Sample comparison in net passenger transportation survey and home based web survey

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In Japan, Net Passenger Transportation Survey (NPTS) gives very valuable information to the researchers and transportation planners. The latest survey was conducted in 2010, and the next survey is preparing for 2015. Conventional NPTS is mainly based on the on-site questionnaire survey for the passenger, which costs relatively expensive. In order to improve the efficiency of NPTS survey, alternative survey channel such as home-based survey would be promising. This study compares the sample characteristics of NPTS and off-site (home based) survey through the internet. The comparison between conventional NPTS and home based survey clarified the difference and indifference of these survey methods.

Key Words : *minimum route frequency, propensity score, gravity model*

1. INTRODUCTION

In Japan, Net Passenger Transportation Survey (hereafter, NPTS) which summarizes inter-regional passenger flow with representative mode and trip purpose has been provided valuable information to inter-regional transportation planning since 1990. NPTS is a composite survey to integrate several sources such as gross passenger flow and cross-sectional volume observation with on-site questionnaire for the passenger. The notable characteristics of NPTS are to provide on-site questionnaire samples with expansion weights as to match the observed cross-sectional volume. The dataset enables disaggregated analysis for route or destination choice behavior to be consistent with macro demand. When a design for a connection between different modes on the inter-regional network (Guo & Wilson, 2011), a detailed route demand obtained by NTPS is neccesary. The problems in NPTS, however, are the huge cost in survey conduct and missing in seasonal demand change, often required in tourism demand analysis. In order to improve the efficiency of survey, alternative survey methods should be considered.

For example, GPS survey is often applied in recent transportation survey to capture a detailed travel behavior and a transition of the demand (Bohte & Maat, 2009). Note that an additional survey in the attributes of respondents, trip purposes or trip modes are required since GPS only gives the locational information. As other survey method, a home-based web survey is also expected to be dominant. Correia and Viegas (2011) collected a stated preference for the car pooling system by using web survey. Liebe *et al.* (2015) compared the influence of internet device type on choice behavior, and then clarified that the data quality is indifferent between the devices. As shown in these studies, a web survey is conveniently introduced as a novel transportation survey method in demand estimation.

Even that web survey is accumulating its reliance as a novel method, further inspections are required to sub-stitute the on-site questionnaire survey about the sample property. This study compares the sample characteristics of NPTS and off-site (home based) survey through the internet. By comparing the sample charateristics of the two surveys, the property of the obtained sample is clarified.

2. SUMMARY IN SURVEY METHODS

(1) Net Passenger Traffic Survey

The net passenger traffic survey in inter-regions

started in 1990, and repeated in every 5 years, which covers car, railway, airline, bus 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 has 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. 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 in 2010. Note that this survey excludes the intra-trips made in each prefecture, or the intra-regional trips in Kanto area, in order to exclude the short distance trips frequently made in daily activities.

The survey items about their trip are as follows: origin, destination, representative mode, route information, trip schedule and trip purpose. The items about personal attributes are sex, age, occupation and accompanied persons.

(2) Web survey for inter-regional passengers

A web survey on inter-regional passenger travel was conducted in 2011. The outline of this survey is shown in **Table 1**. The survey target is the persons with over 18 age who have made the inter-regional travel by themselves. The respondents with their own internet connection are preliminarily registered as monitor in a survey company. In order to keep the representativeness of the obtained sample, sampling rates for each subgroup in sex with generations are designed to be proportional with the national census in 2010. In order to collect the non-trip makers, a screening condition about the trip generation was set in the middle of questionnaire. Therefore, the web survey can estimate the trip generation rate with the non-trip makers.

A respondent of the survey answer the personal attribute items and inter-regional trip frequen-cy in the latest 12 months, which is the screening question to observe no-trip makers. The respondents with no trips were screened out at this point, so then their personal at-tributes were available. The respondents with some trips in the latest 12 months stepped into further ques-tions in the trips they made (up to three trips from the latest). The survey was designed to terminate at get-ting 2000 samples with making trips.

Table 1 A web survey for inter-regional passengers

Survey date	19:00, 10.29 to 13:00, 10.31 in 2011
Target	Over 18, male and female in whole Japan
Survey monitor	Cross-marketing Co-ltd. in Japan
Control items	Every 10 years age, male and female proportion are controlled to be similar with national census in 2010
Screening condition	No trip respondents in past three months are eliminated from the latter half of questionnaire: asking about the details of the trip they made
Items	
-Personal attributes	Sexuality, age, home address, occupation, annual income, household characteristics
-Transportation related services	Mobile phone, transportation IC card, mileage service in aviation, web-reservation service for HSR(SHIN-Kansen) in railway
-Travels except commuting or schooling	Frequency of inter-regional trip in the latest 12 months*, *Details in the past three trips (trip generation timing, schedule, OD, mode, discounting service, fare, payer of the fare, re-visiting frequency to same OD)*

*note: All the respondents answer up to this question, and the following questions (in *italic*) are an-swered by those who makes some trips in a year.

3. COMPARISON BETWEEN NPTS AND WEB SURVEY

Since the number of samples in NTPS is huge but that of web survey is limited, a basic reliance is quite different. For simplicity, we select the samples which respondent live and trip from the southern Kanto area such as Tokyo, Chiba, Saitama and Kanagawa. After using the criteria, we get 1,401 samples in web survey and 48,527 samples in NPTS. Because the number of NTPS's samples is very large compared to that of web survey, we made some comparisons as share of trip distribution, share of mode, share of trip purpose, share of mode and purpose combination, and share of mode and occupation combination among 47 prefectures.

(1) Comparion of trip distribution

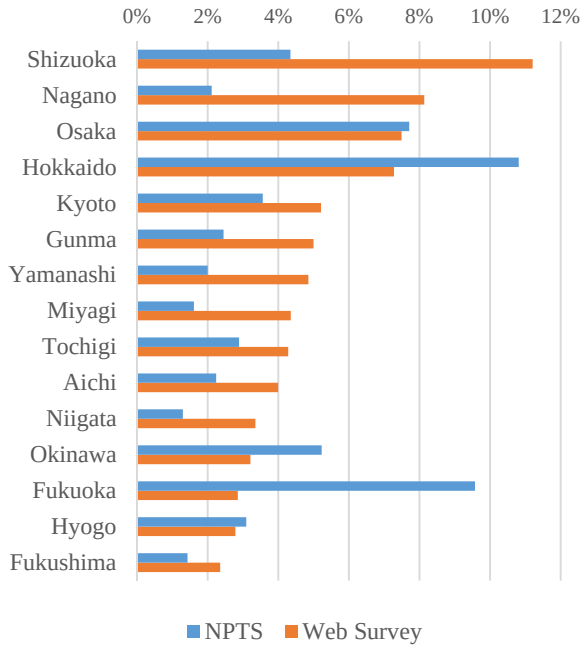

Fig. 1 Trip distribution (top largest share for all purpose)

The top fifteen largest share of trip for each prefecture is shown in **Fig. 1**[1]. In this figure, trip purpose and modal share are not considered. It can be seen that the share of trip in NPTS is quite different in web survey exepted for Hyogo an Osaka Prefecture. In the NPTS, the two largest proportion belongs to Shizuoka and Nagano, followed by Osaka and Hokkaido with the range from approximate 7% to around 11%, whereas Hokkaido, Fukuoka, Osaka, and Okinawa, respectively, are the preferred destination web survey respondents.

(2) Comparison of modal and purpose share

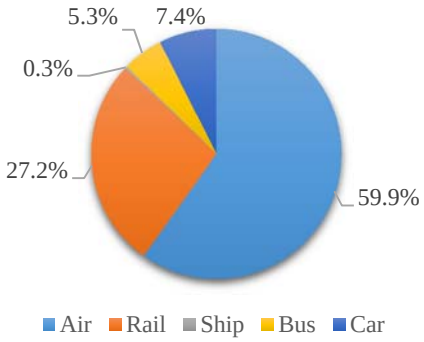

Fig. 2 Mode share in NPTS

The modal share of NPTS is shown in **Fig. 2**. While air trips occupied the majority of trips in NPTS with around 60%, the second model share was rail use proximately 27%. This means that trips with car, bus and ships modes belonged to minor ones in NPTS.

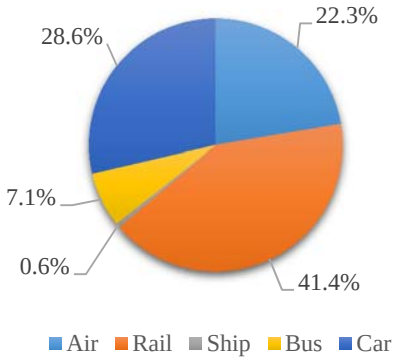

Fig. 3 Modal share in web survey

Fig. 3 shows the modal share in web survey. While the highest modal share in web survey belonged to rail mode with approximately 41%, followed by car and air uses with 28.6% and 22.3%, respectively. Meanwhile, survey just nearly 8% of respondents of web survey traveled by ship and bus. As can be seen from the **Fig. 2** and the **Fig. 3**, for both NPTS and web survey, primary modes are rail and air but other modes are bit minor and not reliable. This paper therefore compare NPTS and web survey with regard to air and rail trips.

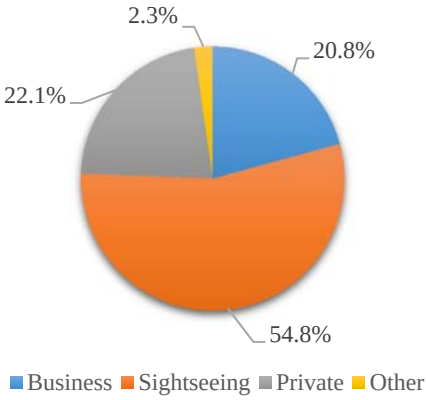

Fig. 4 Trip purpose share in web survey

Fig. 4 describes the trip purposes share in web survey. For web survey, the percentage of sightseeing travel trips (54.8%) was higher than that of private ones (22.1%) which was marginally over business ones.

[1] The detail trip distribution could be seen in Appendix

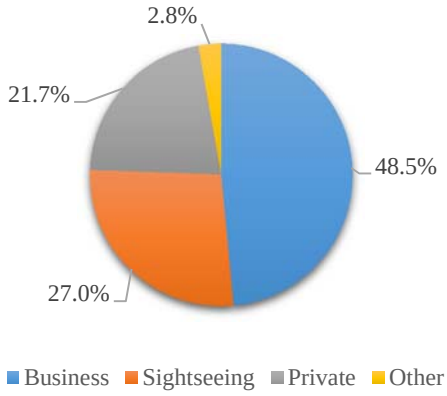

Fig. 5 Trip purpose share of NPTS

The share of trip purpose in NPTS is presented in **Fig. 5**. Nearly half of trips in NPTS were business ones, whereas sightseeing and private ones accounted for 27.0% and 21.7%, respectively.

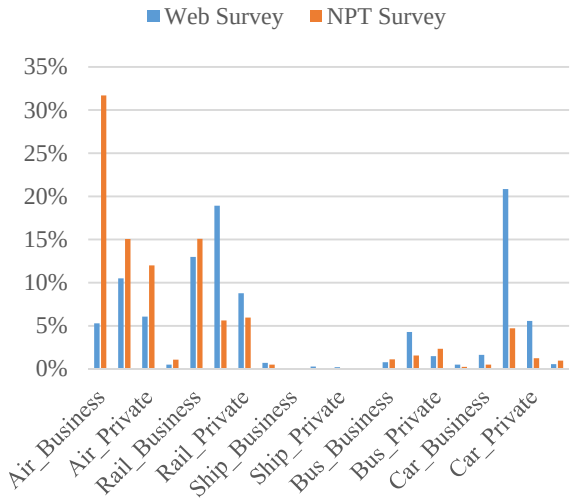

Fig. 6 Mode-purpose share

shows traveling purposes of air and rail trips for NPTS and web survey. Generally, with the same mode choice and trip purpose, there is significantly different in the number of trips for two kinds of surveys. In particular, while traveling by air transport in NPTS survey outnumber that in web survey, the opposite trend is quite true in rail traveling

It should be noted that business trips by air in NPTS survey exceeded over 6 times these in web survey. Whereas in contrast, travelers used buses for sightseeing in NPTS survey were smaller about 3 times larger than ones in web survey.

Fig. 7 and **Fig. 8** show the comparision in air and rail share by destination.

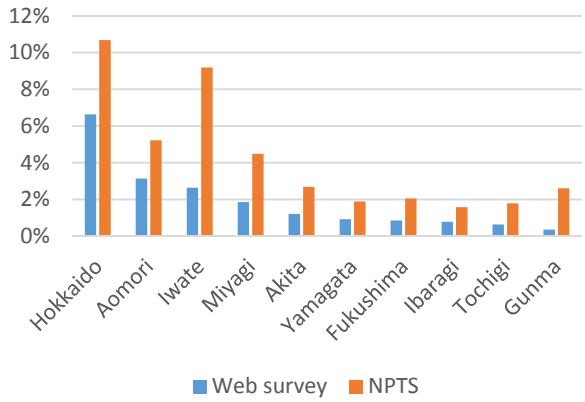

Fig. 7 Air share by destination

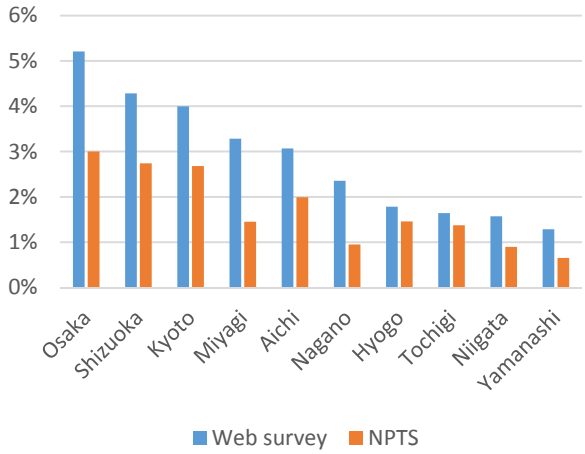

Fig. 8 Rail share by destination

(3) Comparison of mode and occupation share

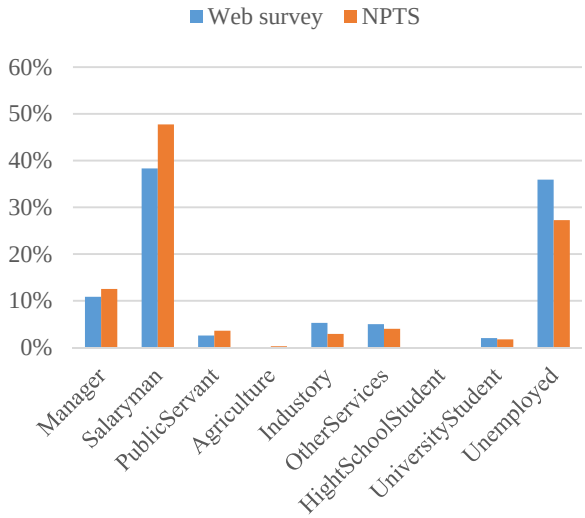

Fig. 9 show the comparion in term of occupation Since we suppose that the difference in destination

distribution would be caused by that in occupation share of both respondents, we confirm them by sample aggregation. share. Almost of respondents are manager, saralyman, and unemployee. In that three group, except unemployee, the occupations in NPTS to make much more trip than that of web survey are manager and salary man.

The share of salary man and unemployed are similar in web survey, while that of NPTS are a bit different. Such tendency seems reasonable, because web survey could be conducted at home whereas NPTS is conducted at on-site, so then not working people and salary man could have much more time

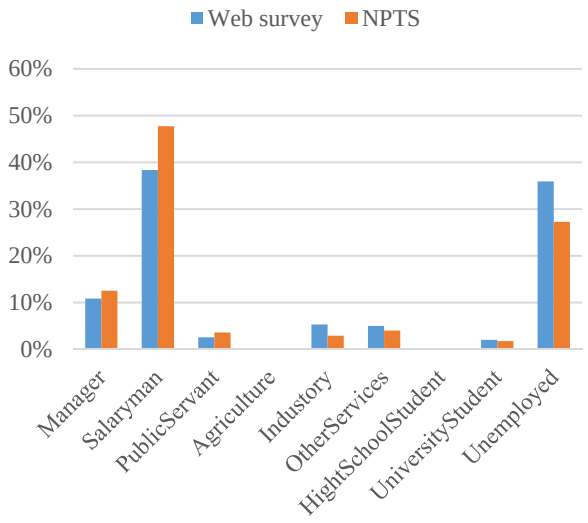

Fig. 9 Occupation share

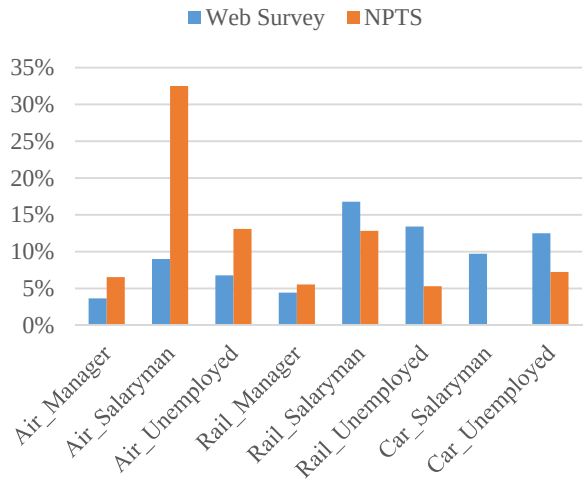

Fig. 10 Mode with occupation share

to answer survey questionnaire. On the other hand, there was lower share (under 5%) for the rest of occupations.To clarify the relationship between mode and occupation, we made some new combined categories named mode-occupation and compare the share of these categories. We select 8 categories that have high proportion. These categories are illustrated on Fig.10.

Fig.10 shows the remarkable difference in air users of salary man category and car users of salary man. Such the diference can also be explained by the difference in observation sites.

4. DISCUSSION AND CONCLUSION

In this study, we compare web-survey with small samples and NPTS with large samples about mode, tripdestination, and the occupation of trip makers. As a result, there are significant difference in modal share and destination distribution. Therefore, we should conclude that such the naïve comparison would not be appropriate.

As a further stury, the sampling rate of NPTS by each mode should take into account for data aggregation. Forexample, responding rate in NPTS which can be measured by raw number of samples.

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