Impact of Low Cost Carriers and Multiple Airport System

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Abstract: This paper estimates the impact of the entrance of low cost carriers on the Eastern Asia international passenger transport markets, especially to the high density short-haul markets, and discusses the efficient management policy of a multiple airport system. We apply a bi-level air transport market model to Osaka-Korea international passenger transport market, and estimate the impact of entrance of low cost carriers. The results suggest that the entrance of LCC improves passenger’s utility, but the profit of legacy carriers is significantly reduced. We also evaluate the slot allocation policy of Osaka-Itami International Airport. Finally we find that the policy used in Osaka-Itami is useful for protecting the legacy carrier’s share, but this effect disappears with the increase of passenger’s sensitivity to airfare.

Key Words: Low cost carriers, Short-haul market, Profitability

1. INTRODUCTION

1.1 Background

The year 2010 was expected to be a turning point for the aviation transport of Japan. At the end of December in 2009, Japan and the US reached an agreement of ‘Open Skies Policy’ and the trans-Pacific markets to and from Japan were finally deregulated. The Open Skies Policy may have significant impact on the transpacific air transport markets, such as the increase of flight frequencies and the reduction of airfare due to fierce competition among carriers. The policy may also give air passengers travelling from and to the Tokyo Metropolitan Area a good opportunity. Although Tokyo International Airport (Haneda Airport) had operated as a domestic airport since 1978, Haneda opened the 4th runway in October 2010 and now has international flights again, an event welcomed by the aviation transport market of Japan. Around the same time, Japan Airlines, the flagship air carrier of Japan, officially announced its bankruptcy and began implementing its restructuring program. These big events are attributed to the global trend of ‘deregulation in aviation transport markets’ and ‘boosting the competition.’

Looking at Eastern Asia air transport markets, some countries, mainly ASEAN countries, have agreements to deregulate their markets and make these more competitive than ever. In particular, the low cost carriers (LCC) are the most aggressive players in these deregulated markets. After the deregulation in ASEAN area, LCCs (Air Asia is the most successful player) entered the markets and increased their shares, capturing passengers from legacy carriers (Windle and Dresner, 1999). According to Ballantyne and McGee (2010), in 2009 LCCs accounted for 15.7 % of Asia’s aviation market, compared to LCC 1% share in 2001. They also suggest that LCC’s share in Asia market will be more than 30 % within two years. Some airports, such as Kuala Lumpur, invited LCCs and succeeded in boosting passenger
demand. LCC is now considered to be the powerful option for increasing demand at airports which suffer from low demand. Currently, the Kansai Airport, the Chubu Airports, and even the Narita Airport propose to invite LCC in order to increase their demand.

Earlier researches and reports show that in the US domestic and EU markets LCC invited more air passengers and the total demand of air passengers increased after deregulation (Vowles, 2001). However, one may point out that the entrance of LCC also brings some negative impact on the markets. In the US, some legacy carriers quit their services in some markets. The aggressive competition between legacy carriers and LCC may lead to the shrinkage of service level of legacy carriers which operate wider networks than LCC. The exit of legacy carriers may lower air passenger’s benefit. From the viewpoint of airport authority, the exit of legacy carrier from the airport means a big loss of income derived from the airport facility charge because legacy carriers usually pay more facility charges than LCC. Thus, in order to provide better guidance to airport management, we need to measure the positive or negative impacts of the entrance of LCC to the markets, in particular to the short-haul international markets which will be deregulated and have more demand.

The entrance of LCC will affect airport management policy, especially for multiple airport systems (meaning two or more airports are located in one area). In the system, suburban airports are usually less convenient than urban airports and used for international flights. LCC operate their flights at these suburban airports, and legacy carriers may lose their share. If the damage is serious enough, legacy carriers will exit from these markets and the overall service level may decrease. Therefore, we hope to find the better way of coexistence of LCC and legacy carriers under the multiple airport system considering some options for airport management.

This paper aims to propose a method of measuring the impact of entrance of LCC to short-haul international air transport markets and discuss directions for improving airport management considering the entry of LCC.

This paper is composed of four chapters. The rest of this chapter describes reviews of literature dealing with a matter of LCC and tools for analyzing air transport markets. Chapter 2 briefly shows the mathematical model, which is proposed as a ‘bi-level air transport market model’ (Takebayashi, 2007, 2010, 2011a). In Chapter 3, the details of case studies for measuring the impact of entrance of LCC on the market are shown and the simulation results are discussed. Chapter 4 highlights some remarkable findings that relate to air transport management.

1.2 Literature Review
Researches of LCC in air transport markets have almost two decades of history. The first publicly known work is a research about the competition between legacy carriers and LCCs (Dresner et al., 1996). They point out what happens in the market after the entrance of LCC. Windler and Dresner (1999) follow Dresner’s work and reveal the legacy carrier’s aggressive response to the entrance of LCC. Vowles (2001) carried out a detailed research on what is called the Southwest Effect in the US domestic markets. These researches are based on econometrics and while these approaches can reveal what happened in the past, however, they cannot discuss what will happen in the future. In order to forecast the change in the markets, we need to introduce a viewpoint of ‘structural analysis on competition.’ For this purpose, we also looked at researches on tools for analyzing air transport markets.
In the past two decades, many articles have dealt with ‘competition.’ Some excellent works such as Brander and Zhang (1990), Oum et al. (1993), and Hendricks et al. (1999) are found. However, most of them focus on carrier’s behavior; they neglect user’s behavior, even though network competition should be affected by user’s behavior. Thus, some supply-demand interaction models were proposed by Hong and Harker (1992), Adler (2001, 2005), and Takebayashi (2005, 2011a). These interaction models tried to express user’s behavior as well as carrier’s behavior, and in these models, the idea of equilibrium was sometimes assumed (Adler, 2005; Takebayashi, 2011a). The equilibrium model has several good features from the theoretical point of view and is useful for forecasting the behavior of carriers and passengers, so we adopted Takebayashi’s model for this research because of the model’s ability to handle the seat availability constraints for passengers, making it more realistic than other models.

2. THE MODEL

2.1 Outline
In this section, we briefly present the bi-level air transport market model (Takebayashi, 2010, 2011a, 2011b), which belongs to the family of Stackelberg games and assumes airlines as leaders and passengers as followers.

Basic assumptions of the model are as follows:

(1) The total volume of Origin-Destination (OD) demand is predetermined and fixed. However, the volume of air passengers is elastic to the service level of airlines.
(2) Each aircraft has a capacity constraint. Passengers consider seat availability.
(3) Passenger’s behavior is determined based on his/her disutility including effects of congestion.
(4) Each carrier gives detailed information about routes to passengers and passengers choose the best available routes.
(5) Passenger’s disutility consists of travel time, travel charges and fares, connectivity and congestion.
(6) Travel time includes access and egress time between a centroid and an airport and line haul time. Travel charge includes access and egress fee and airfare.
(7) Connectivity is expressed by flight frequency in each OD market.
(8) Each carrier maximizes its profit by controlling the number of flights on each link.

2.2 Passengers
Dealing with fixed demand for passenger flow allocation, OD volume should be conserved. Bell (1995) pointed out that the Stochastic User Equilibrium (SUE) with bottleneck allocation problem can be rewritten as an equivalent optimization problem. The general formulation of SUE with bottleneck is given as follows (Takebayashi, 2010, 2011a, 2011b):

\[
\min_{x^r_{kn}} \Gamma(x^r_{kn}) = \frac{1}{\theta} \sum_{n \in N_r} \sum_{x \in D_k^n} x^r_{kn} \left( \ln x^r_{kn} - 1 \right) + \sum_{n \in N_r} \sum_{x \in D_k^n} u^r_{kn} x^r_{kn} \tag{1}
\]

Subject to
\[ \sum_{n \in N'} \sum_{k_n \in K_{n}^{rs}} x_{k_n}^{rs} = X^{rs}, \text{ for } \forall rs \in \Omega, \]  
\[ x_{l^n} = \sum_{rs} \sum_{k_n \in K_{n}^{rs}} x_{k_n}^{rs} \delta_{l^n}^{rs} \leq v_{l^n} f_{l^n}, \text{ for } \forall l^n \in L^n \text{ and } \forall n \in N', \]  
\[ x_{l^n}^{rs} \geq 0, \text{ for } \forall k_n \in K_{n}^{rs}, \forall rs \in \Omega, \text{ and } \forall n \in N'. \]

where,
\[ \theta \] : a predetermined distribution parameter in SUE
\[ rs \] : OD pair, origin \( r \) to destination \( s \)
\[ \Omega \] : a set of OD pairs
\[ k^n \] : a service route in \( rs \) OD market operated by carrier \( n \)
\[ K_{n}^{rs} \] : a set of service routes provided by carrier \( n \) for \( rs \) OD market
\[ x_{k_n}^{rs} \] : a passenger flow from \( r \) to \( s \) on route \( k^n \) provided by carrier \( n \)
\[ u_{k_n}^{rs} \] : disutility of passenger who uses route \( k^n \) of \( rs \) OD market without congestion
\[ X^{rs} \] : an OD volume of \( rs \) OD market
\[ l^n \] : a commercial link operated by carrier \( n \)
\[ L^n \] : a set of links operated by carrier \( n \)
\[ x_{l^n} \] : a passenger flow of link \( l \) operated by carrier \( n \)
\[ v_{l^n} \] : an aircraft size on link \( l \) operated by carrier \( n \)
\[ \delta_{l^n}^{rs} \] : a dichotomous variable that takes one when \( k^n \)th route in \( rs \) OD market includes link \( l^n \), otherwise it takes zero
\[ N' \] : a set of carriers

Equation (1) is an objective function of OD passengers and the first term of the right-hand side shows the entropy term. Constraint set (2) is same as Bell’s formulation. Constraint set (3) is a link flow capacity constraint which is expressed by aircraft size \( v_{l^n} \) and flight frequency \( f_{l^n} \).

Since congestion cost due to link flow capacity constraint is included in passenger’s disutility function \( U_{k_n}^{rs} \), it is treated strictly as a convex function. The disutility function of passengers choosing route \( k^n \) of \( rs \), which consists of deterministic costs, is defined as a linear function:

\[ u_{k_n}^{rs} = \alpha_1 t_{k_n}^{rs} + \alpha_2 \left( \sum_{k_2 \in K_{n,2}^{rs}} p_{k_2} \delta_{k_2}^{rs} + q_{k_n}^{rs} \right) + \sum_{l^n \in L^n} \frac{\alpha_3}{f_{l^n}} \delta_{l^n}^{rs}, \]  

where \( t_{k_n}^{rs} \) is a travel time, \( p_{k_2} \) is an airfare for air route \( k_2^n \) provided by carrier \( n \), \( \delta_{k_2}^{rs} \) is a dichotomous variable that takes one when \( k^n \)th route in \( rs \) OD market uses air route \( k_2^n \), otherwise it takes zero, \( K_{n,2}^{rs} \) is a set of air routes for \( rs \) OD market provided by carrier \( n \), and \( q_{k_n}^{rs} \) is the access/egress charges. \( \alpha_1 \), \( \alpha_2 \) and \( \alpha_3 \) are parameters.
There are some ways of determining airfare, $p_{k_{2}^{y}}$. The simplest way is to sum the airfares of links used by passenger. With this way, $p_{k_{2}^{y}}$ can be expressed as

$$p_{k_{2}^{y}} = \sum_{l_{n} \in l^{n}} p_{l_{n}} \delta_{l_{n}}^{k_{2}^{y}} ,$$

where $p_{l_{n}}$ is an airfare on link $l_{n}$, and $\delta_{l_{n}}^{k_{2}^{y}}$ is a dichotomous variable that takes one when the $k_{2}^{y}$ th air route includes $l_{n}$, otherwise it takes zero.

The third term of right-hand side of (5) refers to average waiting time derived from service frequencies. We suppose that passengers are sensitive to convenience and they consider the average waiting time, which is an expression of the connectivity, as a part of travel cost. Finally, passenger’s disutility function including congestion cost $U_{k_{n}^{rs}}$, is described as

$$U_{k_{n}^{rs}} = u_{k_{n}^{rs}} + \lambda_{k_{n}^{rs}} = u_{k_{n}^{rs}} + \sum_{l_{n} \in l^{n}} \lambda_{l_{n}} \delta_{l_{n}}^{k_{n}^{rs}} ,$$

where $\lambda_{l_{n}}$ is the congestion cost on link $l_{n}$, which is obtained as a Lagrange multiplier relating to constraint set (3). Meanwhile, link $l_{n}$’s congestion cost $\lambda_{l_{n}}$ is obtained as a value of Lagrange multiplier reflecting the activity of constraint set (3).

**2.3 Carriers**

Each carrier’s control variable is flight frequency, $f_{l_{n}}$. Operation cost per flight on link, $l_{n}$, $C_{l_{n}^{OP}}$, is given independently. To avoid complexity, we neglect fixed cost.

Carrier $n$’s problem of profit maximization by controlling $f_{l_{n}}$ is expressed as follows:

[Carrier’s Profit Maximization Problem]

$$\max_{f_{l_{n}}} : \pi_{n}^{n}(f_{l_{n} \in l^{n}}, f_{l_{n} \in l^{n}}) = \sum_{rs \in k_{n}^{rs}} \sum_{l_{n} \in K_{n}^{rs}} \sum_{l_{n} \in K_{n}^{rs}} p_{l_{n}} \delta_{l_{n}}^{k_{n}^{rs}} \delta_{l_{n}}^{k_{n}^{rs}} - \sum_{l_{n} \in l^{n}} C_{l_{n}^{OP}} f_{l_{n}} ,$$

subject to

$$\sum_{l_{n} \in l^{n}} f_{l_{n}} \delta_{l_{n}}^{k_{n}^{rs}} \leq F_{h}^{n} , \text{ for } \forall h \in H ,$$

$$f_{l_{n}} \geq f_{LOW} , \text{ for } \forall l_{n} \in l^{n} ,$$

$$\lambda_{l_{n}}^{rs} = \arg\{\min : \Gamma(x_{l_{n}}^{rs}) \text{ subject to constr.} \} , \text{ for } \forall k_{n}^{rs} \in K_{n}^{rs} \text{ and } rs \in \Omega .$$

where,

$\lambda_{l_{n}}^{rs}$ : the optimal flow of route $k_{n}^{rs}$ in $rs$ OD market

$F_{h}^{n}$ : runway capacity for carrier $n$ at airport $h$
\( \delta_{h}^{n} \): a dichotomous variable that takes one when link \( l^{n} \) includes airport \( h \) and otherwise takes zero

\( f_{low} \): minimum required frequency. In the computation, it is given as a small real number \( \varepsilon \).

\( \Gamma(x_{rs}^{k}) \): an optimal value function for passengers’ route choice behavior

Objective function (8) consists of revenues (first term), and costs (second term). Constraint set (9) means runway capacity constraints for carrier \( n \) at airport \( h \). Constraint set (10) is a nonnegative constraint for \( f_{rh} \). Constraint set (11) means that a passenger flow defined as the best response function to carriers’ behavior \( x_{rs}^{k} \) can be obtained as a solution of SUE.

3. MEASURING THE IMPACT OF ENTRANCE OF LCC

3.1 Outline

In this chapter, we apply the bi-level model to Japan-based international passenger transport markets and discuss the impact of the entrance of LCC to the market.

It is generally known that LCC mainly operate their services in short-haul markets. Some LCC such as Air Asia-X and Jet Star Asia launched their long haul services of which stage length is more than 3000 miles. However, most LCC operate their services in the short-haul markets of where stage length is less than 2000 miles—usually around 1000 miles. Their main markets are still short-haul markets because their main aircraft are B737/A320 series single-aisle aircraft which have 120 to 160 seats per flight. These aircraft have short flying ranges and if these aircraft are used for long haul markets, the payload goes up considerably. Furthermore, the outstanding feature of LCC is quick dispatch, needing only 30 minutes for turnaround. With quick dispatch operation, the efficiency of aircraft rotation is enhanced, which contributes to the increase of profit. The quick dispatch, however, is not needed for the service of the long-haul market. Thus, LCC do not enter the long-haul markets with their main aircrafts.

Considering the features of LCC, they may enter the short-haul international passenger transport markets from and to Japan. Then, one question arises: where do they fly from or to in Japan? The possible candidate cities that are within 2000 miles from Osaka Metropolitan Area (OMA), the second largest metropolitan in Japan, are Seoul, Busan, Jeju, Shanghai, Nimbo, Qingdao, Dalian, Shenyang, Tianjin, and Beijing. For this research, we focus on the market between Korea and the OMA, which consists of six prefectures. According to Civil Aviation Bureau of Japan, an average of 1,873 passengers travel from OMA to Korea per day and the same number of passengers is assumed to travel in the reverse direction. This market is regarded as one of the most congested markets among the Japan-based Eastern Asia transport markets.

The airport management office of Kansai International Airport (KIX) announced plans to invite LCC to increase passenger demand and to improve airport profitability. Nevertheless, some researches point out that the entrance of LCC brings tough competition between legacy carriers and LCC, and has caused some legacy carriers to quit providing services and exit from the market (Murakami, 2003). What we try to do in this chapter is to measure the
positive and negative impacts of the entrance of LCC on the management of KIX.

3.2 Market condition and data
In the following numerical computation, market conditions are assumed to be as follows:

1) We consider an oligopoly market. We set two Japanese carriers (JL and NH), two Korean carriers (KE and OZ), and one LCC.
2) Each carrier’s operating cost per seat kilometer is given.
3) The target market is Seoul-Osaka Metropolitan Area.
4) The shape of service network is predetermined and fixed.
5) Each airfare is predetermined and fixed.

We assume 5) because of the difficulty in grasping the actual movement of international airfares. Thus we compute based on the regular airfare and regular discount fare (known as PEX fare) from IATA’s Passenger Air Tariff (IATA, 2007) under this assumption.

We used the following data sources. The information about OD flows and passenger’s route choice is from the Air Passenger’s Behavior Survey (APBS) 2007 (International flights, Japanese passengers) edited by MLIT (2008). Airfare data is from List of International Airfare, Japan-based Flights edited by OFC (2007). Detailed information about passenger flow and flight frequency between airports is from ICAO’s digital data of Traffic by Flight Stage, which can be accessed via the website of Air Transport Intelligence of ICAO. The financial data of airlines is from Aviation Week and Space Technology Sourcebook (AWST) 2009. The location data of airports is from the website of each airport.

Parameter values in eqn. (5) are obtained from the statistical analysis on passenger’s route choice behavior by using the Air Passenger’s Behavior Survey. The values are:

\[ \theta = 1, \quad \alpha_1 = 0.63, \quad \alpha_2 = 0 \quad \text{and} \quad \alpha_3 = 2. \]

We obtain \( \alpha_2 = 0 \) because there is no difference in airfare among airlines when using IATA’s Passengers Air Tariff (hereafter called PAT) data. However, \( \alpha_2 \) is an important parameter for evaluating the entrance of LCC, and so we give values to \( \alpha_2 \) by scenario in the following case studies.

In the case studies, we deal with the case of OMA-Korea international short-haul market. OMA has three airports, KIX, the Osaka-Itami International Airport (ITM), and Kobe Airport (UKB). Currently, KIX has international flights, while ITM and UKB have only domestic flights. However, the prefectural government where ITM is located claims that ITM is much more convenient for passengers than KIX. For local and central governments, how to take a balance of operation between KIX and ITM is a serious issue and the entrance of LCC may become a trigger for reforming the complicated relation between KIX and ITM. This is one more reason why OMA is focused upon in our research.

The initial conditions of airlines are assumed as follows: The average cost per seat mile of Japan Airlines (JL), All Nippon Airways (NH), Korean Airlines (KE), and Asiana Airlines (OZ) are 24.36, 22.63, 18.4, and 20.22 cents, respectively. According to the APBS, the number of available seats of JL, NH, KE, and OZ are 265, 142, 324, and 274, respectively. The initial flight frequency of each airline is two, and the minimum flight frequency is one.
From PAT 2007, the airfare is 200 (USD) and the travel time is 120 minutes. The flight mileage is 525 miles on Kansai International Airport-Kimpo International Airport (KIX-SEL) leg. Furthermore, we follow Wei and Hansen’s conclusion (Wei and Hansen, 2003) i.e. a mid size aircraft (B767) and a large size aircraft (B777) have lower operating cost per seat mile than that of single aisle aircraft (B737/A320). We assume that B767 class aircraft as regular size in this market and B777 has 5% higher operating cost and B737 has 10% higher operating cost.

Finally, we look into the possibility of having an optimal solution of the SUE problem. The bi-level model assumes that airlines can reduce their flight frequencies in the less profitable market, so it is possible to have a total number of available seats that is less than the OD flow. In this case, SUE with bottleneck problem has no solution. Thus, we set alternative routes for passengers. With the alternative routes, each OD air demand is elastic in relation to the service level of airlines. We set airfare at USD 280, travel time at 480 minutes, and flight frequency at 0.5 flights/day.

3.3 Case Study: Entrance of the LCC to Eastern Asia International Short-haul Market
3.3.1 The base case
Firstly, the model validity is discussed in relation to data from year 2007. Table 1 lists the observed and computed values of outbound passenger flow and flight frequency by airline.

Table 1 suggests that the model can duplicate the behavior of Japanese airlines, while the frequencies of Korean airlines are underestimated. We set this case as the base case for following case studies, corresponding to an average disutility of passengers of 5.75.

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3.3.2 Entrance of LCC and behavior of legacy carriers: direct competition
The LCC was already launched in the KIX-SEL market, but most of these are operated as ‘charter flights.’ KIX officially announced that Korean LCC would launch regular services by the end of 2010. In this section, we discuss the impact of entrance of LCC on the behavior of legacy carriers. In the US and EU market, it was observed that the operating cost of LCC is normally 30% less than legacy carriers’, and so LCC set airfares that are lower than that of legacy carriers—30% on average. We follow this observation and set LCC operating cost as 30% lower than that of legacy carriers. Actually, the operating cost of OZ is close to the average operating cost, so we regard OZ as a representative legacy carrier in the OMA-Korea market.

In the base case, the parameter of sensitivity on airfare $\alpha_2$ is assumed to be zero because there is no difference in the PEX airfares of PAT among airlines. Furthermore, APBS 2007 does not include the passengers who use LCC, so we do not have a way of measuring $\alpha_2$ statistically. Therefore, we try to carry out the sensitivity analysis on $\alpha_2$. We set the value of
α_2 by scenario and observe the impact of entrance of ‘one’ LCC in the market. We set three cases. In Case 1, α_2 takes zero as with the base case; α_2 takes 0.005 in Case 2, 0.01 in Case 3, and 0.015 in Case 4. The number of available seats per flight of LCC is 140.

The results are shown in Figure 1 which depicts the passenger flow by airline by case and shows that the share of legacy carriers decreases with the entrance of the LCC and suggests that their loss (that of the legacy carriers) increases when passengers are more sensitive to airfare. In particular, the share of JL and OZ more seriously decrease compared to NH and KE. Figure 2 shows that the profit of legacy carriers decreases with the entrance of LCC in the OMA-Korea market. In particular, JL suffers the most serious loss from the entrance of LCC, even when passengers are not sensitive to airfare. JL is the carrier with the highest cost among these, so it is found to be hard for JL to bear the aggressive frequency competition with LCC. Thus, JL significantly loses its market share and its profit. By contrast, NH operates the minimum number of flights, so NH does not lose its share at all. Looking at Korean carriers’ response, KE receives more serious damage than OZ, even though its operating cost is lower than that of OZ. The reason is that KE operates the largest aircraft among these four carriers and if it increases flights, the load factor becomes low. Thus, KE
cannot increase the number of flights against the aggressive frequency competition from the LCC.

3.3.3 Entrance of LCC and the behavior of legacy carriers: The case of a multiple airport system

We find that, under the direct competition in the OMA-Korea market, the LCC captures a big share from legacy carriers, and some legacy carriers which suffer from higher operating cost are seriously affected by the entrance of the LCC. This finding suggests that after the entrance of the LCC most of legacy carriers cannot keep their operation and they exit from the market, and therefore markets’ service level would be reduced. In this situation, legacy carriers may claim to operate their services from the airport which is more convenient for passengers (i.e. ITM). Overall, the shrinkage of the network of legacy carriers is undesirable for both passengers and aviation policy makers from the viewpoint of international network services.

Following this context, we need to discuss the effect of re-internationalizing ITM and the possibility of coexistence of all airlines —legacy carriers and LCC. We explore two scenarios. The first scenario is that Japanese airlines can use ITM, while foreign carriers and LCC are not allowed to use ITM. A similar slot allocation policy is found in Milan. Only Italian airlines can use the urban airport which has serious runway capacity constraint and foreign carriers are allowed to use only the suburban airport which does not have serious capacity constraint. This kind of discrimination sometimes becomes a political issue due to issues of lack of fairness, and therefore, it is not easily accepted in reality. However, it is worth understanding how the market changes because of this discriminative policy even if the policy may be unpractical. We just focus on the economic performance of this policy. We set Case 1-2 with same parameter values as Case 1, Case 2-2 same as Case 2, Case 3-2 same as Case 3, and Case 4-2 same as Case 4. At the same time, we compare results with the Base Scenario (all carriers use KIX).

The second scenario is that all legacy carriers use ITM and exit from KIX, while LCC provides its service at KIX. If KIX could offer a much lower airport charge than ITM, this scenario could be realistic. According to some reports, LCC prefers to use suburban airports having charges cheaper than that of urban airports with expensive charge, so LCC may use KIX. We set Case 1-3 with same parameter values as Case 1, Case 2-3 same as Case 2, Case 3-3 same as Case 3, and Case 4-3 same as Case 4. With this scenario, we also examine the effect of price discrimination under multiple airport system (Mun and Teraji, 2010).

The results are presented in Figures 3 to 6. From these figures, we understand that the policy of allowing legacy carriers to use ITM would help protect legacy carriers’ market share, but the profitability of each airline differs according to scenarios.

In Scenario 1 (Case 1-2, 2-2, 3-2 and 4-2), JL can survive in the severe competition against LCC only when passengers’ sensitivity on airfare is small, while other airlines cannot expand their share. Looking at NH, the profitability does not improve, even if it were to provide service at ITM; NH’s market share almost remains the same. We set that NH operates single aisle aircrafts in this market, but the results suggest that the single aisle aircraft may not be suitable for this market. Other competitors adopt B767 or bigger in order to enjoy the economy of scale because B767 has a lower operating cost per seat than the single aisle aircraft. Korean carriers operate their services at KIX, so are less competitive than Japanese legacy carriers. They lose much of their share compared to the base case. Looking at Figure 4,
Figure 3. Share of PAX (outbound): JL and NH use ITM

Figure 4. Profits: JL and NH use ITM

Figure 5. Share of PAX (outbound): All legacy carriers use ITM
Korean carriers’ profit gets much worse than JL, so one may say that this slot allocation policy leads to the direct competition between Korean carriers and LCC, and JL barely avoids the direct competition against LCC. It is interesting that even JL which is exclusively allowed to use ITM still loses its profit due to the competition against LCC. From this, we may say that, if passengers are less sensitive to airfare, this slot allocation policy protects profitability of carriers operating at ITM.

Let us see the second scenario. The results of Case 1-3, 2-3, 3-3, and 4-3 shown in Figure 5 and Figure 6, indicate that Korean carriers remain in fierce competition against LCC, while JL cannot expand its share. In this situation, cost competitiveness of each airline is the important element for Case 1, 2, and 3, showing that Korean carriers can survive if passengers become more sensitive to airfare. On the other hand, LCC has less market share compared to the former cases (Case 1, 2, 3, 4 and Case 1-2, 2-2, 3-2, 4-2) because competitors enjoy some advantage of having services at ITM. But LCC still has dominant market power. The results of these two scenarios suggest that it is not easy for legacy carriers to survive without improving their cost structure, even if they have the advantage in airport use, in form of the right of ITM use.

Finally, the passenger’s benefit should be discussed. Comparing the base case with Case 1, the value of the average disutility of all passengers remains almost the same. In order to evaluate the efficiency in network use of passengers, we compare Case 1 with Case 1-2 and 1-3, Case 2 with Case 2-2 and 2-3, Case 3 with Case 3-2 and 3-3, and Case 4 with Case 4-2 and 4-3.

Referring to Figure 7, the results show that if passengers are sensitive to airfare, the entrance of LCC lowers the total passenger’s disutility. Thus, we can confirm that the entrance of LCC is welcomed by passengers. However, we also find a difference in disutility by different slot allocation policies. The Base Scenario gives the worst disutility in every case. However, in the Figure, each line of passenger’s disutility comes closer with the increase of passenger’s sensitivity to airfare. When passengers are not so sensitive to airfare, a policy to use ITM (Scenario 1 or 2) is beneficial for passengers. This tendency, however, gradually diminishes with the increase of passenger’s sensitivity to airfare, because passengers prefer to use cheaper flights, i.e. LCC flights. Therefore, we may say that if passengers become more sensitive to airfare, using ITM policy does not impact on passenger’s benefit.
4. CONCLUSION

This paper estimates the impact of entrance of low cost carriers to the OMA-Korea air transport market by applying a bi-level air transport market model. The results suggest that the entrance of LCC improves passenger’s utility and is desirable for passengers, but in terms of airline’s profitability, legacy carriers experience a serious loss of profit. If this unprofitable situation continues, legacy carriers which operate wider networks than LCC will be forced to reduce their services, which in turn would finally lead to the decline in passenger’s utility. On this point, the airport authority needs to implement some policies to avoid the shrinkage of the service networks operated by legacy carriers. Our model assumed that the OD demand including alternative routes is not stimulated by improvement of mobility. The entrance of LCC itself increases options for international air passengers and it may boost air demand. Therefore, airlines may actually get more profit than estimated by the model.

The results also suggest that the policies of using ITM may be useful for protecting legacy carrier’s share. On the other hand, one of the flag carriers may lose profit due to the entrance of LCC if this policy is adopted. Another finding about these policies is that if ITM is re-internationalized, passenger’s usage rate of KIX will drop. Although the airport authority is considering the increase in demand of KIX by inviting LCC, re-internationalizing ITM will not be beneficial to the operation of KIX. With regard to passenger’s behavior, the share of LCC will increase with the increase of passenger’s sensitivity to airfare and the utility of passengers will be improved.

We may conclude that the way of coexistence of legacy carriers and LCC is tough to find, and if the airfare competition against each other is kept, legacy carriers should seek to lower their operating cost in order to bolster their competitiveness. If legacy carriers’ succeed in reducing their operating costs, the policy of using ITM for all legacy carriers may be effective for the coexistence between legacy carriers and LCC and be beneficial for passengers.
REFERENCES


