SUBSTITUTION EFFECT OF HIGH SPEED RAIL FOR AIR TRANSPORT IN CASE OF CONTINUOUS FLIGHT CANCELLATIONS

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Abstract

At around 0:40 p.m. on May 27, 2016, an engine fire accident occurred at the c-runway of Tokyo International Airport. Under the influence of this accident, 362 domestic flights going to arrive and depart in Tokyo International Airport were canceled, and totally 422 flights were affected. Moreover, it was reported that more than 70,000 air passengers were affected by the accident. The affected travelers were compelled to decide their subsequent correspondence. Someone canceled their trip instantly, someone kept waiting for resumption of flight operation, and someone changed transportation mode such as high speed rail to move to their destination. Actually, there are no research investigating the travel behavior just after the continuing flight cancelation. Therefore, this study analyzing the behavior of travelers encountering the flight cancelation. There are no data for analyzing this aspect. Thus, an internet survey was conducted. The respondents were limited to the affected travelers by this engine fire accident. More than 400 respondents can answer the questionnaires. In this study, the subsequent correspondence of the affected travelers was analyzed from the two aspects. One is willingness to continue their scheduled trip and the other is success or failure of trial to move to the scheduled destination on that day. The factors influencing the willingness was identified through the estimation of the discrete choice model and the factors influencing the result of the trial was also identified through the estimation of discrete choice model.

Keywords: high speed rail, flight cancellation, decision making, travel behavior

1 Introduction

At around 0:40 p.m. on May 27, 2016, an engine fire accident occurred from the aircraft running for taking-off on the c-runway of Tokyo International Airport. Under the influence of this accident, 362 domestic flights going to arrive and depart in Tokyo International Airport were canceled and some flights were diverted. Totally 422 flights were affected. Moreover, it was reported that more than 70,000 air passengers were affected by the accident. The affected travelers were compelled to decide their subsequent correspondence. Someone canceled their trip instantly, someone kept waiting for resumption of flight operation, and someone changed transport mode such as high speed rail to move to their destination. There are several previous studies regarding the reduction of intercity transport function. Taniguchi et al. [1] focused on the latent air passenger demands caused by suspension of the Shinkansen. Kato et al. [2] investigated the flight delays and cancellations at Sendai Airport. Moreover, Aratani et al. [3] also investigated the aircraft activities and airport operations in the aftermath of the Great East Japan Earthquake. Meanwhile, Asakura et al. [4] investigated the change in travel behavior after transport network degraded by the natural disaster. Actually, there are no research investigating the travel be-

havior just after the continuing flight cancelation. Therefore, this study analyzed behavior of travelers encountering the flight cancelation. In this study, the subsequent correspondence of the affected travelers was analyzed from the two aspects. One is willingness to continue their scheduled trip and the other is their success or failure of the trial to move to the scheduled destination on that day. The factors influencing the willingness was identified through the estimation of the discrete choice model and the factors influencing the result of the trial was also identified through the estimation of discrete choice model. In the following chapter, questionnaire survey conducted in this study was described. In chapter 3, the subsequent correspondence of affected passenger is described. In chapter 4, logit model which can describe the willingness to move to the scheduled destination on that day and another logit model which can describe the result of the correspondence. In chapter 5, the results of this paper is concluded.

2 Data

There are few studies regarding traveler's subsequent correspondence to sudden flight cancellation because of data constraint. Thus, internet survey was conducted to collect the data on the subsequent correspondence of the affected traveler. Outline of the survey is shown in Table 1. Amount of data is totally 300. The descriptive statistics value is shown in Table 2. The date when the accident occurred is Friday. Therefore, the share of the business purpose makes up 60 %.

Table 1   Outline of survey

Date of survey	25-27 October 2017
Survey method	Internet questionnaire
Target respondents	Traveller who was going to move by air on May 27, 2016
Available sample	300
Survey items	· Scheduled travel itinerary · Time when recognizing the accident · Place where recognizing the accident · Consequence of the flight supposed to be used · Subsequent correspondence: Transportation mode and route · Socio-economic Individual attributes

Table 2   Descriptive statistics

Gender	Male: 77 %, Female: 23 %
Age	20's: 19 %, 30's: 38 %, 40's: 23 %, 50's: 16 %, 60's: 4 %
Trip purpose	Business: 60 %, Sightseeing: 30 %, Others: 10 %

3 Subsequent correspondence and results

The affected travelers were compelled to decide their subsequent correspondence. It is thought that there were travelers who canceled their own trip instantly, that there were travelers kept waiting for resumption of flight operation, and that there were travelers changed transportation mode such as Shinkansen (high speed rail) to move to scheduled destination. The affected travelers are greatly divided into two groups. One group is consist of the affected travelers who had not started their own scheduled travel and the other group is consists of those who were traveling. 215 respondents are belonged to the first grope and other 85 respondents are belonged to second grope. Firstly the willingness to move to the scheduled destination of the affected traveler is analyzed and secondly the success or failure situation of the traveler having intention to move to the destination was examined.

Figure 1 shows the results of the examination. Figure in left shows the result for the passenger who had not started their travel and figure in right shows the result for the passenger who was travelling. As shown in the figure, 80 % of the traveller not stating the travel had an intention to move to the destination on that day and 20 % abandoned instantly. And, 63 % (=108 out of 172) succeeded to move to the destination on that day. On the other, 92 % of the traveller during travel had an intention to move to the destination on that day and 8 % abandoned instantly. And, 76 % (=56 out of 78) succeeded to move to the destination on that day.
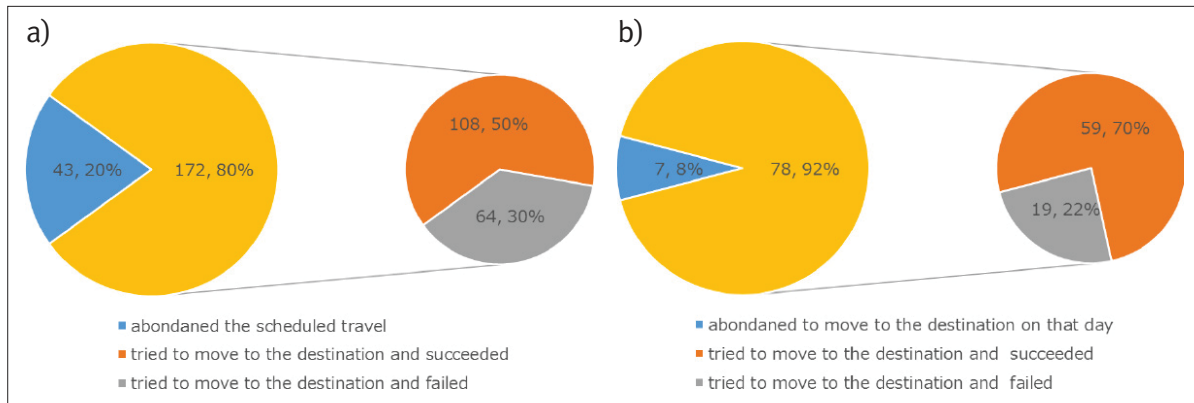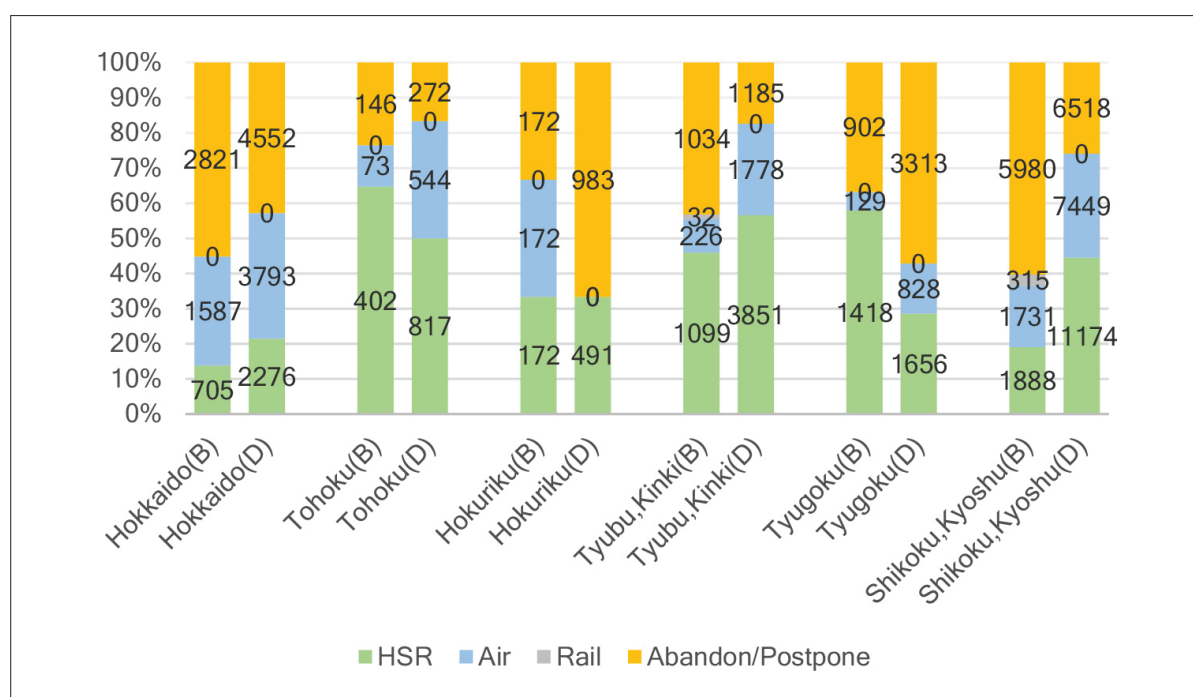

Figure 1   Subsequent correspondence and result – a) before the travel, b) during the travel

These figure show another aspect. 50 % of the traveller before stating travel could not move to the destination and also 30 % of the traveller during the travel could not move to the destination. Especially, these 30 % passengers were compelled to lengthen their stay when they were away from home. In addition, transport mode for moving to the destination were asked in the survey to the passenger who moved to the destination on that day. The share of each transport mode were apparently different by the district because of the existence of alternate transport mode.
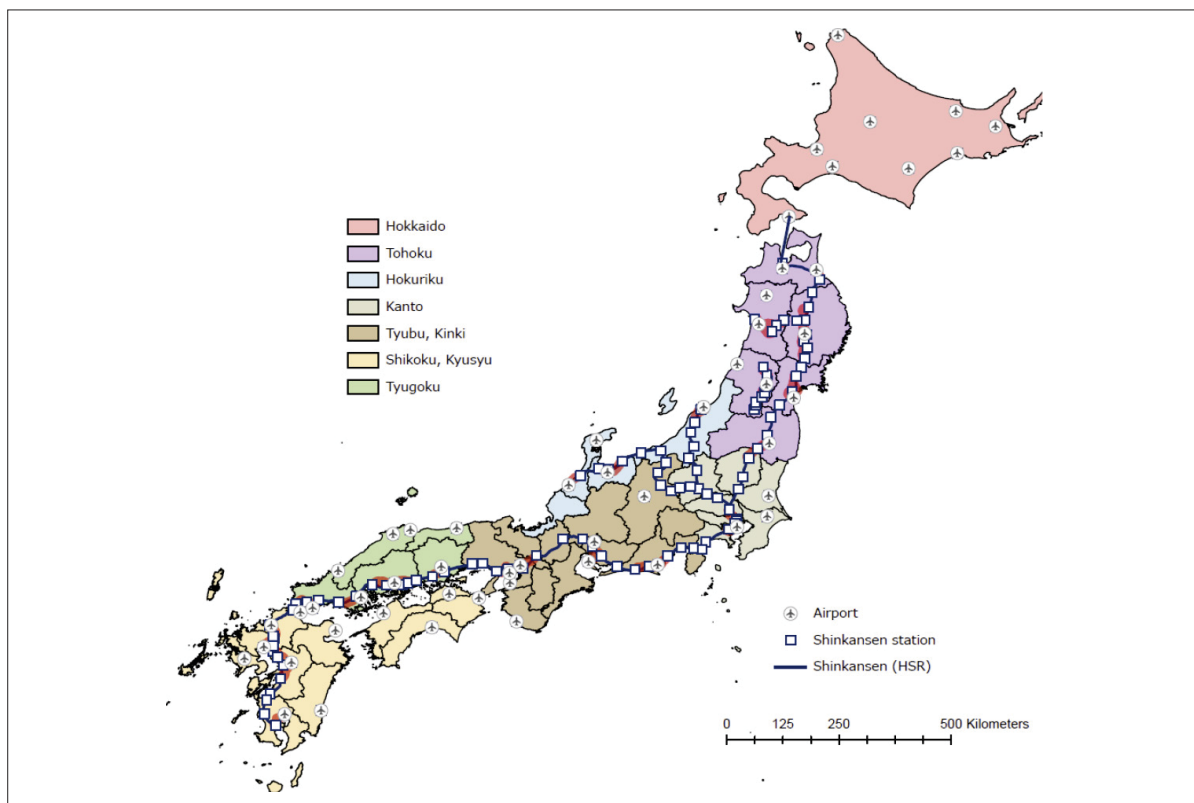
Figure 2   Location of the airports and Shinkansen (HSR) stations

Figure 2 shows the location of the airport and station of the Shinkansen (HSL) and accessibility from certain airport to certain Shinkansen station. Several red lines connecting airport and station indicate that the travel time between the airport and station is within one hour by car. It shows that the number of airport that locates close to the station of the HSR is limited. Then, another statistics of the air passenger movement published by Ministry of Land, Infrastructure, Transport and Tourism was utilized to estimate the actual number of subsequent correspondence by district. Figure 3 shows the result of the estimation.

Tow bars of each district indicate the type of grope of the affected traveller. (B) indicates "before travelling" and (D) indicates "during travel". There are low abandon/postpone ratio in Tohoku, and Tyubu & Kinki districts because these district are well connected to the Tokyo Metropolitan area by HSR. On the other, there are high ratio of abandon and postpone the travel in Hokkaido and Shikoku & Kyushu districts because there are far from Tokyo and there are low accessibility to/from Tokyo by HSR. Meanwhile, there is high ratio of the air in Hokkaido district.

Figure 3   Subsequent correspondence by district

4   Model estimation

In this chapter, two kinds of model are estimated. One is a model that presents the willingness to move to the scheduled destination after encountering continuous flight cancellation. The other model is a model that presents the probability of success to move to the destination for the passenger who want to move to the destination. Binary logit model was employed as the method for parameter estimation.

Purpose of travel, with/without companion and age of traveller are considered as the explanatory variables of the first model. Table 3 shows the estimation result of the first model. There are two models for the traveller before starting travel and the traveller during travel. The estimated coefficient with (+) sign indicates a positive impact on the willingness and one with (-) sign indicates a negative impact.

Since the sing of the coefficients of travel companion and age are positive for both models. It means that traveling alone strength the willingness to move to the destination and over-

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sixties also strength the willingness for both passengers before traveling and during travel. Meanwhile, the sing of the coefficient of travel purpose is negative for the affected traveller before starting travel and positive for the affected traveller during travel. It indicates that business purpose weaken the willingness of the traveller not starting travel and strengthen the willingness of the traveller during travel.

Table 3 Binary logit model of the willingness to move to the destination

Explanatory variables	Before the travel		During the travel	
	coefficient	t-value	coefficient	t-value
Travel purpose (business: 1, otherwise : 0)	-0.291	-7.95	0.638	5.69
Travel companion (alone: 1, otherwise: 0)	0.582	14.6	0.634	5.80
Age (over 60: 1, otherwise: 0)	7.096	2.58	6.071	2.30
Constant term	9.372	3.41	10.160	3.68
Log-likelihood ratio	0.267		0.329	
Hit ratio (%)	80.0		91.7	
Number of sample	215		85	

Table 4 shows the estimation result of the second model. There are two models for the traveller before starting travel and the traveller during travel. Access condition to Shinkansen (HSR) station from airport, existence of flight from/to Narita international airport which is alternate airport of Haneda airport, status of mileage member (high status:1, otherwise: 0) and residential area are considered as the explanatory variables of the second model. The estimated coefficient with (+) sign indicates increase of possibility to move to the scheduled destination and one with (-) sign decrease the possibility.

The estimated coefficient of the access condition to HSR station and mileage status and residential area are positive. It indicates that the better accessibility to the HSR station from scheduled departure airport increase the possibility to move to the scheduled destination, higher mileage status increase the possibility, and that resident in Tokyo metropolitan area increase the possibility. Meanwhile, existence of alternate airport and flight is not effective to increase the possibility, since the sing of the alternate flight from/to NRT is negative. By comparing the largeness of the estimated value, the accessibility to the HSR is important factor to increase the possibility to move to the destination on that day.

Table 4 Binary logit model of the success of willingness to move to the destination

Explanatory variables	Before the travel		During the travel	
	coefficient	t-value	coefficient	t-value
Access condition to HSR station from airport (within 60 min. 1, otherwise : 0)	2.00	10.1	2.01	10.1
Alternate flight from/to NRT (existence: 1, otherwise: 0)	-1.40	-5.32	-1.49	-5.11
Status of mileage (high status:1, otherwise: 0)	0.712	14.6	0.763	5.80
Residential area (Tokyo metropolitan: 1, otherwise: 0)	0.168	6.69	0.294	6.46
Constant term	1.51	16.3	1.51	6.35
Log-likelihood ratio	0.373	0.370		
Hit ratio (%)	70.2	69.4		
Number of sample	172	78		

5   Conclusions

In this study, the engine fire accident of the airplane which occurred at around 0:40 p.m.on May 27 in Tokyo international airport was focused since there were large number of affected travellers. In this study, the internet questionnaire survey was conducted to obtain the data regarding the subsequent correspondence of the affected travellers. As the result of aggregative analysis, it becomes clear that almost affected traveller had an intention to move to the scheduled destination. However, the traveller who wanted to move to the destination did not always succeed to do it. In addition, it becomes clear that subsequent correspondence of the affected traveller were differ by the district. The existence of the alternate transport mode have to do with this phenomena. The factors influencing the intention to move to the destination and the factors to affect the possibility to do it were respectively identified through by the model building. In this study, two kinds of model were estimated. One is the level of intention to move to the destination on that day and the other is possibility to move to the destination. It becomes clear that the access condition to HSR station from the airport is significant factor influencing the possibility to move to the scheduled destination. Research on the subsequent correspondence after the flight cancellation has just been started. Therefore, the data collection and the basic analysis should be continued.

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