Discussion Papers In Simulation Studies No.1

Airport Choice and Flight Connectivity
- Empirical Analysis of Airport Choice among Domestic and International Passengers -

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March 2014

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7-1-28 Minatojima-Minamimachi, Chuo-ku, Kobe, Hyogo, 650-0047, JAPAN

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Abstract

This paper presents an empirical analysis of airport choice and passenger movement on international flights from local cities in Japan to Narita and Haneda Airports in the Tokyo metropolitan area. The primary purpose of this analysis was to understand the profiles and motivations of airline passengers and their implications for airport policy in the metropolitan Tokyo area. The data on which this analysis is based are from a 2010 survey by Japan's Ministry of Land, Infrastructure, Transport and Tourism (JMLIT). This was the first survey conducted since slots for international long-haul flights were assigned for the newly-constructed runway and terminal facility at the Haneda Airport.

The analysis was conducted using a probit model and confirmed that connectivity between local cities by air is a crucial element in passenger selection of a departure airport. At the same time, it was found that Japanese airlines, as well as their associated Alliances, are successfully attracting passengers arriving from local cities by making use of the Haneda Airport. These findings can be used as input into decisions on the relative function of the two airports as well as the establishment of a strategic hub in the Far East.

Keywords: Dual-Airport Policy, Connectivity, Airport Choice, Probit Analysis, Hub Airport

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1.0 Introduction

Competition among airports is increasing on both a global and regional basis and many airports are actively expanding their capacity or upgrading their facilities to establish themselves as a hub airport. Once a an airport is established as a hub airport, a great deal of passenger and cargo traffic flows into the airport, resulting in opportunities for economic development. This phenomenon may be even more pronounced in the Far East, where rapid economic growth over the past two decades has led to increased air traffic. This has led, not only to expansion or upgrade of existing runways and facilities, but also to the constructions of new airports. One of these, Incheon International Airport in Seoul, South Korea, perhaps one of the most successful of these new airports, has become a strong competitor of Narita International Airport. Beginning in the late 1990s, the South Korean government initiated a program of construction and support for the airport, adopting the "Open-Sky" policy, which enabled the country's air travel industry to expand its networks. Korean airlines have instituted flights between many local cities in Japan and Incheon with high frequency and it has routed passengers from local areas in Japan through Incheon instead of Narita[1].

As a result of the expansion of Incheon, a significant change was made to Tokyo's Dual-Airport Policy, which had been in place since the opening of Narita International Airport

[1] As of September 2013, 5 Korean airlines– Korean Air, Asiana Airlines, Jeju Air, Easter Jet and Jin Air–are traveling to 25 airports in Japan from Incheon: Narita (Tokyo), Haneda (Tokyo), Nagoya, Osaka, Sapporo, Asahikawa, Hakodate, Aomori, Akita, Sendai, Shizuoka, Niigata, Toyama, Komatsu, Okayama, Hiroshima, Yonago, Takamatsu, Matsuyama, Oita, Nagasaski, Kumamoto, Miyazaki, Kagoshima and Okinawa.

in 1978, to allow long-haul international flights to and from Tokyo International Airport (Haneda) beginning in October 2010. Prior to this time, the policy of the Japanese government had been to split the function of the two airports, with Haneda dedicated to domestic flights and Narita to international flights. The policy brought to light a number of problems with Narita Airport, however, including a poor domestic flight network which required many passengers traveling within the local area on domestic flights to transfer to Narita from Haneda, a distance of approximately 90 km. (Narita's poor domestic network has been pointed to as a reason why many local passengers prefer Incheon International Airport.) In addition, slot constraints and restrictions on operating hours made it difficult for Narita to expand their volume of both international and domestic connection flights. These constraints initially came about because of strong opposition to airport construction by local communities, requiring the government to construct inadequate facilities in an effort to appease the communities. This led to the existence of only one runway (4,000m) until 2002, when another runway (2,180m) was opened. The second runway was extended to 2,500m in 2009, but problems with the taxiway prevented the slot expansion until early 2013. In addition, the operating hours of the airport were restricted to between 6:00 a.m. and 11:00 p.m. since the airport's opening. The accessibility of Narita from downtown Tokyo has also been poor in terms of mode of transportation, time, and cost. While the government was aware of these inconveniences, it resisted allowing Haneda Airport to accommodate international flights for a

long time. It must be one of the harmful effects by the government's fault to distinguish the functions of the two airports.

As demand for international flights increased, the government made efforts to expand the capacity at Narita, but it was not sufficient to accommodate the increasing volume of air traffic, and the problem of poor connectivity between local cities and Narita persisted. At the same time, other Asian countries adopted strategic policies to build hub airports to cater to international air traffic in the region, Incheon being a key example. The increase in hubs in other regional countries led the Japanese government to amend their policy and designate Haneda as a second international hub airport. In 2002, the government allowed international flights from Haneda to Gimpo International Airport in Seoul, in order to accommodate increased demand during the FIFA World Cup. Subsequently, flights began between Haneda and Shanghai Hongqiao International Airport in 2007, Hong Kong in 2008, and Beijing in 2009. In October 2010, Haneda was allowed to operate international flights for long-haul destinations in late night and early morning hours, and it now has been served for 24hours after 30 March 2014.

This situation has given passengers in the Tokyo metropolitan area the option of two airports for international flights. This is crucial issue, not only for passengers in the area, but also for passengers arriving from local cities in Japan. Given the poor connectivity from local cities to Narita (which has led many passengers to fly into Incheon instead of Narita), it is

important to understand the profiles and motivations of passengers when choosing a connecting airport. This information will provide insight into how to best utilize both of the Tokyo airports and how Japan can compete with Incheon for international travelers.

There has been a great deal of research on airport choice; however, most has focused on passenger choice in a multi-airport region. For example, there are many studies based on data from a survey conducted by the Metropolitan Transport Commission in the San Francisco Bay Area (San Francisco, San Jose and Oakland) in the United States. Pels et al. (2001, 2003), Basar and Bhat (2004), and Hess and Polak (2005) conducted empirical analyses of airport choice. In Asia, Loo et al. (2005) and Loo (2008) examined the Pearl River Delta Area (Hong Kong, Guangzhou, Shenzhen, Zhuhai and Macau). Loo (2008) used a stated preference methodology to assess factors related to airport choice based on surveys conducted in Hong Kong International Airport. In these studies, travel time to an airport, fare, flight frequency, number of airlines, and personal attributes were used as independent variables. However, these studies did not focus on passengers on incoming domestic connecting flights from other local cities. In Japan, Hanaoka (2002) examined the airport choice issue in the Greater Osaka Area (Itami and Kansai) based on passenger movement data collected by Japan's Ministry of Land, Infrastructure, Transport and Tourism (JMLIT). This research, however, focused primarily on the relationship between airport choice for domestic flights and access problems for passengers living in the region.

In research on connectivity for multi-airport cities, Derudder et al. (2010) looked at four major cities: London, New York, Los Angeles, and San Francisco. They found that there were functional divisions among airports, both in terms of their geographical scale and their specific role in the airline network. Hess (2010) examined passenger preferences for specific types of airports using a multinominal logit model to demonstrate that the ability of passengers to reach their final destination with minimum transfers is very important, especially for business travelers. Hess et al. (2007) examined airport and airline choice based on stated preference survey data analyzed using a multinominal logit model, and found that minimizing the number of connections is crucial for business travelers. Marcucci and Gatta (2011) examined regional airport choice in Italy (Bologna, Forli, Ancona, and Rimini airports) using multinominal logit modeling and found that connection capability is an important factor for airline passengers. Hess (2008) examined air travel choice in a survey using a stated preference method to find that the number of connections is one of the most important determinants when choosing a flight.

Although the Tokyo metropolitan area is a multi-airport region, the function of the two airports had been divided, therefore there has not been an empirical analysis of the airport choice issue between Narita and Haneda as international points of departure for either passengers living in the region or for passengers arriving from local cities in Japan. This study investigates how Narita and Haneda are functioning as international connection airports since

long-haul international flights became available from Haneda, and how the number of passengers served by both airports can be maximized.

2.0 Hypotheses

This paper focuses on airport choice between Narita and Haneda for passengers traveling from local cities in Japan, in order to provide insight into the benefits of establishing a strategic hub airport. The table-1 shows the status of the two airports for the 2010's winter schedule.

Table-1: Outline for Narita and Haneda Airport

		Narita	Haneda
Domestic	Number of Destination connected by Direct Flight	8 Airports	51Airports
	Average Flight Frequency on Weekly Basis	97 Flights	1,557 Flights
	Number of Operating Airline (Exclude Codeshare Operator)	3 Airlines	7 Airlines
International	Number of Destination connected by Direct Flight	93 Airports (42 Countries)	17 Airports (11 Countries)
	Average Flight Frequency on Weekly Basis	1339 Flights	378 Flights
	Number of Operating Airline (Exclude Codeshare Operator)	55 Airlines	18 Airlines

Source: Official Website of Narita International Airport Corporation (http://www.naa.jp/en/annual/index.html)
Official Website of Japan Airport Terminal Co. Ltd. (https://www.tokyo-airport-bldg.co.jp/company/en/ir/)

It can be hypothesized that the reintroduction of international flights at Haneda has benefitted passengers, particularly those traveling by air from local cities, for whom Haneda may be more convenient than Narita. It is further assumed that passengers would also be negatively impacted by the time and cost of transferring from Haneda to Narita, as well as the need to repeat the check-in process at Narita, as regulations require. Haneda may also be

preferred over Narita by business travelers. As Midgley and Wills (1969) found in their survey conducted in the UK on the route decisions of air travel passengers, passengers are interested in reaching their final destination as quickly as possible.

In addition to the impact on passengers, there are ways in which the Japanese airline industry may have benefitted from the reintroduction of international flights at Haneda. Japan Airlines (JAL) and All Nippon Airways (ANA) have been allowed not only to expand their routes to Southeast Asia, America and Europe from Haneda, but also to increase their flight frequencies to South Korea, China, Hong Kong and Taiwan. The addition of a second major hub for international flights has also enabled them to accommodate more international connecting passengers from local cities. The extensive domestic flight network into Haneda could help airlines offer passengers attractive fares and other benefits, in addition to easier connectivity. If that means that JAL and ANA could decrease passengers' opportunity cost, that could provide an incentive for passengers to choose JAL or ANA over other overseas airlines. In addition, JAL is a member of "One World" and ANA is a member of "Star Alliance," which expands the airlines impacted by the establishment of Haneda as an international hub and makes it as relevant to the alliances as it is to JAL and ANA.

Slot constraints have also restricted the scheduling of long-haul flights out of Haneda to late night and early morning hours, which may also create an obstacle for some passengers. If the constrain would be removed, Haneda could be served for more passengers.

3.0 Method

The following premises were analyzed using an econometric random utility model. When U_i^m is the utility for individual passenger (*i*) when (*i*) chooses an airport (*m*) between two alternatives (Haneda and Narita), the relationship can be denoted as following;

$$U_i^m = \boldsymbol{x}_i^m \boldsymbol{\beta} + \epsilon_i^m$$

$\boldsymbol{x}_i^m$denotes a vector of characteristics that influence the choice of the airport, $\boldsymbol{\beta}$ denotes the coefficient vector, and ϵ_i^mdenotes the random disturbance term. The utility of an alternative depends on its attributes, including individual characteristics. Theoretically, we can say that an individual maximizes their utility when choosing an alternative from a given choice set. Therefore, (*i*) chooses (*m*) when airport (*m*) provides him with higher utility than airport (*n*). This implies the following;

$$P_i^m = \text{Prob}[U_i^m \geq U_i^n;\ m \neq n] = \text{Prob}[\boldsymbol{x}_i^m \boldsymbol{\beta} + \epsilon_i^m \geq \boldsymbol{x}_i^n \boldsymbol{\beta} + \epsilon_i^n;\ m \neq n]$$

The conditional probability of the choice of airport (P_i^m), given its attributes and the characteristics of the individual, can be represented by the probability of the utility greater than the alternative.

This paper analyzes the profiles of international airline passengers arriving from local cities in Japan to depart from Narita and Haneda.

3.1 Empirical Model

Based on the idea of a random utility model, we specify an empirical model as

follows:

$$y_i^m = \beta_0^m + \sum_{k=1}^{K} \beta_k^m X_{i,k}^m + u_i,$$

where *i* represents each individual sample *(i=1,...,n),* β^m are unknown parameters to be estimated, y_i^m is an dependent variable, $X_{i,k}^m$ are *k* of independent variables which affect airport choice, and u_i is an error term. The dependent variable y_i^m is designated as 1 if an individual i chooses Narita airport and y_i^m is designated as 0 if an individual i chooses Haneda airport. The independent variables $X_{i,k}^m$ are dummy variables: Direct International Flight from Haneda, Direct International Flight from Narita, Direct Domestic Flight to Narita, Class, Airline: JAL, Airline: ANA, Alliance: One World, Alliance: Star Alliance, Purpose: Business, Purpose: Leisure, and Long-haul Destination. We estimated six types of models, in which subset of the variables are used—Long-haul Destination is utilized for creating the cross terms with Purpose: Business or Purpose: Leisure.

3.2 Data

We utilized the data from the "Survey of International Passenger Movement on Air-transport (2010)," conducted by JMLIT. The survey was conducted at all international airports in Japan on several days in August and November in 2010. We extracted a sample of international passengers traveling from local cities in Japan by air to depart from Narita and Haneda. The original sample size was 24,778, but responses with missing values and those from passengers leaving for Seoul, South Korea as the final destination were eliminated. The

reason for excluding Seoul is that it is easily accessible via a one to two hour flight from many local airports in Japan, making it less likely that passengers would connect through Narita or Haneda.

A description of the variables used for the analysis is provided in Table-2; we set "y" (Narita or Haneda) as the dependent variable and analyzed the impact of 11 independent variables on airport choice. In addition, we created two cross terms to look for combined effects for choosing the airport. The Descriptive Statistics are shown on Table-3.

Table-2: Description of Variables

Independent Variable	**Description**
y	Departure airport choosen by a passenger (Narita = 1 , Haneda = 0)

Dependent Variable	**Description**
Direct_International_Flight from Haneda	Direct international flight from Haneda is available to a passenger's destination (Yes = 1 , No = 0)
Direct_International_Flight from Narita	Direct international flight from Narita is available to a passenger's destination (Yes = 1 , No = 0)
Direct_Domestic_Flight to Narita	Direct domestic flight to Narita is available from a passenger's departed airport (Yes = 1 , No = 0)
Class	Travel class (First & Business class = 1, Economy class = 0)
Airline_JAL	Passenger flying with Japan Airlines (Yes = 1 , No = 0)
Airline_ANA	Passenger flying with All Nippon Airways (Yes = 1 , No = 0)
Alliance_One World	Passenger flying with an airline of "One World" Member (Yes = 1 , No = 0)
Alliance_Star Alliance	Passenger flying with an airline of "Star Alliance" Member (Yes = 1 , No = 0)
Long-haul_Destination	Passenger departing for long-haul destination, America, Europe, Africa, Middle-East and Oceania (Yes = 1 , No = 0)
Purpose_Business	Purpose of travel is "Business" (Yes = 1 , No = 0)
Purpose_Leisure	Purpose of travel is "Leisure" (Yes = 1 , No = 0)

Table-3: Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
y	854	0.814	0.389	0	1
Direct_International_Flight from Haneda	854	0.515	0.500	0	1
Direct_International_Flight from Narita	854	0.811	0.391	0	1
Direct_Domestic_Flight to Narita	854	0.710	0.454	0	1
Class	854	0.235	0.424	0	1
Airline_JAL	854	0.365	0.482	0	1
Airline_ANA	854	0.309	0.462	0	1
Alliance_One World	854	0.422	0.494	0	1
Alliance_Star Alliance	854	0.410	0.492	0	1
Long-haul_Destination	854	0.903	0.296	0	1
Purpose_Business	854	0.254	0.436	0	1
Cross_Term_B (Long-haul_Destination & Purpose_Business)	854	0.204	0.403	0	1
Purpose_Leisure	854	0.657	0.475	0	1
Cross_Term_L (Long-haul_Destination & Purpose_Leisure)	854	0.615	0.487	0	1

4.0 Results and Discussion

A summary of the results of a probit regression analysis is shown in Table-4. Probit regression is an appropriate analytic approach when the dependent variable (Airline) can have only one of two values (Haneda or Narita). The analysis shows that passengers choose to depart from Haneda for international travel if a direct flight is available to their destination. Since passengers arriving from local cities incur additional costs if they are required to transfer from Haneda to Narita, this finding is reasonable and supports the importance of Haneda as the hub airport. When a direct flight is available from Narita to their international destination, passengers will choose Narita, which is likely related to the number of destinations that are served only by that airport.

Passengers also choose Narita as the connecting airport if a direct domestic flight is available from their nearest local airport. There is clearly no need to transfer between the airports, in this case, so cost is not an issue, and Narita offers a greater number of flights and more frequent departures than Haneda.

Narita is also the airline of choice for passengers traveling in higher service classes. This result is related to the fact that newer and better aircraft with better cabin equipment is used for flights from Narita. This is more obvious for JAL and ANA in terms of an aircraft rotation. Given that Narita is the main hub for the two airlines and they face severe competition from other airlines, it would be reasonable for them to assign better aircraft to Narita rather than to Haneda.

When flying with JAL or ANA, passengers are most likely to choose to fly from Haneda. This is consistent with the finding that passengers tend to choose Haneda if a direct flight is available to their destination. Assuming that most passengers would prefer to use the same airline for both the domestic and international legs of a trip, the convenience of checking in only once may outweigh the fact that there are a relatively limited number of international destinations from Haneda. Haneda is also the airport of choice for travelers on One World and Star Alliance member airlines.

As expected, a passenger traveling for business tends to choose Haneda. This may reflect the business traveler’s option to choose convenience over price. On the other hand,

passengers flying to a long-haul destination for business are likely to choose Narita over Haneda. Given the restrictions on daytime long-haul flights from Haneda, the opportunity cost may be lower, making Narita a reasonable choice for business travelers.

The research show no significant effect for passengers traveling for leisure purposes only, but for long-haul leisure travel, passengers choose Narita. When consider the result that a significant effect is not observed in Model-6 but in Model-5, it might be possible to say that JAL and ANA succeeds in obtaining passengers flying to a long-haul destination with leisure purpose by themselves. This reflects the fact that they are keen to local promotion of international leisure package tours departing from Haneda.

Passengers joining from local cities are induced to fly to Haneda by the extensive domestic network of JAL and ANA. One World and Star Alliance also enjoy the benefits brought by JAL and ANA.

Table-4: Summary of Results

Variables	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
Direct_International_Flight from Haneda	**-1.541*** **	**-1.602*** **	**-1.431*** **	**-1.494*** **	**-1.518*** **	**-1.580*** **
	(0.174)	(0.175)	(0.172)	(0.173)	(0.174)	(0.174)
Direct_International_Flight from Narita	**0.773*** **	**0.785*** **	**0.615*** **	**0.630*** **	**0.739*** **	**0.753*** **
	(0.199)	(0.197)	(0.207)	(0.206)	(0.202)	(0.200)
Direct_Domestic_Flight to Narita	**0.555*** **	**0.540*** **	**0.500*** **	**0.488*** **	**0.532*** **	**0.518*** **
	(0.118)	(0.118)	(0.121)	(0.121)	(0.119)	(0.119)
Class	**0.439*** **	**0.389*** **	**0.464*** **	**0.410*** **	**0.457*** **	**0.403*** **
	(0.145)	(0.144)	(0.148)	(0.148)	(0.147)	(0.146)
Airline_JAL	**-0.619*** **		**-0.661*** **		**-0.654*** **	
	(0.151)		(0.154)		(0.154)	
Airline_ANA	**-0.607*** **		**-0.621*** **		**-0.641*** **	
	(0.156)		(0.158)		(0.158)	
Alliance_One World		**-0.901*** **		**-0.947*** **		**-0.916*** **
		(0.212)		(0.218)		(0.214)
Alliance_Star Alliance		**-0.942*** **		**-0.964*** **		**-0.951*** **
		(0.212)		(0.218)		(0.214)
Purpose_Business			**-0.605*** **	**-0.569** **		
			(0.228)	(0.232)		
Cross_Term_B			**0.621** **	**0.600** **		
(Long-haul_Destination & Purpose_Business)			(0.251)	(0.255)		
Purpose_Leisure					-0.249	-0.183
					(0.258)	(0.257)
Cross_Term_L					**0.419***	0.323
(Long-haul_Destination & Purpose_Leisure)					(0.249)	(0.247)
Constant	**1.287*** **	**1.699*** **	**1.434*** **	**1.843*** **	**1.251*** **	**1.658*** **
	(0.187)	(0.242)	(0.208)	(0.261)	(0.196)	(0.250)
Observations	854	854	854	854	854	854
Log likelihood	-318.723	-316.567	-315.093	-313.391	-316.737	-315.305
Adjusted McFadden's Index (R2)	0.206	0.212	0.210	0.215	0.206	0.210

Notes_Titles
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.0 Conclusion

The results of this study suggest that Haneda has strong potential to be the international hub airport for the Tokyo metropolitan area, and would be the most functional hub airport in Japan, especially for business travelers in terms of the connectivity advantages it offers. It is true that there are still many restrictions in place preventing Haneda from expanding its international flights, but JMLIT has announced that additional slots will be granted to international flights out of Haneda in March 2014. At present, an increase of 42 international flights per day is expected, approximately 20 of those to be assigned to JAL and ANA, with the remainder going to overseas airlines. When these additional flights are

permitted to have daytime departures, both airlines will be able to improve the flexibility and efficiency of their operations. Daytime departures from Haneda will also have greater utility for passengers. This change in policy will provide the two Japanese airlines, along with other overseas carriers, an opportunity to expand their international network from Haneda, especially for long-haul destinations. Passengers traveling internationally, as well, will benefit from the increased options. As mentioned in the introduction, the Japanese government has focused much of their attention and resources on Narita, based on its historical background, and has been reluctant to expand the international operations at Haneda. This has inconvenienced passengers and, as a result, allowed Incheon to position itself as an international hub for local cities in Japan.

At the same time, this analysis reveals that connectivity is crucial for passengers arriving from local cities. With restrictions in place that prohibit expansion of Haneda to accommodate increased demand, it is inevitable that passengers will utilize Narita as their primary gateway for international flights. Moreover, given that 24-hour operation is not permitted at Narita, it is clear that both Tokyo airports are falling behind Incheon in efforts to become a strategic international airport in the Far East. These results support the value of the Dual-Airport Policy and highlight the urgency of improving the function of Narita. Of paramount importance is the improvement of connectivity. Although it is expected that the number of aircraft moving through Narita will be increased by 30,000 and reach 300,000 in

2014, it will not be enough of an increase to maximize the competitiveness of Tokyo's airports[2]. It will still be necessary for the Japanese government to reach a consensus with local communities around the airport on solutions for the problem of noise pollution that has restricted the volume of air traffic.

Based on the increased competitiveness of Korean Air and Asiana Airlines resulting from the South Korean government's support of Incheon, the internationalization of Haneda and Narita has the potential to revitalize the Japanese airline industry. Establishing steady passenger flows into Narita and Haneda will help JAL and ANA to regain their competitive stature, while benefitting the people of Japan, as well.

Finally, it is important to note that this study did not include passengers using Shinkansen high-speed rail to access Haneda or Narita from local cities. Future research on airport choice should include Incheon and Shanghai airports, as well as Haneda and Narita, and should address the issue of airport choice specifically for passengers in the Tokyo metropolitan area.

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[2] The number of aircraft moving at competitors is as following;
Incheon (Seoul) 271,224 per year (2013)
Pudong (Shanghai) 361,720 per year (2012)
Source: Official Website of IIAC
http://www.airport.kr/iiac/pds/sta/Sta_01.iia?lang=E
Official Website of CAAC
http://www.caac.gov.cn/I1/K3/201303/P020130327299233850801.pdf

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