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# A Choice Experiment for Air Travel Services

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**Abstract.** Our purpose of this study is evaluating preferences for air travel services connected between the east and west central cities in Japan, Tokyo and Osaka, to consider the appropriate re-allocation design of airports in Japan. We employ a choice experiment and recruit more than 500 respondents in east and west areas in Japan and investigate their preferences. Our results are as follows. The existing airline connected west hub airport, Itami, in Osaka and east hub airport, Haneda, in Tokyo is much preferred to the other lines connected cities surrounding Osaka and Tokyo. Kobe and Kansai international airports are preferable to Itami airport, while Haneda is the much preferable to Ibaraki and Narita international airports. Increasing the mileage program and the availability of web check-in have positive significant effects but these impacts are small. These results imply that the most important factor for using air travel services is convenience for traveling by using the nearest airports. In this meaning, if the new airlines can be connected to Haneda, the government's re-allocation plan from Itami airport to Kobe and Kansai international airports has a chance to succeed to minimize the economic efficiency loss for the people traveling between east and west areas in Japan.

**Keywords:** Air travel service, choice experiment, internet survey

## 1 Introduction

Relaxation of regulation in an entrance of airplanes becomes attractive for people who want to select cheap airplanes over the world. Entrancing of low cost carriers (LCC) enhances competitions in air travel market, which makes air travel much more familiar and convenient not only for sightseeing for abroad but for daily business scenes in domestic areas.

Now LCC market is rapidly increasing in Japan because of relaxation of regulation. In the past five decade, domestic airplane market in Japan was restricted and allowed to remain duopolies or oligopoly. Especially, in Japan, the railways are developed very well and the technology for the rapid express is highly qualified, which is often compared with TGV in France and imported to Taiwan and Vietnam. In this

situation, the government allows to oligopoly in the airplane market in order to protect airplane market from hard competition with railways.

This protective policy has, however, imposed incurring high cost for people who use the airplanes and block the entrance of newcomers and disturbed competitions between incumbents and newcomers. In this situation, LCC is expected as useful newcomers because of much cheaper tickets than existing airplanes. The price of ticket in LCC is often less than two thirds of that in existing airplanes and sometimes a half of its price. That price facilitates people who want to travel in the long distance because the air travel saves time for travel relative to the railway travel.

Although LCC became a newcomer to introduce attractive price for air traveling, it is concerned to hold an issue of safety and security commitment and that of comfort for people taking the in-flight services as well as ground services at the airport. In the safety issue, it is criticized that cost saving induces cut-off appropriate human and technological resources they need to spend. In the in-flight services, LCC save the space and reduce the seat-pitch in order to increase the number of seats. Additionally, almost all the beverages are not free. In the ground services, a web check-in is not available so that people need to wait for long line to obtain a boarding-pass. Additionally, the airports for LCC are located in the countryside far from the hub port and facilities in those airports tend to be poor. People need to walk from the getting on/off the airplane because buses are not employed in order to save cost for running.

Considering these issues allows us to explore what kinds of people prefer LCC to existing airplanes and which factors are important to choose airplanes and airports in their air travels. In this study, we focus on Japanese domestic air travel services. Our target regions are Tokyo, the principle of Japan, and Osaka, the west central Prefecture. They are located in east area and west areas in Japan, respectively, and it takes about 300 miles between these areas. There are the most many airlines and rapid express railways between these prefectures. There is the most competitive traveling area in Japan. Although the rapid express takes at least two hour and half, airplanes take within one hour.

Additional interesting viewpoint for considering air travel market in Japan, both Osaka and Tokyo have three airports surrounding these areas. Haneda airport, Ibaraki airport, and Narita international airport are candidates to go to Tokyo from Osaka. Haneda is the domestic hub airport and Narita international airport is the international hub airport. Ibaraki is a local area and it takes two hour and half from Tokyo but it spends only 500 JPY by bus and the airplane is LCC so that a ticket price from Osaka to Tokyo is the cheapest among these airports.

On the other hand, Itami airport, Kobe airport, and Kansai international airport are candidates to go to Osaka from Tokyo. Itami airport is the domestic hub in the west area and Kansai international airport is the hub for international airlines in the west area. Kobe airport is the newest airport that has only domestic airlines and only Kobe has a LCC to go to Ibaraki airport.

Now Japanese government tries the re-allocation of airlines in those airports and re-constructs strategy for airport services, but it is hard journey because re-constructing allocation of airlines changes the people moving, traveling and business,

which leads economic loss or benefits. This makes stakeholders not reach a consensus.

Our purpose of this study is evaluating preferences for air travels between these two areas in order to consider the appropriate allocation design of air travel services in Japan market. Solving this issue leads economic benefits not only to the other domestic areas but also to the world. Since Japanese are one of the biggest travelers in the world, appropriate re-allocation in the domestic market enhances the efficient moving and traveling, which leads saving cost and time for leaving abroad.

In this end, we employ a choice experimental method to evaluate preferences for air travel services. We use the internet survey system and recruit 500 recipients living in the east area (called Kanto district) near to the three east airports and west area (called Kansai district) near to the three west airports in Japan. We found that the airline connected between east and west domestic hub airports, Itami and Haneda, is the most preferred for air traveling. Kobe and Kansai international airports are preferable to Itami airport, while Haneda is the much preferable to Ibaraki and Narita international airports. On the other hand, in the in-flight and ground services, only the availability of web check-in and increasing mileage programs are preferred but these impacts are small. Based on the results above, the government's re-allocation plan from Itami to Koabe and Kasai international airports has a chance to succeed to minimize the economic efficiency loss if they are connected to Haneda airport.

Air travel services have been studied by lots of survey analysis by using multinomial logit analysis. For instance, Hess and Polak (2005) consider the multi-airport regions and evaluate preference for these airports. Balcombe et al. (2009) evaluate consumer willingness to pay for in-flight service. Hough and Hassanien (2010) investigate preference of transport choice behavior of Chinese and Australian tourists in Scotland. Bliemer and Rose (2011) surveyed previous all studies on preferences for air travel services. Especially, in Japan, Furuichi and Koppelman (1994) investigate multi airports choice and discover that access time, access cost and flight frequency has significant effects. Additionally, Keumi and Murakami (2012) consider the utility of connection between local airports and international hub airports. Based on these studies, we focus on the combination of airport locations and in-flight and ground services as the air travel services and compare these preferences.

The remainder of the paper is organized as follows. Section 2 presents the design of a choice experiment. Section 3 shows the model structure. Section 4 analyzes the result and Section 5 summarizes the conclusions.

## **2 Design of a Choice Experiment**

We conducted an internet survey based on the choice experimental method. Recipients are recruited from Kanto and Kansai districts. Kanto district is the group of Prefectures located in the east side of Japan including the principle of Tokyo. Kansai district, on the other hand, is the group of Prefectures located in the west Japan including Osaka, the second biggest Prefecture and central city in the west side of Ja-

pan. Kanto district has Haneda, Narita and Ibaraki airports. Kansai district has Itami, Kansai and Kobe airports.

In the choice experiment, the three alternatives of departure airports in the designated choice sets were Itami airport, Kansai International airport, and Kobe airport as shown in Figure 1. These airports are departure airports for people living in Kansai district, while those are arrival airports for people living in Kanto district.

**Fig. 1.** An example of choice sets

Airports in Kansai district	Itami	Kansai	Kobe
Airports in Kanto district	Narita	Haneda	Ibaraki
Airfare (JPY)	14000	5000	9000
Number of flights	14	10	2
Web check-in	Available	Available	Non-available
Seat-pitch (cm)	78	68	78
Mileage program (%)	100	50	0
Your Choice			

The attributes and the levels being tested were show in Table1. We also inform how long it takes from each airport to Tokyo by bus and its cost. Therefore, a full factorial design with three airports in Kanto district, three values of airfares, four numbers of flights, two types of web check-in, two types of seat-pitch and three levels of mileage programs resulted in 432 ( $=2^2*3^3*4$ ) alternative management combinations. Since these combinations constituted an unreasonably large design in practice, a D-optimal fractional factorial design with 42 alternatives was developed and separated into three blocks of 14 choice sets by using Design Expert (version 7).

**Table 1.** Table 1. Attributes and levels used in the choice experiment

Attributes	Levels
Airports in Kanto district	Haneda airport, Narita International airport, Ibaraki airport
Airfare	4000 JPY, 9000 JPY, 14000 JPY
Number of flights	2, 6, 10, 14
Web check-in	Available, Non-available
Seat-pitch	68 cm, 78 cm
Mileage programs	0 %, 50%, 100%

### 3 Model Structure

Random utility theory is central to the concept of choice modeling. The basic assumption embodied in the random utility approach to choice modeling is that decision makers are utility maximizers, which implies that decision makers choose the alternative that maximizes their utility, given a set of alternatives. The utility of an alternative for an individual ( $U$ ) cannot be observed; however, it can be assumed to consist of a deterministic (observable) component ( $V$ ) and a random error (unobservable)

component ( $\varepsilon$ ). Formally, an individual  $q$ 's utility of alternative  $i$  can be expressed as follows:

$$U_{iq} = V_{iq} + \varepsilon_{iq}. \quad (1)$$

Hence, the probability that individual  $q$  chooses alternative  $i$  from a particular set  $J$ , which comprises  $j$  alternatives, can be written as the following:

$$\begin{aligned} P_{iq} &= P(U_{iq} > U_{jq}; \text{ for all } j(\neq i) \in J) \\ &= P(\varepsilon_{jq} < \varepsilon_{iq} + V_{iq} - V_{jq}; \text{ for all } j(\neq i) \in J) \end{aligned} \quad (2)$$

To transform the random utility model into a choice model, certain assumptions regarding the joint distribution of the vector of random error components is required. If random error components are assumed to follow the type I extreme value (EV1) distribution and to be independently and identically distributed (IID) across alternatives and cases (or observations), a conditional logit model (McFadden, 1974) can be obtained. In the conditional logit model, the choice probability in Equation 2 is expressed as

$$P_{iq} = \frac{\exp(\mu V_{iq})}{\sum_{j=1}^J \exp(\mu V_{jq})}. \quad (3)$$

Further, assuming that the deterministic component of utility is linear and additive in parameters  $V_{iq} = \beta' X_{iq}$ , the probability in Equation 3 can be rewritten as

$$P_{iq} = \frac{\exp(\mu \beta' X_{iq})}{\sum_{j=1}^J \exp(\mu \beta' X_{jq})}, \quad (4)$$

where  $\mu$  represents a scale parameter that determines the scale of the utility, which is proportional to the inverse of the distribution of the error components. It is typically normalized to 1.0 in the conditional model.  $X_{iq}$  are the explanatory variables of  $V_{iq}$ , normally including alternative-specific constants (ASCs), the attributes of alternative  $i$  and socio-economic characteristics of individual  $q$ , and  $\beta'$  is the parameter vector associated with matrix  $X_{iq}$ .

Based on the above discussions, this study estimates two indirect utility functions.

$$\begin{aligned} \text{Model 1: } V_{iq} &= ASC_{kansai} + ASC_{kobe} + \beta_1 Airport_k + \beta_2 Airfare_i \\ &+ \beta_3 Flights_i + \beta_4 WebCheck - in_i + \beta_5 Seat - pitch_i + \beta_6 Mileage_i \end{aligned}$$

$$\begin{aligned} \text{Model 2: } V_{iq} &= \beta'_1 ASC_{kansai} * Airport_k + \beta''_1 ASC_{kobe} * Airport_k + \beta_2 Airfare_i \\ &+ \beta_3 Flights_i + \beta_4 WebCheck - in_i + \beta_5 Seat - pitch_i + \beta_6 Mileage_i \end{aligned}$$

where  $ASC_{Kansai}$  and  $ASC_{Kobe}$  are dummy variables indicating the selecting of alternative Kansai or alternative Kobe with respect to alternative Itami such as reference alternative.  $k$  represents Haneda, Narita, and Ibaraki airports.  $Airport_k$  is a dummy variable indicating  $k$  airport.  $Airfare_i$  is the price of airline ticket for alternative  $i$ .  $Flights_i$  is the number of the flight per day for alternative  $i$ .  $WebCheck - in_i$  is a dummy variable taken the value 1 if a web check-in is available.  $Seat - pitch_i$  is the seat pitch size by shown in cm for alternative  $i$ .  $Mileage_i$  is the percentage of mileage program

where one can earn mileages for alternative  $i$ .  $ASC_{Kansai} * Airport_k$  and  $ASC_{Kobe} * Airport_k$  are interaction term of  $ASC_{Kansai}$  and  $ASC_{Kobe}$  with dummy variable indicating  $k$  airport, respectively. Finally,  $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_1',$  and  $\beta_1''$  are the parameters to be estimated.

## 4 Results

The internet survey was conducted in June 2012. The respondents were recruited from among residents from 10,000 households in the Kanto and Kansai districts by the internet survey system. 505 participants answered the survey. Their socio-economic backgrounds are summarized in Table 2.

**Table 2.** Socio-economic background

Variable	Mean	Definition
Age	51.00	Year in age
Gender	1.39	1: Male; 2: Female
Income	3.54	1: less than 3 million yen; 2: 3-5 million yen; 3: 5-7 million yen; 4: 7-10 million yen; 5: 10-15 million yen; more than 15 million yen
Marriage	1.80	1: No; 2: Yes
Children	1.30	1: Yes; 2: No

Here we show conditional logit estimation results by LIMDEP 9.0 and NLOGIT 4.0. Table 3 shows the results of conditional logit model in Models 1 and 2. In Model 1 as show in main effect, two alternative specific constants,  $ASC_{Kansai}$  and  $ASC_{Kobe}$  are significantly and positive signs, which imply that people will get higher utility from alternative Kansai or Kobe than from alternative Itami. Two variables *Narita* and *Ibaraki* are significantly and negative signs, which imply that people prefer Haneda airport to others. The variable *Airfare* is significantly and negative sign, which imply that people prefer cheaper price. The variables *WebCheck-in*, *Seat-pitch* and *Mileage* are significantly and positive signs, which imply that people prefer to be able to check-in the website, to be longer size in the seat and to earn more mileages. We further consider estimation results by the marginal willingness to pay (WTP), which means how much people want to pay for each attribution, estimates for each variable. People have a willingness to pay 8,478 JPY to use Haneda airport as compared to Narita one, or 16,375 JPY to Ibaraki one, respectively. They imply that Haneda airport is very important among airports in Kanto district for both people in Kansai and Kanto districts. People have a willingness to pay 1362 JPY to be able to check-in in the website.

In order to consider the preference between airports in Kansai and Kanto districts, we use interaction terms such as  $ASC_{Kansai} * Airport_k$  and  $ASC_{Kobe} * Airport_k$  in the Model 2. The reference alternative is alternative Itami for both interaction terms. The variables  $ASC_{Kansai} * Haneda$  and  $ASC_{Kobe} * Haneda$  are significantly and positive signs, which imply that people prefer Kansai and Kobe airport to Itami if they use the

Haneda airport. They are as same as the results of two alternative specific constants in Model 1. Since other interaction terms are significantly and negative sings, which imply that people prefer Itami airport to others if they use Narita or Ibaraki airports. The results in the variables *Airfare*, *WebCheck-in*, and *Mileage* are the same as the Model 1. However, the variable *Flights* is significantly and negative sign, which imply that people prefer the less number of the flights between two areas. In the marginal WTP estimates, people value between Kansai and Haneda airports at 4305 JPY and between Kobe and Haneda at 1758 JPY as compared to using between Itami and Haneda. They imply that people prefer Kansai and Kobe airports as same as the results in Model 1. Moreover, people prefer Itami airport when they use Narita and Ibaraki airports because the WTP estimates in other interaction terms with Narita and Ibaraki are more than 3596 JPY and 8832 JPY, respectively.

**Table 3.** The conditional logit regression results in the Models 1 and 2.

Variables	Model 1		Model 2	
	Coefficient (S.E.)	Marginal WTP (JPY)	Coefficient (S.E.)	Marginal WTP (JPY)
ASC <sub>Kansai</sub>	0.78*** (0.03)	-	-	-
ASC <sub>Kobe</sub>	0.49*** (0.03)	-	-	-
Narita	-0.84*** (0.04)	8478	-	-
Ibaraki	-1.63*** (0.04)	16375	-	-
ASC <sub>Kansai</sub> *Haneda	-	-	0.43*** (0.04)	4305
ASC <sub>Kansai</sub> *Narita	-	-	-0.35*** (0.04)	3596
ASC <sub>Kansai</sub> *Ibaraki	-	-	-0.88*** (0.05)	8832
ASC <sub>Kobe</sub> *Haneda	-	-	0.17*** (0.05)	1758
ASC <sub>Kobe</sub> *Narita	-	-	-0.83*** (0.04)	8398
ASC <sub>Kobe</sub> *Ibaraki	-	-	-1.81*** (0.07)	18165
Airfare	-0.00*** (0.00)	-	-0.00*** (0.00)	-
Flights	0.00 (0.00)	-	-0.00** (0.00)	78
WebCheck-in	0.13*** (0.03)	1362	0.16*** (0.03)	1605
Seat-pitch	0.01*** (0.00)	104	0.00 (0.00)	-
Mileage	0.00*** (0.00)	12	0.00*** (0.00)	13
Log likelihood	-6321.4		-6587.1	
McFadden's $R^2$	0.15		0.11	
Observations	7070		7070	

Notes: \*\*\*, \*\*, and \* denote that the parameters are different from zero at the 1%, 5%, 10% significance levels, respectively. WTP is calculated by using the estimated price parameter.

## 5 Conclusions

In this study, we evaluate the preference for air travel services constituted of airport locations and in-flight and ground services by using conditional logit model in the internet survey. Our results are as follows.



- Among all line alternatives, the existing line connected west and east hub airports, that is, Itami and Haneda, obtains the highest marginal WTP.
- Kobe and Kansai international airports are preferable to Itami airport.
- Ibaraki and Narita international airports are less preferable to Haneda airport.
- Haneda airport obtains the highest marginal WTP for people living in east and west areas in Japan.
- Increasing the mileage program and the availability of web check-in have the small marginal WTP.

These results imply that the most important factor for using air travel services is convenience for using the nearest airport. Based on Haneda as the east domestic hub airport, Kobe and Kansai international airports have a possibility to become an alternative to Itami as the west domestic hub airport. However, Haneda does not have alternative airports because Ibaraki and Narita international airports have less values than Haneda airport. Therefore, the most important airport is Haneda. If the new airlines can be connected to Haneda, the government's re-allocation plan from Itami airport to Kobe and Kansai international airports has a chance to succeed to minimize the economic efficiency loss for the people traveling between east and west areas in Japan.

In this study, we combine the survey answered by people living in east and west areas. In the future research, we need to divide them into two groups and compare their preferences. We also consider the difference in preferences between sightseeing travelers and business travelers. In our models, the frequency of flights does not have big impact to their choice. When we focus on the business scenes, it is likelihood to be important factor as the measure of convenience for air travel services. To obtain the robust results, we further need much more recipients.

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