Korean Air Passengers' Choice Behaviour*

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I. INTRODUCTION

Domestic air travel is unusual in Korea because the country is not large enough to take advantage of air travel. International air travel was severely regulated by government until the late 1980's, and besides regulation, the common people in Korea have not been wealthy enough to take frequent international trips. In such conditions, Korean people in general have not

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been accustomed to taking an airplane until recently. Now, many Koreans can have the chance to take a trip abroad, because the regulation against "going out of country" has been greatly eased by the act of "liberalisation of foreign travel" in 1988, and even the common people have the economic ability to use international air travel. It is therefore interesting as well as necessary to study particular people's behaviour in the relatively new situation of international air travel.

This research will study the choice behaviour of Korean people for their international air trips. It will concentrate on the study of flight choice behaviour by Korean air travellers who are travelling long distance to North America or Western Europe flying more than 10 hours. As an initial study of the Korean international air travel market, the major objective of the research is to identify the factors and their importance for flight choice, and with these findings, relative importance between variables will be estimated (for example, the value of travel time).

A disaggregate model will be more useful than an aggregate model to reach such objectives as described above. As a research method to calibrate models, Stated Preference(SP) Techniques will be utilised. Often it is not easy to calibrate an efficient model with Revealed Preference(RP) data because there is not sufficient variation of all variables of interest and there are also often strong correlation between variables or between variables and other invisible factors. SP Techniques which allow the researcher to experiment, can offer a solution to these problems. With clearly defined attributes and attribute levels, SP experiments can give researchers the chance to have sufficient variation of variables interests, and an orthogonal design which ensures that the attributes presented to respondents are varied independently from one another, avoids multi-collinearity between attributes. The drawback of SP Techniques is that the data obtained represent individuals' statements of what they would do given hypothetical choices. However, people may not necessarily do what they say. This disadvantage can be overcome by presenting respondents with as realistic a set of situation as possible. Therefore, it is desirable that SP design and data gathering process should be devised according to the information obtained from RP data. So, it is necessary to have sufficient quality RP data which will result reliable SP models.

The necessary RP data was gathered through the survey of this study because there has not been any research related to international air travellers' behaviour in the market, until now. The survey to gather RP data was conducted at passenger terminals of Kimpo International Airport in Seoul Korea, by distributing and collecting a self administered questionnaire. This paper will not present the detailed procedure of the survey and data analysis. However, it was found that the surveyed RP data well represent the population (Yoo, 1995), and the findings from the data would be utilized for SP design as described in the section II.

II. SP DESIGN PROCEDURE

1. Introduction

With clearly defined attributes and attribute levels, SP experiments can give researchers the chance to have sufficient variation of variables of interest, and an orthogonal design which ensures that the attributes presented to respondents are varied independently from one another, avoids multicollinearity between attributes.

However, strict orthogonal design might be undesirable in some circumstances as strict orthogonal design often produces too many alternatives for respondents to manage. In addition, where the orthogonal design concept is strictly applied, it could produce unrealistic options. For example, travel time and travel cost should be correlated in some circumstances. In such cases, the alternatives composed by strict orthogonal design which secure complete independence in variation of attribute level would be ridiculous to respondents. Since people may not actually do what they indicate in their response to a hypothetical situation, the reality of the hypothetical alternatives is very important in order to induce reliable responses from the respondents. Therefore, a compromise between orthogonality and reality is usually unavoidable for the SP design.

Another point to be considered for the SP design is simplicity in order to lead the respondent to view the hypothetical options consistently and logically without fatigue. To secure simplicity in the design, it is necessary to reduce the number of alternatives. This will require a limit on the number of

attributes and their levels.

The subsequent subsections will describe the concrete procedure of the SP design for this research. These will include the design of the response measurement scale, attributes and their level selection, hypothetical alternative composition, and the alternative set composition.

2. Response Measurement Scale

There are three kinds of measurement scales which have been used for SP experiments: ranking across options, rating each option, and choices among options. The selection among these three measurement scales depends on the purpose of research, survey environment and the method to be used for analysis. The survey environment of this research is compatible with choice experiments because the survey is conducted in an airport departure lounge, and the respondent does not have enough time to consider rating or ranking the alternatives. The choice data can be analysed through logit modelling, which allows statistical testing.

3. Attributes Selection

All the factors influencing air passengers' flight choice should be included in the attribute set to understand travellers' behaviour. However, it must be pointed out that few respondents are consistently adept at evaluating many attributes at a time. Therefore, it is a major concern at the initial stage of SP design to select a few important attributes and set their level considering reality, and simplicity of the hypothetical alternatives.

The major factors influencing air flight choice in the market were found through the RP data analysis. They were as follows; *air fare, air journey time, service frequency, and the nationality of airline.* These four factors can be adopted as good attributes for the SP experiment, as they have reality as identified through observed behaviour. The remaining part of this subsection will describe a detailed definition for each attribute.

Air Fare

The air fare represents the actual ticket price paid by travellers. This study will only consider the air fare for economy class, and the samples for the SP

survey are selected from economy class travellers, in order to simplify the SP experiment. However, it is necessary to know how the corporate business travellers, who are the employees of large corporations, consider the air fare attribute for their flight choice, as the air fare is often paid by the corporation they are employed by, for their business travel. The findings obtained from RP data show that about 90% of business travellers usually considered the ticket price because the company or department to which they belonged had a budget constraint for travel (Yoo, 1995). Therefore, the air fare factor must be included in the attribute set for business travellers, as well as leisure & VFR travellers.

Journey Time

Because almost all of the flights in the market of this study, use the same departure and arrival airport for the same destination city, the SP design consider air journey time for the travel time factor.

There were no significant differences in flying time between the services of each airline for the same destination if the flight was non-stop direct. The variation of air journey time depended on whether the flight was non-stop or an intermediate-stop one. That is to say, journey time is closely correlated to the existence/non-existence of an intermediate-stop. It is undesirable to include journey time and existence/non-existence of an intermediate-stop as an independent separate variable. It would be desirable to present one travel time variable which can represent the mixed effect of air journey time and intermediate-stop factors, in order to secure not only the reality of experiment but also to reduce the number of attributes.

Service Frequency

According to the RP survey data, many people answered they had chosen the flight because the "flight schedule" was suitable. Some of them may have been influenced by the departure date, some of them may have been influenced by departure time, and some of them may have been influenced by either arrival time or arrival date. It would be too complicated a design to manage if we considered those four aspects of time schedule as separate attributes. It is, therefore, desirable to use one attribute which can include all

those aspects.

This attribute of "flight schedule" might be closely correlated with flight frequency. If there are more frequent flights for one flight number than another, it can result in more convenient time schedule. So, it is undesirable to include "flight time schedule", and "flight frequency" independently in the attribute set, and this study will use *service frequency* to include all these aspects stated above.

Nationality of Airline

Through the analysis of RP data, it was revealed that the nationality of the service provider was an important factor in flight choice. Many Korean travellers did not feel confident with speaking or listening and understanding English or other foreign languages. So, they prefer Korean airlines which served by Korean cabin crews, to foreign airlines. Perceived preference differentiation between Korean airline service and foreign airline service might be considered as service level factors.

4. Setting Attribute Level

Determining the level of attributes to compose hypothetical alternatives, requires considerable care in order to induce reliable responses from respondents. One serious constraint might be that the number of attribute levels should be limited, since the number of options which respondents consistently consider, is not large. A major consideration in selecting the level of attributes is range and degree of variation. Since the realistic levels of attributes are crucial to lead the respondents to a logical consideration, it is desirable to use the information observed within a real market, in order to set the range and degree of variation of attribute level. Customization in selecting the attribute levels are also useful to ensure realism within the attribute levels are also useful to ensure realism within the attribute level because different individuals may have different experience for the realistic level of attribute.

The factorial design has the of advantage orthogonality, whereas the alternatives can present an unrealistic combination of attribute levels. In such cases, such alternatives as seem unrealistic, should be removed in order to

improve data quality, sacrificing the orthogonality of design.

Additional consideration for setting the levels of attributes is complexity and competitiveness. Complex choice tasks result in ignoring some attributes. Avoiding obvious dominance, and securing competitiveness in attractiveness of alternatives also lead respondents to consider their responses to the questions seriously, and so results in realiable data.

(1) Attribute Level of Journey Time

The air journey time means the time difference between take off time at the origin airport and landing time at the final destination airport. It was found through the RP survey that air journey time for the same destination varied according to the existence/non-existence of intermediate-stop. The flight hours for the same destination with a direct non-stop flight were almost all the same regardless of the flight number.

In SP design, journey time had to be customised by the samples' destinations, in order to secure reality in hypothetical alternatives. Three levels were assigned for this attribute: "L"(low), "M"(medium), and "H"(high). "L" level of journey time for each destination, was set at the average value of real data of non-stop flights for each destination. The "M" level was set at the value of three hours added to non-stop flights, as most one intermediate-stopping flights take two and half to three hours more than a non-stop flight in the market of this study. The "H" level was set at the value of five hours added to non-stop flights because it was revealed that some intermediate-stop flights took five hours more than a non-stop flight. The questionnaire had to notify respondents that the "M" and "H" levels of this attribute are only associated with one intermediate-stop.

More than one intermediate-stop was excluded from consideration because it was found in the RP survey that there were not enough respondents who had used such an air-route. Table II-1 shows the attribute level for each destination. Destinations were grouped by flight hours on a non-stop flight.

(2) Attribute Level of Air Fare

Need to Customise Air Fare Attribute

The air fares paid by travellers are systematically differentiated by several factors. It is desirable to customise the level value of air faire attribute to respondents' experience in order to secure reality in SP experiment.

According to the RP survey data, it was revealed that air ticket price was profoundly differentiated by residing country of the traveller. Notably, the people who lived in the USA paid far less than the people who lived in Korea for the same flight. It was also found that travellers normally preferred Korean airlines when other conditions were the same. The people who used Korean airlines usually paid more than the people who used foreign airlines for a trip with the same conditions.

This research decided to segment the respondents by mainly travelled destination, nationality of airline mainly experienced, and residential country, for the SP design and survey.

Correlation of level' value of journey time and air fare attributes

The air fare of non-stop flight is normally higher than that of intermediate-stop flight for the same destination because intermediate-stop flight takes longer to reach its destination. It would be desirable in the SP design to have a correlation between the travel time and the cost attributes in order to secure reality.

<Table II-1> Attribute Level for Journey Time

(a) Los Angeles and San Francisco	
Level Class	level's value (Int.-stop*)
L	11 hours (0)
M	14 hours (1)
H	16 hours (1)
(b) New York, Paris, Frankfurt, and London	
Level Class	level's value (Int.-stop*)
L	13 hours (0)
M	16 hours (1)
H	18 hours (1)

* The value of "0" in the parenthesis means that the journey time is related to non-stop flight, the value of "1" means that the journey time is related to one intermediate-stop flight.

Considering the VOT which was roughly estimated through the RP data analysis, this research adopted the policy to correlate the level value of journey time attribute and air fare attribute as follows. If an alternative was composed with the "M" level of journey time, the air fare attribute level was set at 130 dollars less than the corresponding level's value of a non-stop flight. In the case where an alternative is composed with the "H" level for the *journey time*, the air fare level was set at a value of 40 dollars less than the corresponding alternative of "M" level of *journey time*, thus making it 170 dollars less than the corresponding alternative with a non-stop flight.

Setting Air Fare Attribute Level

Although it is desirable to assign many levels for the air fare attribute because of its importance in consumer choice behaviour, if there are more than three levels, then it results in too many alternatives for the respondents to manage. Therefore, three levels were applied for the air fare attribute; "H"(high level), "M"(medium level), and "L"(low level). The actual value for each level was assigned considering the ticket price for each segment within the real market. "H"(high)level reflected the average ticket price of each segment which was found through the RP data analysis of this study. "M"(medium)level was set at the value subtracting 10% from high level, and "L" level was set at the value subtracting 20% from high level(see table II-2). These decreasing rates of 10% and 20% were determined by considering reality. The "M"(medium)levels set by this method are set at around the minimum price of the RP data. The "L"(low)levels are set at lower than the minimum price of the RP data. This low value is justified because the air fare within the market of this study is on a declining trend.

(3) Attribute level of service Frequency

For the customisation of level's value for the service *frequency* attribute, samples should be segmented by destinations as there is a significant variation of service frequency by destination city. Two levels were assigned to this attribute; "H"(high)level and "L"(low)level. "L"(low)level represented the level of current service frequency, and "H"(high)level represented the level of improved service frequency.

<Table II-2> Level's Value for Air Fare Attribute

a. Destination of Los Angeles and San Francisco

(1) Segment 1, (For Korean airline User, Korean Resident)

air fare level / journey time level	L	M	H
L(non-stop flight)	$700	$790	$880
M(3 hour longer, Int.-stop)	$570	$660	$750
H(5 hour longer, Int.-stop)	$530	$620	$710

(2) Segment 2, (For Korean airline User, USA Resident)

air fare level / journey time level	L	M	H
L(non-stop flight)	$540	$610	$680
M(3 hour longer, Int.-stop)	$410	$480	$550
H(5 hour longer, Int.-stop)	$370	$440	$510

(3) Segment 3 (For Foreign airline User, Korean Resident)

air fare level / journey time level	L	M	H
L(non-stop flight)	$660	$750	$830
M(3 hour longer, Int.-stop)	$530	$620	$700
H(5 hour longer, Int.-stop)	$490	$580	$660

(4) Segment 4 (For Foreign airline User, USA Resident)

air fare level / journey time level	L	M	H
L(non-stop flight)	$520	$590	$650
M(3 hour longer, Int.-stop)	$390	$460	$520
H(5 hour longer, Int.-stop)	$350	$420	$480

b. Destination of New York
omitted

c. Destination of European Cities(Paris, Frankfurt, London)
omitted

Table II-3 shows the level's value of service *frequency* attributes. Frequency values for the "L" level was determined by reflecting current service frequency per week by airline nationality. Where there was a difference in the number of flights offered by Korean airlines and foreign airlines, then the larger number was adopted.

However, it was found that when people plan long distance air travel in the situation of such a low frequency market, their concern was for the convenience of a departure-arrival date or time, without reference to time intervals between departure or the number of services per week. Therefore, it is necessary that the service frequency should be translated to the degree of convenience for the departure or arrival time for the SP questionnaire in order to induce reliable answer from the respondent.

If there is one flight or more than one flight per day, usually being seven flights per week or more, then most passengers can depart or arrive on the day that they want. If there are fewer than seven flights per week, passengers' choice of travel day is limited. For travel to European cities, the "L"(low)level was set at the value of three flights per week, and "H"(high) attributed level was set at seven flights per week, i.e. daily service. "H" level represented daily service, which was represented as the statement "convenient flight date" to the respondents for the purpose of the questionnaire. "L"level, which meant three flights per week as frequency of the same level as the real market, was represented as "inconvenient flight date." Respondents were to be informed through questionnaire that a "convenient flight date" meant that they can travel on the day they want and an "inconvenient flight date" meant that choice was restricted to either a day before or after the day he/she required.

For the destinations of New York, San Francisco, and Los Angeles, "L"(low)level was set at the value of seven flights or more per week, which meant there was a daily service available. Under such circumstances, every one can depart on the day they want, if there are seats available on that flight. "H"(high)level meant two flights or more per day, which gave the traveller the chance to choose a convenient departure time. Under such circumstances, it might be reasonable to say that "L"level is translated to "inconvenient flight time schedule", "H"level is translated to "convenient flight time

schedule", for the purpose of the SP questionnaire.

In conclusion, table II-3 can be translated to a verbal expression for the SP questionnmaire. Table II-4 shows this verbal expression of table II-3 for the SP questionnaire composition.

(4) Attribute Level of Nationality of Airline

The *nationality of airline* had two levels. "H"(high)level was for Korean airlines which also includes Korean Air, and Asiana Airlines. "L"(low)level was for all foreign airlines. This attribute is the 'dummy' variable in which the level value of "0" is for Korean airline, and level value of "1" is for foreign airlines.

5. Composition of Hypothetical Alternatives

Three levels were assigned for each attribute of *journey time* and *air fare*, and two levels were assigned for *service frequency* and *nationality of airline* attribute. Although the level's value of *air fare* and *journey time* were correlated, the combination of each level would be independent.

If a full factorial design is used, there would be 36 combinations of alternatives, with two three level and two level attributes. This would end in an unmanageable number of choice sets. It is, therefore, desirable to use fractional factorial plans to estimate the main effects only, assuming interactions to be negligible, in order to reduce the number of alternatives to a manageable size. The fractional factorial plan which estimates the main effects only, produces mine options which secure orthogonality between attributes. Table II-5 shows these nine combinations of attribute level.

<Table II-3> Level Values for Service Frequency Attribute

air fare level / journey time level	L	H
Los Angeles	28	56
New York	14	28
San Francisco	7	14
Paris, Frankfurt, London	3	7

<Table II-4>Level Values for Service Frequency translated to Verbal Expression For SP Questionnaire

air fare level / journey time level	L	H
Los Angeles	convenient in flight time schedule	convenient flight time schedule
New York	inconvenient flight time schedule	convenient flight time schedule
San Francisco	inconvenient flight time schedule	convenient flight time schedule
Paris Frankfurt, London	inconvenient flight date	convenient flight date

<Table II-5>Experimental Design of Alternative Composition with Two Three Level Attributes and One Two Level Attribute

	Time (3 levels)	Air Fare (3 levels)	Frequency (2 levels)	Nationality (2 levels)
Alt. 1	L	L	L	L
Alt. 2	L	M	H	L
Alt. 3	L	H	L	H
Alt. 4	M	L	H	L
Alt. 5	M	M	H	L
Alt. 6	M	H	L	L
Alt. 7	H	L	L	L
Alt. 8	H	M	L	H
Alt. 9	H	H	H	L

6. SP Questionnaire Composition

The SP survey would be conducted in the departure lounges of Kimpo International Airport. The questionnaire needed to be simple and easy to answer as air passengers waiting in departure lounges do not have enough time to consider complicated questions. Because of the extreme time con-

straints on air passengers in the departure lounge, it was needed to make the SP experiment a pairwise choice game. The samples would be Korean air travellers who are going to take a flight to a specified destination.

The questionnaire was composed of two parts. The first part was for segmentation of the samples for the customisation of the attribute levels. The second part was for the main SP experiments which was composed of a pairwise choice game of hypothetical alternatives.

There was 36 choice pairs which were constructed from 9 alternatives. Among the 36 pairs, 8 pairs were composed of one dominated alternative and one dominant alternative in every aspect of the attribute level, and the other 28 pairs were composed of competitive alternatives. Since these are too many choice pairs for one respondent to answer in a short time, those pairs were divided into three groups. So, three respondents were necessary to compose one whole set of choice pairs. One dominated-dominant pair was included in each group to test that the respondent conducted the choice experiment properly.

III. SP Survey

The questionnaire and technical procedure of main SP survey was finalised through pilot survey. For the main SP survey the sample segmentation by destination and airline nationality was applied to the sampling plan. Since destination and airline nationality could be distinguished by flight number, there was no difficulty to select the intended number of respondents for each segment. The composition of the number of the sampled passengers by destination and airline nationality for the SP experiment needs to be similar to that of the RP surveyed data, because observation composition of RP data is representative of the population. So, quota sampling strategies were applied. Table III-1 shows the numbers of samples assigned for each destination and for each airline nationality, reflecting RP data composition of this study.

The place of the survey was the departure lounge of Kimpo International Airport Passenger Terminals. The method of survey would be to interview with presenting questionnaire, by four interviewers including the author.

<Table III-1> Number of Samples Assigned to each Segment for Main Survey

destination	airline's nationality	number of samples assigned
Los Angeles	Korean airline user	192
	foreign airline user	102
New York	Korean airline user	141
	foreign airline user	81
San Francisco	Korean airline user	42
	foreign airline user	72
European Cities	Korean airline user	99
	foreign airline user	42
TOTAL		771

Flight numbers to designated destinations, were selected, and the interviewers tried to be at the corresponding gate's departure lounge, 90 minutes earlier than the take off time, with the survey questionnaire which corresponds to the destination and airline nationality of the flight number.

At first, an interviewer approached every Korean traveller arriving at the departure lounge more than 40 minutes before take off time, and presented the first part of the questionnaire mainly for segmentation of samples. Any of the other three interviewers approached the travellers who had finished the first part of questionnaire, and after reviewing their answers, the interviewer decided the segment cell to which the respondent belonged. They were then presented with the corresponding second part of the questionnaire, which included the main SP choice experiments.

If it was revealed that the current journey purpose of a respondent was business (or leisure & VFR) by the answer to the first part question, he/she was presented with the second part questionnaire for business travellers (or leisure & VFR travellers). The difference of questionnaire for business travellers and for leisure & VFR travellers is only the difference in the assumption of the hypothetical choice game which is included in the introductory section of the second part of the questionnaire.

If it was revealed that the main residential country was Korea (or foreign

country) by the answer to the first part question, he/she was presented with the second part questionnaire for Korean residents (or foreign residents). The difference of questionnaire for Korean residents and for foreign residents is the difference in value of levels of the air fare attribute, as stated in section II.

Among the business travellers, 457 samples participated in the SP survey. 16 respondents among those 457 respondents were proved to have conducted the SP choice experiment carelessly by choosing dominated alternatives in the dominant-dominated pair, or alternative "A"(or "B") for all the questions. Among the leisure & VFR purpose travellers, 470 samples participated in the SP survey. Twenty three respondents among those 470 respondents were proved to have conducted the SP choice experiment carelessly.

IV. Logit Model Calibration with SP Data

1. Input Data for Model Calibration

441 respondents as business travellers, and 447 respondents as leisure & VFR travellers, were finally selected as input data for logit analysis. These compose 147 (=441/3) sets of whose choice pairs for business travellers, and 149 (=447/3) sets of whole choice pairs for leisure & VFR travellers, because three respondents compose one whole set of choice pairs.

For service *frequency* attribute, the verbal expression in the questionnaire is translated to number of flights per week, the same way as it was translated from number of flights per week to verbal expression, at the SP design stage. For example, for the respondents travelling to Los Angeles, "convenience departure time" is translated to 56 flights per week, "inconvenient departure time" is translated to 28 flights per week. For the attribute of *nationality of airline*, the value of "0" was assigned for Korean airlines, and the value of "1" for foreign airlines.

2. Calibration Results and Model Validation

Logit models were calibrated with SP data defined in the previous section, utilising ALOGIT software produced by Hague Consulting Group (Daly, 1988). The model estimates would test the hypothesis that travellers pre-

ferred low air fare, short journey time, high frequency service, and Korean nationality of airline. The model would also identify the degree of importance of those variables for air flight choice in the market. The utility function of the model can be expressed as:

$$U=a_1JT=a_2FARE+a_3FREQ+a_4NATION$$

where: JT is the journey time expressed by the unit of minute
FARE is the air fare expressed by the unit of US dollar
FREQ is the number of flights per week
NATION is the nationality of airline; "0" for Korean airlines, "1" for foreign airlines
a_1, a_2, a_3, a_4 are for the coefficients to be estimated.

A separated model was calibrated for business travellers and leisure & VFR travellers. Table IV-1 shows the parameter estimates with the corresponding t-values, the likelihood ratio test, and the Rho-square.

The values of likelihood ratio test can reject the null hypothesis that all the parameters are zero at the 0.01 level of significance. That means the hypothesis of independence between the model probability and explanatory variables can be rejected. The value of "Rho-squared" is used to measure the goodness of fit of the model. "Rho-squared" value of 0.1997 for business travellers, and 0.2024 for leisure & VFR travellers indicate the model fit is not very good but not bad.

All the coefficients have the right sign. Negative signs for the coefficients of *journey time* and *air fare* attributes indicate the passengers dislike high travel cost and long journey time as expected. Positive signs for the coefficient of *service frequency* attribute is also as expected. A negative sign for the coefficient of *airline's nationality* indicates that Korean passengers prefer Korean airlines to foreign airlines which is also expected.

Journey time, *air fare*, and *service frequency* parameters are significant at 99 percent level. The nationality of airline parameter is found to be significant at 90 percent level for the business travellers, and a little bit poorer than 90 percent confidence level for leisure & VFR travellers.

<Table IV-1> SP Model Calibration Results

segments by journey purpose / coefficients	Business	Leisure & VFR
a_1	-0.008036	-0.007266
	(-22.6)	(-20.5)
a_2	-0.008629	-0.009041
	(-21.4)	(-21.8)
a_3	0.04625	0.06026
	(18.8)	(19.8)
a_4	-0.1181	-0.09272
	(-2.2)	(-1.7)
Likelihood ratio test	923.5	955.8
Rho-squared	0.1997	0.2024
$X^2(0.01, 4)$	13.28	13.28
(t-values are shown in parenthesis)		

With the values of likelihood ratio test, Rho-squared, and the sign and t-value of coefficient estimated, it was internally validated that the models were generally good. However, it is very desirable to validate the model with external data, if it is possible. Since the principal drawback of the SP method is that individuals' stated preferences may not correspond closely to their actual preferences, external validation of the SP model is seriously recommended, although the external validation of the SP model has not been common in practice because of lack of suitable real world data.

Fortunately, there are revealed preference (RP) data obtained through the survey, which can be used to validate the model calibrated with the SP data. Since each of these RP data records is composed of the same variables as SP data, it is not difficult to validate the SP model by estimating the prediction success rate. That is, the utility of each alternative in the RP data was calculated by replacing the value of each variable in an RP alternative on the SP model, and then, it was checked that the utility of the chosen alternative was

the highest. In the case that the chosen alternative had the highest utility among all the alternatives available to the respondent, the prediction was considered a success. The overall prediction success rate was revealed to be more than 70%, which could be considered as a good fit of model. So, these SP models were also validated as a good fit by the external data.

3. Results Analysis—Relative Importance of Variables

Since it was calibrated with hypothetical alternatives, the absolute value of any one sole coefficient in the SP model needs more external information to be used for the interpretation of the value. Instead, the SP model is useful for seeing the relative importance which can be estimated by comparing the absolute value of coefficients.

Several ratios calculated by comparison with any two coefficients would be presented to analyse the air travellers' choice behaviour in the market.

(1) Value of Travel Time (VOT)

The most frequently utilised relative importance in transport studies, is the ratio between travel time value and travel cost value, which is usually mentioned as value of travel time(VOT). VOT can be calculated utilising the formula;

$$VOT = a_t / a_c$$

where; a_t is the coefficient of time variable (*journey time* variable in this case)
a_c is the coefficient of cost variable (*air fare* in this study)

Table IV-2 shows VOT for business travellers and that for leisure & VFR travellers. From the information in this table, it can be said that the business travellers in the market would be prepared to pay 93 cents more to reduce 1 minute of journey time, and leisure & VFR travellers would be prepared to pay 80 cents more to save 1 minute in air travel time. The result that the VOT of business travellers is bigger than that of leisure & VFR travellers appears normal.

<Table IV-2> VOT by Journey Purpose

journey purpose	VOT
Business	0.93 (US $/minute)
Leisure & VFR	0.80 (US $/minute)
average (business and Leisure & VFR)	0.87 (US $/minute)

(2) Additional Value to Pay for Korean Nationality of Airline

Through the study of observed preference in the market, it was identified that Korean airlines are preferred to foreign airlines by Korean international travellers.

The models calibrated with SP data also show that respondents prefer Korean airlines to foreign airlines, as stated at previous sub-section. It is possible to estimate how much more the traveller would like to pay to take a Korean airline, by comparing the coefficient of *nationality of airline* to the coefficient of *air fare*, as expressed by the following formula;

$$\textit{Additional Value to Pay for Korean nationality of airlines} = a_n / a_c$$

where; a_n is the coefficient of nationality, which is significant at 90% level for business travel and 80% for leisure & VFR travel models.

a_c is the coefficient of air fare, which is significant at 99% level.

Table IV-3 shows the additional value to pay for Korean airlines. It shows that business travellers are willing to pay more than leisure & VFR travellers in order to take Korean airlines.

This suggests that business travellers place more weight on the service factor which is represented by comfort obtained through language and cultural identity.

The last column of the table shows the values estimated considering the distance. These values represent the premium value for every thousand kilometers for a traveller to pay in order to take a Korean airline.

<Table IV-3> Addotional Value to Pay for Korean Airlines

journey purpose	Value for Korean Airline	Value for Korean Airline (cents/1000 kilometre*)
Business	13.7(US $)	114 (cents/1000kilometre)
Leisure & VFR	10.3(US $)	86 (cents/1000kilometre)
Average	12.0 (US $)	100 (cents/1000kilometre)

* The values in this column were estimated assuming that the distance in 12,000 kilometres on average.

(3) Value to Pay for Service Frequency Increase

Relative importance of *service frequency* to air fare can also be calculated utilising the following formula:

Value to pay for service *frequency* increase=a_f / a_c

where; a_f is the coefficient of *service frequency* variable

a_c is the coefficient of *air fare* variable

Table IV-4 shows the relative importance of *service frequency* to *air fare*. It is an unexpected result that leisure & VFR travellers place higher value on service frequency than business travellers. It can be roughly explained that since the industrial structure in Korea is manufacturing centred, the majority of business travellers are from big or small manufacturing companies or professional technicians, who are not compressed by tight time schedules, and they do not care seriously about the convenience of the flight schedule. Instead, they care about a comfortable journey and short journey time. (However, this research does not study in detail the reasons why business travellers care less about the service frequency. It must be reserved for further study.)

(4) Trade-Off between *service frequency* and *travel time*

The relative importance between service frequency and travel time is estimated utilizing the following formula, and the results are presented in the table IV-5. This kind of value could be useful information for airlines' route

<Table IV-4> Value to Pay for service frequency increase

Journey purpose	Value of Frequency Increase
Business	5.36 (US4/1 flight per week)
Leisure & VFR	6.67 (US4/1 flight per week)
Average (business and leisure & VFR)	6.02 (US4/1 flight per week)

planning. The choice between a hub-spoke route and a direct route depends on the consideration of trade-off between service frequency and travel time. Hub-spoke route planning usually increases the frequency between major cities sacrificing the travel time. On the other hand, the direct route has an advantage of short travel time with low frequency available.

Trade-Off Ratio between *service frequency and travel time*=a_f/a_t
where; a_f is the coefficient of *service frequency* variable
a_f is the coefficient of *journey time* variable

<Table IV-5> Trade-Off between service frequency and travel time

journey purpose	Trade-Off Ratio
Business	-5.75 (minutes/1 flight per week)
Leisure & VFR	-8.29 (minutes/1 flight per week)
Average (business and leisure & VFR)	-7.02 (minutes/1 flight per week)

V. Conclusion

The SP model was calibrated and validated as good to be utilised for analysis of air flight choice behaviour in the market. The models calibrated with SP data are most appropriate for estimation of relative importance of variables. In this study, the relative importance of variables was estimated by comparing each variable's coefficients.

In the transport area, the most frequently utilised relative importance is the trade off ratio between travel time and travel cost, which is often expressed as VOT. VOT in the market was found to be about 87 cents per

minute. It was also found that the VOT of business travellers is higher than that of leisure & VFR travellers, as expected. In the situation of the market in this study, the purpose of saving travel time with additional cost might be traveller's desire to lessen the uncomfortability caused by long time flight.

The value of taking Korean airlines which are mainly discriminated from foreign airlines, by the service in Korean language, Korean crew, Korean food or other cultural aspects, is 12.0 US dollars. However, through RP data analysis, it was revealed that the amount which Korean airline users paid in comparison to foreign airline users ranged from 30 dollars to 130 dollars more, according to the segment classified by destination and residential countries. This means that Korean international passengers preferred Korean airlines to foreign airlines, more heavily in the real market than their stated preferences. This might be because Korean airlines could have an advantage in marketing activities or some other advantage as home country carriers, the travellers chose Korean airlines in spite of more significantly differentiated prices than their intention. It has also been revealed that business travellers are willing to pay more extra money for Korean nationality of airline than leisure & VFR travellers. This seems to say that business travellers place more weight on in-flight service than leisure & VFR travellers.

The SP model also shows that the value of one additional flight per week is about six dollars and trade-off ratio between service frequency and travel time is about 7 minutes per flight. The VOT and the value of service frequency could be useful information for air transport planning in the subject market.

The competition in the Korean air transport market will be more severe in near future. This will lead to variety of choice options for air travellers. So, the research activities should also be more various and more refined SP techniques should be applied.

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