ANALYSIS OF INTERNATIONAL AIR PASSENGER CHARACTERISTICS IN THE ASIAN REGION

Tetsuo YAI
Associate Professor
Department of Civil Engineering
Tokyo Institute of Technology
2-12-1 O-okayama, Meguro-ku
Tokyo 152, JAPAN
Fax.: +81-3-3726-2201

Kazuyuki TAKADA
Research Associate
Department of Civil Engineering
Tokyo Institute of Technology
2-12-1 O-okayama, Meguro-ku
Tokyo 152, JAPAN
Fax.: +81-3-3726-2201

Naohisa OKAMOTO
Researcher
Institute for Transport Policy Studies
3-18-19 Toranomon, Minato-ku
Tokyo 105, JAPAN
Fax.: +81-3-5470-8419

abstract: International air travel behavior is analyzed in terms of two aspects. Firstly, characteristics such as travel pattern in the Asian region are examined. The International Passenger Survey was carried out at the New Tokyo International Airport (Narita) in this study to obtain trip chaining data of foreign passengers. Travel patterns such as a passenger visits more than two countries in one travel are extracted. Secondly, the differences of preference dependent on nationalities for air transportation service are analyzed by Stated Preference survey that is simultaneously done at Narita. Moreover, the service choice models are estimated for each nationality of passengers with ordered logit model. Then, the differences of heterogeneity by nationality are compared using the concept of willingness to pay for the service elements.
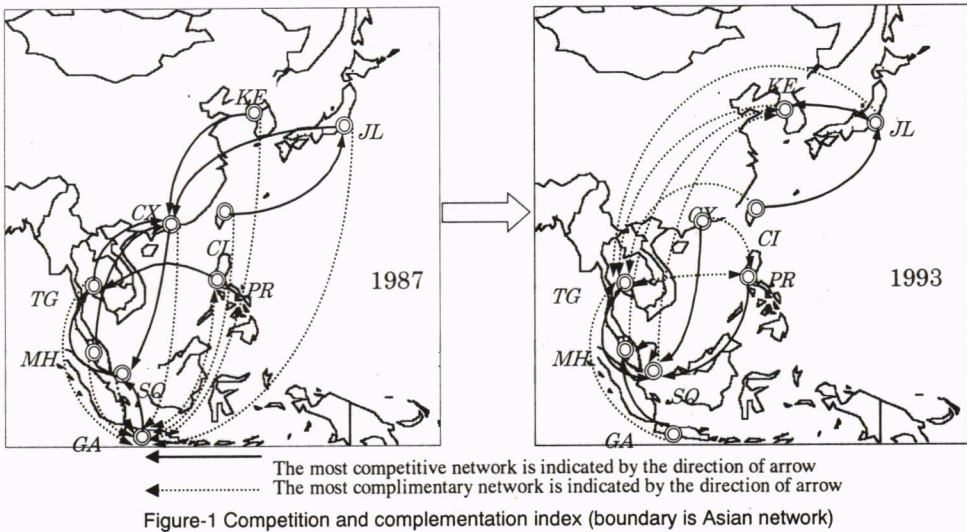
1. INTRODUCTION

The recent economic growth in Asian region has promoted international air passenger demand. It is expected that this growth trend will continue in the future. In many Asian countries, large-scale international airports are now under construction to meet the future huge demand.

At present the competitive condition surrounding airlines in terms of network has changed and has become intense because of network expansion by the respective airlines. Figure-1 shows the historical change of competitive condition between airlines shown by a simple index which is obtained using the combination of airports served by each airline (Takada(1996)). This network expansion in the Asian region provides passengers more choices of flights. For passengers who travel in this region, it becomes easy to fly between countries/cities and similarly to travel plural countries in one travel.

Then, the importance of research on region-wide international passenger movements has been increasing in order to develop international air transportation facilities. Furthermore, the consideration of multinational characteristics such as differences of preference for air transportation service is needed. However the quantitative analysis has not progressed so far due to the delay of data preparation for the Asian region. Therefore, international passenger survey is conducted recently at Narita Airport in October, 1996.

In chapter 3, the international passenger survey is explained in terms of its originality and contribution to further research. Moreover, some noticeable trends are deduced and some characteristics of passenger flow in the Asian region are shown.

The most competitive network is indicated by the direction of arrow
The most complimentary network is indicated by the direction of arrow

Figure-1 Competition and complementation index (boundary is Asian network)

In chapter 4, preference for international air transportation service is analyzed using stated preference data. The ordered logit model is employed to estimate preference parameters of utility functions. The Comparison of parameters is done according to passenger's nationality. It is demonstrated here that the heterogeneity of preference for air transport service exists among different nationalities.

2. REVIEW OF RELATED PAPERS

In the last 15 years, a lot of studies focusing on air transportation networks were conducted in the world. From the view point of demand analysis, Oberhausen et.al.(1982) focused on passenger demand by means of time-series analysis. Harvey(1987) analyzed air passenger behavior and proposed the hierarchical structure of passenger behavior. Morichi et.al.(1989) analyzed not only international air passengers but also domestic air passengers to evaluate air transport policies in Japan. In their study, three kinds of model such as trip production model, departure airport model and trip generation model were developed to explain international passenger travel behavior. The last model was utilized to forecast induced demand using accessibility variable that varies according to level of service of each airport. They carried out one case study treating Fukuoka-Hong Kong city pair to evaluate the effect of flight frequency change and proposed increase of the international flights from/and to local airports in Japan order to decentralize the flights at Narita airport. Furuichi et.al(1994) developed integrated forecasting models for international air passenger demand using discrete choice models and air passenger survey data in Japan. The last two studies analyzed only Japanese travel behavior, therefore these are not sufficient to evaluate international air transport policies and network design problem when we consider air passenger demand in neighboring countries.

A research on Pacific air transportation market was conducted by Hansen et.al.(1990). They mainly analyzed the impact of demand growth and the effect of high terminal costs at Narita Airport. The results of their simulation indicated that the increase of passenger demand made it possible to operate intercontinental direct flights not via Narita. An alternative Asian

airport would become a major gateway because of high operation costs of airlines at Narita airport.

Meanwhile, Kuwang et al. (1996) analyzed travel behavior of Korean international passengers detailed using SP experiment for international service. Moreover, Yai et al. (1995) proposed the method to estimate the demand between U.S. and Asian countries integrating many kinds of data such as immigration statistics of each country and the ICAO's statistics. And estimated route choice model, in terms of airline choice, was utilized to calibrate the benefit occurred with the changes of service level. In the last two papers mentioned above, the variables that were used to explain the weight of preference for the service are almost same. In this paper, same kinds of variables are also used for SP survey. Region-wide, which means passengers nationality is widely treated, international passengers are focused on in this paper. The models of service choice are estimated by SP method using variables that are same of those papers.

3. INTERNATIONAL TOURIST SURVEY

The diversity of international travel characteristics increases with the passenger demand increase. The processes of travel demand expansion easily explain it. In the first stage, the passengers for business purpose occupied most of the travel demand. And the passengers who traveled abroad in group-tours added. Finally, the passengers who traveled abroad by themselves added. Moreover, heterogeneity of international passengers who visit a certain country increases with varieties of nationalities. It is a need to consider diversity of international travel characteristics and the heterogeneity of international passengers to estimate the passenger demand for improvement and development of airports.

However, the delay of the preparation of data dealing with worldwide passengers has prevented from analyzing travel behavior in the international air transportation field. In Japan, Ministry of Transportation has conducted large-scale international passenger survey every two years since 1989. The research on travel behavior related to Japanese overseas travelers is advanced and many results of research are utilized for policy-making such as new airport construction and internationalization of airports located in local region in Japan.

The fact that the users of international airports in Japan were mainly Japanese passengers improved preparation of data related to Japanese passengers sufficiently. And there was progress only in the research on Japanese travel behavior. In recent years, the number of nationalities of passengers, and the total number of passengers, who visited Japan and who transited in Japan has been increasing. Therefore, the necessity of recognition of travel behavior of foreign passengers has been raised for planning of future airport improvement.

Therefore in this study, international passenger survey named "International Tourist Survey" has been conducted on passengers except for Japanese passengers at Narita International airport. The summary of survey is shown in Table-1 and contents of survey in Table-2. The main question asked to passenger was his trip chain that means the whole travel route, including the airports used for transit, from his residence and to his residence. The responses to this question are utilized for the analysis of travel behavior. The question also includes the item such as second or third country visited by the passengers in his current travel in the

Asian region.

Table-1 Summary of International Tourist Survey

Date	October 24-29, 1996
Location of Survey	Transit Lounge in Terminal 1 of the New Tokyo International Airport(Narita)
Qualification of Respondent	-the Foreign Traveler Departs from Japan -the Foreign Traveler Passes Narita for Transit
Languages used	English, French and Korean
Number of Samples	1165

Table-2 Questions of International Tourist Survey

Question	Contents
Attributes	Nationality/ Residence/ Sex/ Age/ Occupation/ Income
Contents of current travel	length of travel date/ route/ visited cities/ purpose of visit/ length of stay/ number of accompanies/ air seat class/ fare of air ticket
Travel experience/Travel desire to Asian region	Number of times to visit Asia last five years by countries/ desire to visit Asian countries
Stated Preference for International Air Transportation Service	Ranking of willingness to buy for international travel ticket

Moreover, the SP survey was conducted in this survey to investigate of differences of characteristics due to the passenger's nationality. The details of the question of SP(Stated Preference) will be explained in chapter 5.

4. CHARACTERISTICS OF INTERNATIONAL TRAVEL IN ASIA

In this chapter, travel pattern of passenger's current travel is firstly analyzed. Table-3 shows the average number of countries visited with respect to their residence and travel purpose. This indicates that there is a pattern in which a passenger visits more than one country in one travel. In the Asian region, international air transportation is mainly used for traveling between countries because these countries are usually separated geographically by sea, which is completely different from the European case. Therefore, the comprehension of travel pattern that represents the above activity of international passengers will be utilized for the demand forecasting in the Asian region.

Meanwhile, Figure-2 shows the share of the purpose to visit the 6 major countries. Some trends can be easily deduced from the figure. There are many passengers who pass through airports for transit, especially for visitors to Japan, Singapore and Hong Kong (H.K.). The reason why Narita has a high share of transit passengers is that now the U.S airlines are using Narita as a base airport for transit for passengers who travel between the U.S. mainland and Asian countries. Meanwhile, Singapore and H.K. are used as hub airports for the passengers who travel within the Asian regions. However, since the survey was executed only in Terminal 1 at Narita where the U.S. airlines mainly use, the share of transit passengers at Narita may be higher than the actual situation.

From these results, it can be inferred that there are many types of passengers and that each airport is used for a specific purpose such as transit. Then, travel pattern is analyzed using

the sample of the U.S. passengers who visit second countries in one travel. Figure-4 shows travel pattern for the U.S. passengers in terms of countries visited except for transit. About 40% of the passengers have visited more than two countries. There is a general trend that the passengers stop at East Asian countries such as Japan, Korea and China as their first visited countries. According to increasing number of countries visited, they frequently visit the countries located in Southeast Asia. It was mainly caused by the fact that there are no non-stop flights between the U.S. mainland and ASEAN countries and almost passengers travel these countries after visiting other countries located in East Asia.

The travel pattern was inspected applying quantification method of the third type. If there is a typical travel pattern in terms of countries visited, these countries are spatially positioned closely. Figure-4 shows the results of calculation for sightseeing passengers using 1st and 2nd axis. In this case, these axes do not have significant meaning. Every objective region could be intuitively divided into 4 segments. The first group is composed of Japan, Taiwan and Korea, the second one is composed of Singapore, Thailand, Malaysia, Indonesia and Vietnam, the third one is composed by Hong Kong and China and last one is composed of the Philippines, Australia and New Zealand. The interpretation for each segment is shown in Table-4.

Table-3 Number of countries visited

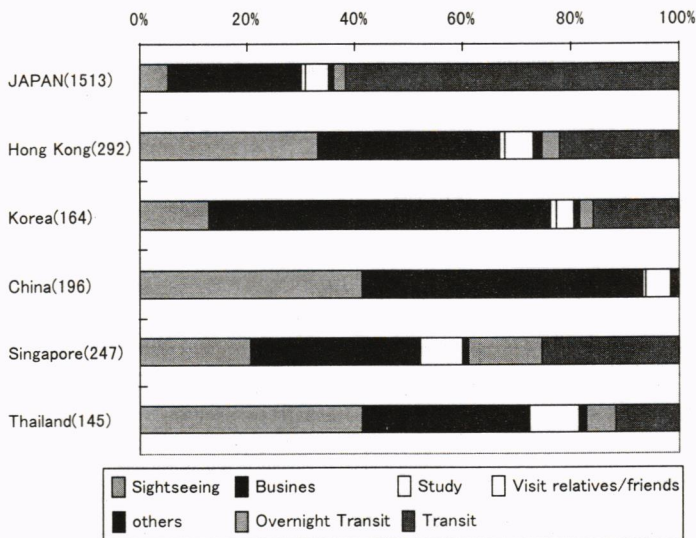| Residence	Sightseeing	Business
North America	1.94	1.67
Central America	2.14	2.07
Europe	1.88	1.94
East Asia	1.16	1.16
Southeast Asia	1.35	1.40
Oceania	1.75	2.04

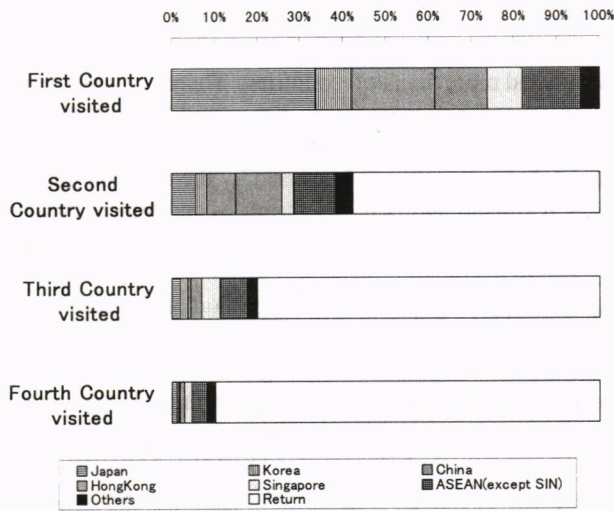Figure-2 Purpose of visit (to each country)
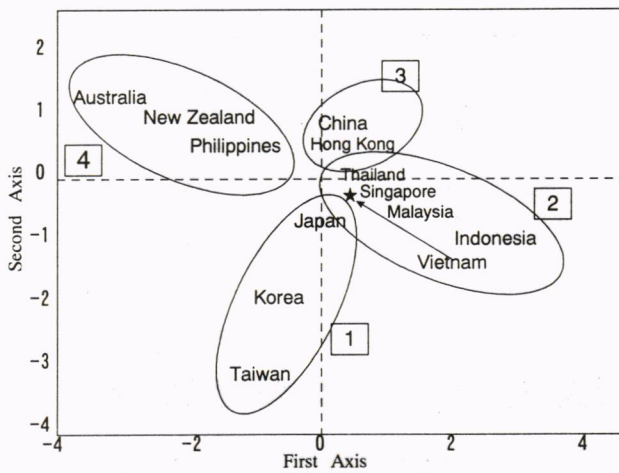
Figure-3 Travel Pattern of U.S. passenger

Figure-4 Pattern of countries visited for U.S. sightseeing passengers

Table-4 Interpretation of segments

Segment	Characteristics	Travel pattern
1st group	Urban recreation	The passenger visited only one region, especially Korea and Taiwan, in current travel
2nd group	Southeast Asia	The passenger used Singapore as a hub to visit some countries locates in Southeast Asia
3rd group	China gateway	The passenger visited Hong-Kong as a gateway to visit China
4th group	Recreation	No particular relation between countries visited

There is a travel where the passenger visits some countries in one travel and some patterns to visit countries. The research on travel behavior such as trip chaining must be analyzed to consider air transportation in Asia because air transport is main mode for international passengers in this region.

5. PREFERENCE FOR AIR TRANSPORTATION SERVICE

There are many kinds of service including FFP (Frequently Flyers Program), non-stop flight, low price fare. Business passengers generally prefer the more frequent flights and the shorter line haul time, while sightseeing passengers also consider the level of fare in addition to the above services. Moreover, some passengers prefer flights using their countries' flag carriers. As have been described, passengers have heterogeneity of preference for air transportation service. Perception of this fact would be important to the design of air transportation facilities including air network in this region. Therefore, passenger's preference for air transportation service is analyzed in section 5.2. using Stated Preference Survey within the International Tourist Survey.

5.1. Stated Preference (SP) Analysis

Preference for air transportation service is investigated in the International Tourist Survey. The respondent was asked to rank every alternative in a given choice set comparing several kinds of service. The contents of comparable service are fare, total travel time, flight frequency, nationality of airline. And other descriptive explanations such as seat class, required time for transit were added to all alternatives.

Two types of questionnaire were provided, one is a long-distance flight and another is relatively short- distance flight, because it was thought that the passenger's preference for services would be changed by flight length. Then, specific city-pairs were set for each case, Tokyo- London /New York was given for long distance case and Tokyo-Singapore was given for short distance case.

The design of SP survey was done using orthogonal array. The parameter estimation for each passenger was given up because of constrained time for a personal interview and fatigue for ranking every alternative. Then, parameter estimation for each nationality was conducted which is the one of the main purposes of this survey. Summary of SP's design such as comparable variables is shown in Table-5 and the example of questionnaire form is also shown in Figure-5.

Parameters of service choice model were estimated using ordered logit estimation method. Initially, a priori segmentation based on socio-economic attributes was done for parameter estimation, however, the explanatory power of estimated parameters was not statistically significant. It was because that there are many captive groups in each segment. For instance, a passenger who gives large weight to fare level has ranked alternatives in order of cheaper fare service without considering other services. Therefore, the sample is divided into two segments in this study according to the results of the 1st ranking. One segment is the set of samples who preferred business class and the other is those who preferred economy class and parameters were separately estimated.

Table-5 Summary of SP design

Variables	Assumed conditions		Number of Categories
	Long distance case (Tokyo-London, New York)	Short distance case (Tokyo-Singapore)	
Airline nationality	Domestic Foreign	Domestic Foreign	2
Round trip fare	2,000 US$(Business class) 1,800 US$(Business class) 1,200 US$(Economy class) 1,000 US$(Economy class)	1,200 US$(Business class) 800 US$(Economy class) 700 US$(Economy class) 600 US$(Economy class)	4
Total flight time	12hours(non-stop) 15hours(1stop, 1 hour for transit) 17hours(1stop, 3hours for transit)	6hours(non-stop) 8hours(1stop, 1hour for transit) 10hours(1stop, 3hours for transit)	3
Flight frequency	2 flights per week 7 flights per week 14 flights per week	2 flights per week 7 flights per week 14 flights per week	3

If you would go sightseeing abroad by your own expense, what kind of ticket do prefer to buy?
Please rank them from 1 to 4, with being the ticket you would most prefer.

Q1. Imagine that you are fling from Tokyo to London or New York.

Ticket Sample:
· Airline Nationality
· Round Trip Fare(Seat Class)
· Total Flight Time(Stop, Transit Time)
· Flight Frequency

Ticket A
· Your flag carrier
· 2,000 US$ (Business class)
· 15 hours (One Stop , 1hour)
· 14 flights per week
Rank

Ticket B
· Foreign carrier
· 1,800 US$ (Business class)
· 15hours (One Stop , 1hour)
· 7 flights per week
Rank

Ticket C
· Foreign carrier
· 1,200 US$ (Economy class)
· 15 hours (One Stop , 1hour)
· 7 flights per week
Rank

Ticket D
· Your flag carrier
· 1,000 US$ (Economy class)
· 17 hours (One Stop , 3hours)
· 2 flights per week
Rank

Figure-5 example of questionnaire form

Table-6 Service choice model of international air passengers who prefer economy class

	U.S.	Canada	Korea	China	South East Asia	Europe
Fare	-0.3202	-0.4303	-0.2645	-0.3043	-0.2602	-0.3210
(100US$)	-18.790	-6.749	-5.415	-4.388	-3.546	-11.968
Time	-0.1447	-0.3189	-0.0636	-0.0652	0.0251	-0.1684
(hour)	-4.737	-2.930	-0.648	-0.474	0.171	-3.492
Frequency	0.0252	0.0530	0.0166	0.0531	0.0732	0.0356
(times/week)	3.654	2.060	0.657	1.653	1.818	3.070
Nationality of airline	0.2344	0.1613	-0.0505	-0.1996	-0.3464	0.0717
(1 or 0)	3.936	0.834	-0.262	-0.778	-1.297	0.823
likelihood ratio	0.1908	0.2334	0.1770	0.2144	0.1627	0.1861
hit ratio(%)	58.96	59.89	56.99	58.10	62.07	56.68
number of sample	718	63	62	35	29	267

Estimation results of parameter for the passenger who prefers economy class are shown in Tables-6. Most of estimated parameters are statistically significant except for few cases. The description of estimation results will be explained in the next section.

5.2. Preference of Air Transportation Service

In this section, the heterogeneity of preference by nationality of passengers is analyzed using the results of estimated parameters. The concept of "willingness to pay" for service is

employed. Comparison between fare parameter and other service parameters is of use to evaluate the difference of the values of willingness to pay for each service. And the results of evaluation are shown in Table-7. The facts that the value for each service by passenger's nationality is different imply the necessity of considering multinational characteristics of international passengers for making air transportation policies.

The willingness to pay for unit time means the value of time. There is a trend that the value of time for a passenger whose country has high-income level is relatively higher than other cases. This value would be useful as the index to measure consumer benefit in the case that some service make travel time shorter. And, the willingness to pay for unit frequency means the value of one flight and the willingness to pay for nationality of airline means the value of domestic carrier. Especially, U.S. passengers prefer their domestic airlines. It might be due to the fact that the U.S. passengers usually participate FFP. About 84% of U.S. passengers participate FFP according to the survey, therefore domestic airline preference can be related with FFP.

Table-7 Trade-off between fare and other services   (US$)

Willingness to pay for	U.S.	Canada	Korea	China	South East Asia	Europe
Unit Time(hour)	45.19	74.11	24.05	21.43	-9.65	52.46
Unit Frequency(one/week)	7.87	12.32	6.28	17.45	28.13	11.09
Nationality of airline	73.20	37.49	-19.09	-65.59	-133.13	22.34

6. CONCLUSION

International travel behavior in Asian region is analyzed in terms of two aspects. One point is to comprehend the characteristics of passenger movement in the Asian region. Another point is to analyze the differences of preference for international air service. These are accomplished using the survey data. The usefulness of the International Tourist Survey is demonstrated through the results of this paper. Since the survey data in this research are collected only the foreign passengers who was in Narita Airport. The actual travel behavior might be slightly different. Therefore, it is necessary to analyze travel behavior more accurately. For this reason, it is expected that standards of data preparation will be developed in Asia.

Moreover, the results of SP survey show distinct differences of preference dependent on passenger's nationality. Model parameters can not be estimated before sample segmentation is executed. The other kinds of formula, such as the dogit model, must be considered to estimate the parameters. The service choice models estimated in this research will be sufficiently utilized to evaluate the level of air transportation service in the Asian region.

ACKNOWLEDGEMENTS

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