generate from the rural regions, after adjusted by the population size of the origin area. **Figure 4** shows the plot about the tendency of trip generation per capita. Note that $\Phi(\hat{y}_{2i})$ is calculated from the deterministic part of trip generation function y_{2i} in which all of the factors relating the origin area are included. The potential of tourism trip generation per capita is higher in Hokkaido, Tohoku, Kanto and Kyusyu area. Except Kanto, the tendency of the trip generation in **figure 4** is consistent with the parameters in **table 4.**
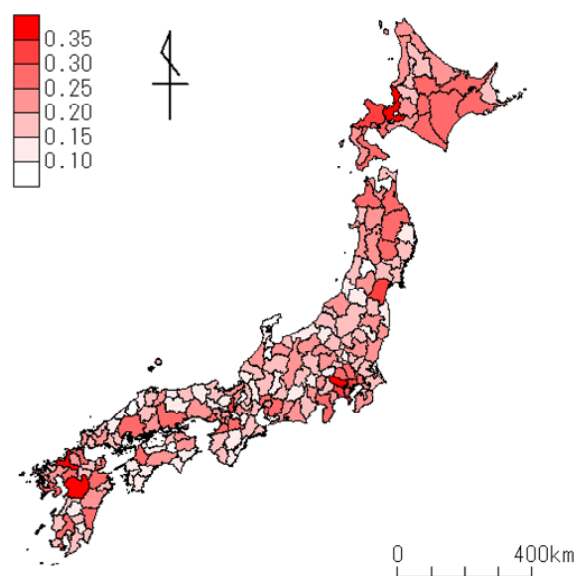
Figure 4 Tendency of tourism trip generation, a plot of $\Phi(\hat{y}_{2i})$ per capita

In gravity model, the log sum parameters for the modes and the trip duration are both positive and highly significant. Among the parameters in terms of the destinations, Hokkaido, Tohoku, Kanto and Kyusyu have positive and significant, while Chubu and Kinki have negative and significant. All the regional tourism resource parameters are positive and significant. Based on t-values, the most significant factor to determine the tourism destination choice is the number of museums, and the following factors in descending order are as follows; "Disney land", "national park", "sea side", "famous hot spring", "traditional area", "traditional building", "Hakkeijima", "world heritage", "theme park" and "natural preserved area". Considering the above order, the tourism heading to the urbanized areas is dominant in Japan. Interestingly, absolute difference in temperature is positive and significant, while absolute difference in longitude is negative and significant.

The absolute difference in temperature can occur by the difference in altitude and not always observed in the long distance trip. However, the difference in longitude is always required long trip, then it could work as the impedance. Parameters of the forest area and developable area are significant, negative and positive, respectively. The parameter of areal population is positively estimated, and its value is larger than trip generation model, hence the area with larger population will increase the possibility of trip generation.

5. SIMULATION ANALYSIS

We set the two scenarios to simulate the effect of level-of-service improvement. The simulated cases are the discounting all the expressway fare at 30% (case 1), and the introducing the super express railway between Tokyo and Osaka in 1.5 hours (case 2). **Figure 5** shows the result of the simulation in case 1 by aggregating the demand at each origin, or destination, respectively. The passenger increase from the origins is almost proportional to the population of each area, and that heading to the destinations is almost similar with the case of origin. In case 1, we can find that 5 to 15 % increase of tourism passengers in holiday. **Figure 6** shows the result of the simulation in case 2. The setting of case 2 is supposed to introducing the MAGLEV (magnetic levitation) train, which would decrease the travel time about 40% comparing with the existing "Shinkansen" express railway between Tokyo and Osaka.
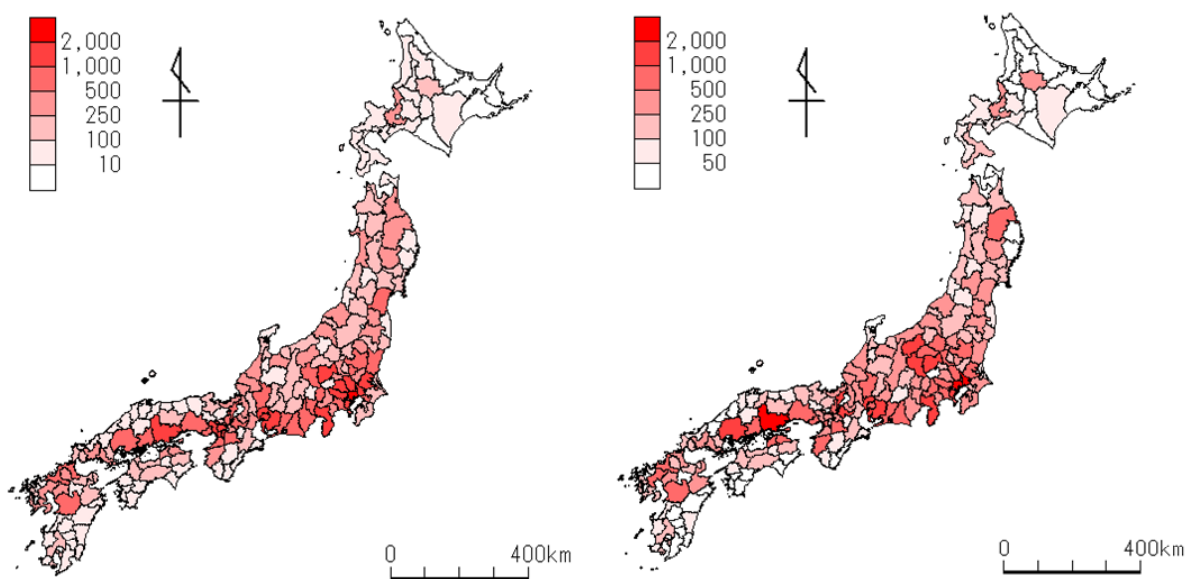

Figure 5 Increase of passengers in case 1; expressway fare discount
(left: aggregated by the origin, right: aggregated by the destination, trips / day)
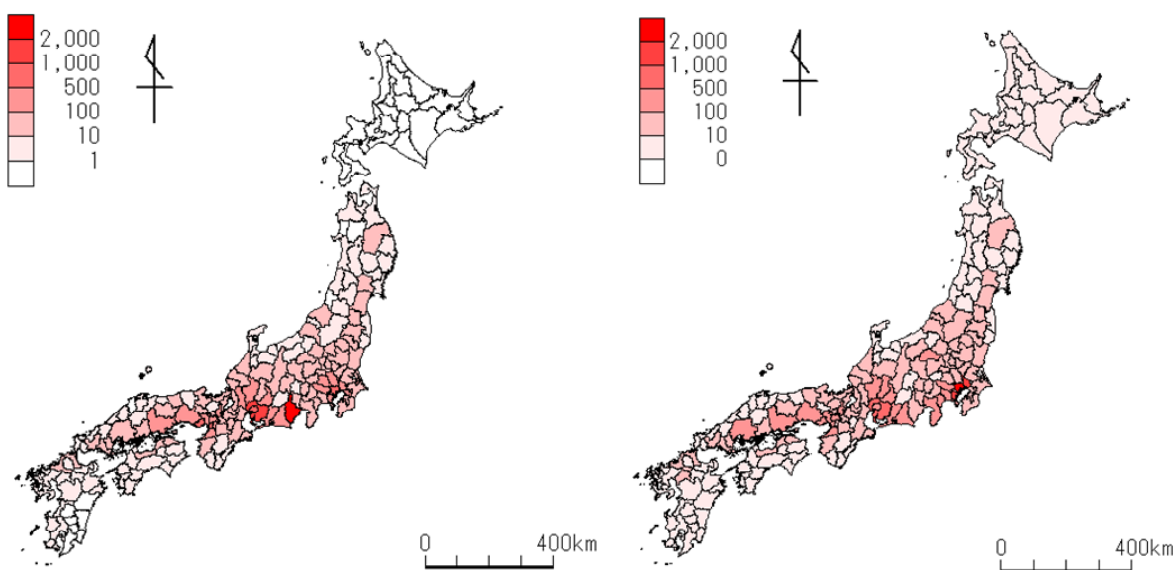

Figure 6 Increase of passengers in case 2; super express railway between Tokyo and Osaka
(left: aggregated by the origin, right: aggregated by the destination, trips / day)

In **figure 6**, we can find that the increase in tourism demand is seen for almost all areas, even in the LOS improvement by MAGLEV is set between Tokyo and Osaka. Therefore, the multimodal use of railway service would increase the tourism demand heading to the broader destinations.

6. SUMMARY AND CONCLUSION

In order to clarify the characteristics of tourism demand in Japan considering the attractiveness of regional tourism resource, the possibility in corporation among the tourism resources located in the neighbor regions, and the influence of demographic characteristics of trip maker, the simultaneous model of the trip generation and the distribution of tourism is estimated. From the tourism duration choice model, MST (maximum stay time at destination within the round trip in a day) nonlinearly influence on the utility of the trip within a day. The passengers with MST from four to six hours have lower utility to choose the trip within a day. In terms of gender and generations, female or over sixties tend to prefer the longer trip duration than the other demographic groups, which corresponds to the target in tourism industry, as often referred. Corporation with the famous hot spot and national park or natural preserved area will effectively prolong the duration of tourism. The estimated parameters in the tourism generation / distribution model showed that most of the female except forties largely contributes to the trip generation. If the other conditions are identical, the trip generation from the rural area tends to be larger than the urban area. In terms of trip distribution, the tours to urbanized area or "Disney land" as well as the tours to traditional area and hot spring seem to be dominant in Japan. The absolute difference in temperature between origin and destination area significantly contributed the destination attractiveness. Therefore, the tourist would expect the novel experience at the destination with the different climate condition. From the view point of tourism resource management, the maintenance policy to keep the novelty felt by the distant tourists is important.

Remaining issues are as follows. Trip destination choice was not directly modeled due to the less variation of the choice set at determining the destination, and their detailed LOS information. Additional survey to fill up such information is required. For the modeling aspect, the size and classification of the touring destination recognize by the trip maker should be carefully modeled (Eymann and Ronning, 1997). Further, longitudinal comparison of tourism demand will shed light to clarify the cohort effects on the trip generation.

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