Journal of Air Transport Management xxx (2016) 1–12

Contents lists available at ScienceDirect

Journal of Air Transport Management

journal homepage: www.elsevier.com/locate/jairtraman

# Dynamically interdependent business model for airline–airport coexistence

Nobuaki Minato [a, *], Risako Morimoto [b]

[a] Graduate School of Technology Management, Ritsumeikan University, Kyoto, Japan
[b] School of Oriental and African Studies, University of London, London, United Kingdom

ARTICLE INFO

*Article history:*
Received 30 December 2015
Received in revised form
7 July 2016
Accepted 3 August 2016
Available online xxx

*Keywords:*
Airport
Airline
Coexistence
System dynamics
Load factor guarantee

ABSTRACT

Governments provide various forms of financial support for sustaining unprofitable regional airways, especially when such airways are essential to local livelihoods and economies. However, inefficient provision of subsidies has been subject to worldwide criticism. Therefore, this study examines the load factor guarantee, a dynamically interdependent business model for airline-airport coexistence where an airline and an airport agree on the load factor of a flight, after which either party compensates for any discrepancies between the actual and agreed-upon load factor. The model is calibrated by using 2003–2014 data regarding Noto Airport and All Nippon Airways, and system dynamics are employed to model the dynamic interactions between the two parties. The findings show that successful coexistence between an airline and an airport hinges on the integral management of annual negotiations regarding the target load factor and the monthly demand adjustment of subsidies. In addition, although a subsidy represents a temporary financial loss for an airport, it is an effective way of maintaining long-term, airline–airport coexistence. This model is applicable to unprofitable airways worldwide, and it contributes to their sustainable management.



## 1. Introduction

In general, regional air transportation is characterized by thin air traffic demand with wide fluctuations. Thus, its operational efficiency is lower than that of trunk routes (Suzuki et al., 1995). Critical factors for enhancing the profitability of regional air transportation include fleet selection and daily frequency (Sato et al., 1990). However, at the micro level, air traffic demand forecasts are imprecise (Lyneis, 2000), adding to an airline's difficulties when making decisions and developing new regional airways.

In order to reduce the business risk associated with the entry of a new regional airway, governments provide financial support when air travel demand is expected to be low and air transportation is particularly important to local livelihoods and economies (Minato and Morimoto, 2010, 2011a). Various measures, such as profit loss compensations, landing fee reductions, and fuel tax reductions, are then put in place (Nomura and Kiritooshi, 2010). However, these measures do not essentially mitigate the problem. In addition, anticipated social changes prevent regional air transport systems from solely relying on public financing.

The financial issue becomes more critical when regional air transport systems are not fully supported by governments. For example, in Japan, although air routes to remote islands are subsidized by the central government (Matsumoto, 2007; Minato and Morimoto, 2011b), there are specific conditions in terms of alternative transportation measures and competitions. Moreover, if an airport is not located on an island, it is out of the scope. As a result, the local government that owns the airport must prepare a special financial treatment in order to sustain the airway. However, such subsidies have been criticized in numerous studies, due to their inefficiency (Williams and Pagliari, 2004; Santana, 2009; Grubesic and Matisziw, 2011; Lian and Ronnevik, 2011; Matisziw et al., 2012). Thus, introducing a gaming situation between an airline and an airport might improve such inefficiency through interactive decision-making processes.

In this regard, the present paper examines the load factor

*Abbreviations:* LFG, load factor guarantee; DEA, data envelope analysis; EAS, Essential Air Service; PSO, Public Service Obligation; ANA, All Nippon Airways; SD, system dynamics; SFD, stock and flow diagram; TAR, target load factor adjustment rate; MAE, the mean absolute error; MAPE, the mean absolute percentage error; DAR, demand adjustment rate.

* Corresponding author.
*E-mail address:* minanobu@fc.ritsumei.ac.jp (N. Minato).

http://dx.doi.org/10.1016/j.jairtraman.2016.08.002
0969-6997/

guarantee (LFG), a dynamically interdependent business model that attempts to share the business risk between an airline and an airport (Fig. 1). This model might be able to manage the sustainability of airways, based on market principles in which each player acts for a better payoff in commercial activities. The LFG is an agreement under which an airline and an airport (usually owned by a local government in Japan) negotiate the load factor of regional flights beforehand. The airport and government then compensate for any discrepancies between the actual and the agreed-upon load factor. An airline may also transfer a portion of its revenues to a local government when the actual load factor is higher than the guaranteed load factor (Noto Airport Promotion Council (NAPC), 2015). The LFG allows airlines to maintain load factors above the breakeven level, and thus, it encourages them to enter new regional air routes, even when profitability is uncertain. In addition, the owner of the airport, the local government, is encouraged to increase the number of local air passengers in order to enhance the load factor of a regional airway. As a result, a symbiotic relationship between an airline and an airport is established through this business model.

Many researchers have analyzed the efficiency of the Japanese regional air transport system. Yoshida and Fujimoto (2004) employed data envelope analysis (DEA) to evaluate 67 Japanese airports. Their findings indicate that airports on the Japanese islands are more efficient than those on the mainland. Barros et al. (2010) used the Malmquist input-based index to evaluate 16 Japanese airports operating from 1987 to 2005. They found that the airports (on average) became less efficient and experienced technological regression. Kato et al. (2011) analyzed the financial records of 41 Japanese airports and concluded that the "airports managed by local governments are very difficult to sustain financially without subsidy." In general, 5.2 million passengers are required for airport profitability. However, most Japanese regional airports have fewer than 2.5 million passengers (Kato et al., 2011). Many researchers have concluded that the Japanese air transport system is far from efficient and as a result, measures need to be taken in order to reduce/eliminate such inefficiency.

Inefficiency of regional air transport systems has been discussed worldwide as national subsidy program issues. For example, in the United States, the Essential Air Service (EAS) is a government program that provides a minimum level of air transport service for small communities and connects them through carrier hubs to the national network (Grubesic and Matisziw, 2011). In Europe, the Public Service Obligation (PSO) ensures "minimum" levels of air service to remote areas by subsidizing non-commercial routes (Lian and Ronnevik, 2011). Santana (2009) compared the EAS and the PSO in order to find higher costs for airlines under the PSO program. Grubesic and Matisziw (2011) pointed out that market coverage is often redundant and suggested alternative definitions of "community eligibility" that would increase programmatic efficiency and reduce federal spending on subsidies. Lian and Ronnevik (2011) noted the disadvantages of only providing subsidies for local residents and argued that regional non-residents must pay full fares, which, in turn, restrict the potential for incoming tourism.

Studies have shown two essential trends in managing an unsustainable regional air transport system. The first is the removal of inefficiency from the system in order to realize healthier management. In this regard, researchers tend to evaluate the productivity of airlines and airports as well as promote natural selection through competition. The second trend is the survival of the system depending on resources drawn from outside the system. Based on this approach, various national subsidy programs for airlines and airports can be found worldwide. However, it is important to explore another measure in which each regional air transport stakeholder bilaterally relies on others while coexisting in a market, rather than competing with them or being parasitic on public financing. It is expected that the LFG scheme will be one of the measures to achieve the overall objective.

Limited studies have been conducted on the LFG scheme. Hihara (2007) analyzed the LFG agreement between Ishikawa Prefecture and All Nippon Airways (ANA) in Japan. His study attempted to forecast future load factors and pay-offs by considering the impact of the LFG agreement on both parties' decision-making processes. However, the results were not significant, due to the scarcity of data. Fukuyama et al. (2009) analyzed the LFG agreement between Tottori Prefecture in Japan and Korea's Asiana Airlines. Their research considered the LFG as a Nash bargaining competition between the airline and the local government, and examined the rationality of negotiations by using multivariate regression analysis. The negotiations between the two aforementioned parties yielded an approximate Nash bargaining solution in 2007. The above-mentioned studies also analyzed the LFG by using mathematical modeling with static data input. However, they did not consider multi-year dynamic interactions between the airline and the airport (Hihara, 2011, 2012), which could significantly affect the future state of the business model.

The purpose of the present paper is to identify key success factors for managing the LFG scheme by analyzing the feedback effect of each party's decision-making process on long-term, airline-airport coexistence. The remainder of the paper is organized as follows. Section 2 explains the methodology used for evaluation, while Section 3 provides an overview of the model

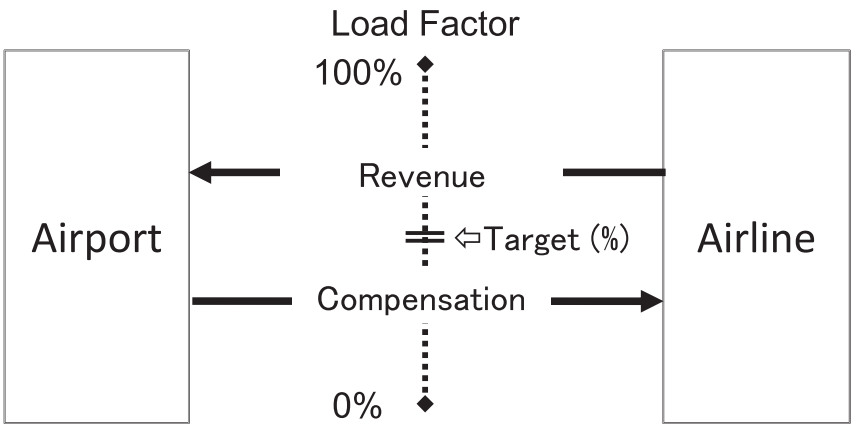


**Fig. 1.** A dynamically interdependent business model between the airline and airport.

Please cite this article in press as: Minato, N., Morimoto, R., Dynamically interdependent business model for airline–airport coexistence, Journal of Air Transport Management (2016), http://dx.doi.org/10.1016/j.jairtraman.2016.08.002