abstract

The effect of travel service establishment/demolition on time-series change of inter-city travel patterns

In the future, the demand for inter-city travel in Japan will decrease because of diminishing population. This decline in demand may result in some public travel services becoming unprofitable. Then, the subsidies from the local governments make a important role, because the policy of subsidies directly decide the existence of the service. But on account of their limited budget, it is next to impossible to keep the existence of all travel services by subsidies. Therefore, it is important for local governments to assess the effects of each travel service existence on inter-city travel patterns, and to check the substitution levels between other travel services.

In this research, this effect are analyzed from the 20 years data of Japanese inter-city travel patterns. And we propose the inter-city travel demand model for assessing the effect. This model is constructed two sub-models. First one is the destination and mode choice model, and second one is the travel frequency distribution model.

In chapter 3, the destination and mode choice model are formulated. And the parameters are estimated by the five time-points repeated cross-sectional data of Inter-Regional Travel Survey in Japan. This survey started in 1990, and repeated in every 5 years, which covers five modes (car, rail, airline, bus and ship) and domestic inter-prefecture travel from all regions in Japan. The features and contributions of this chapter are following two points.

First point is that this model can explain the different cross-elasticity between destinations in order to express the change of destination choice ratio accurately. Most inter-city travel demand model (ex. Kato et al., 2011) assumed the equal cross-elasticity between destinations, because of the limitation of Nested Logit model (NL model). In this research, we apply the Generalized Nested Logit model (GNL model) to destination and mode choice. This model allows the similarity between alternatives of same mode and different destination, as a result the cross-elasticity between destinations can be different. Parameter estimated result indicates that there is the similarity between alternatives of same mode and different destination. In other words, travelers tend to change their destination to the zones where they can access easily by same mode. This trend is important for assessing the destination change caused by the travel service establishment/demolition.

Second point is “decomposition approach”. The existences of travel services are strongly related with some socio-economic conditions of zones. Then, some socio-economic conditions are able to cause bias for estimating the effect of travel service existence as ‘covariates’. In most previous work, they controlled the effects of major social-economic indexes, like population, average income and so on. However, any other un-observed effects may affect as ‘covariate’ and cause bias. In this research, we focus on the difference of affected target between social-economic conditions and travel service establishment/demolition. Social-economic conditions affect on zone level, on the other hand, travel service establishment/demolition affect on link level. In the “decomposition approach”, the zone level difference of travel pattern are controlled in order to estimate the parameters for the effects of travel service existence. This approach enable us to remove bias caused by all covariates which affect on zone level. We compare the model derived from decomposition approach with that from previous approach. As the result from the comparison, it was concluded that the model from previous approach very likely to be biased, and the model from “decomposition approach” are more stable for time and expected to forecast the future travel patterns more accurately.

In chapter 4, the travel frequency distribution model are formulated. We apply this model to the repeated cross-sectional data of travel frequency distribution data for the past 20 years, and analyze the effects of travel service establishment/demolition on travel frequency distribution. This data are sourced from the National Survey on Time Use and Leisure Activities of Japan, a questionnaire with large-scale samples.

This model express the travel frequency distribution as the combination of three groups; selective group in which individuals choose their travel number randomly, zero frequency group in which individuals never travel, and high frequency group in which individuals always travel more than 10 times per year. Then, the shape of a travel frequency distribution are explained by three parameters; two of them explain the component ratio of three groups and the other parameter explain the average travel frequency of selective group. Here, we estimate the three difference of each three parameters; (1) age, (2) birth cohort and (3) spatiotemporal difference from the travel frequency data.

The estimated results indicated that the average annual travel frequency decreased for 20 years, the zero frequency ratio is increasing, and these time series changes can be explained by the changes in age composition and differences among birth cohort.

Using this estimated results, we forecast the travel frequency distribution until 2060, considering changes in age composition. The results indicates that: by 2040, the total overnight sightseeing travel volume will decrease 40 million from that in 2010.

Moreover, we estimate the effect of travel service establishment/demolition on travel frequency distribution from the regression analyses of estimated spatiotemporal differences.

We apply these models to forecast the effects of Hokuriku High Speed Railway establishment in chapter 5. Then, we quantify and summarize the features of are the effects of travel service establishment on inter-city travel patterns.

This analysis and estimated parameters in chapter 3 and 4 lead to the following three sentences about the effects of travel service establishment/demolition.

First one is that indirect effect on destination choice is none or negative. This indirect effect is that the travel service establishment/demolition firstly affect the social-economic condition, secondly this change of social-economic condition affect the destination choice ratio. In the "decomposition approach", this indirect effect are estimated dividedly. The estimated result indicate that there are negative indirect effect on business and private travel and no indirect on sightseeing travel.

Second one is that travel service establishment (demolition) increase (decrease) the travel volume, but it cannot change the component ratio of zero frequency group. Component ratio of zero frequency group is different between prefectures and increasing for 20 years. However, the travel service establishment cannot change this trend.

Third one is that 'destination change' is larger than the 'the change of travel generation volume' in the effect of travel service establishment/demolition. For example, Hokuriku high-speed railway increase travel volume to Ishikawa and Toyama, however most of this change are caused by 'destination change'. Therefore travel volumes to other prefectures decrease. This conclued that travel service establishment/demolition will change the allocation of intercity travel or communication. On the other hand, the effect on total travel volume is smaller than the effect on allocation.