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Co-opetition alliance models of parallel flights for determining optimal overbooking policies

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ABSTRACT

In recent times, some airlines have entered into a partial alliance with their rival airlines in the common market. In this paper, we explore how much this so-called *co-opetition* alliance benefits participating airlines by improving their overbooking policies. We aimed to determine the optimal overbooking policies when two competing airlines operate in such an alliance and explore whether and how their partial cooperation through such an alliance agreement with each other on two parallel flights enhances revenue and service quality as well as reduces fuel cost. We show rigorously that this type of partial cooperation increases expected profits and service levels. An empirical study was conducted on actual cases in the China air travel market for routes between Hong Kong and Beijing to illustrate the win–win effect of this type of alliance application.

1. Introduction

The civil aviation industry has capital-intensive operations, low profit margins, and intimidating competition. To secure steady cash flow, airlines need to enhance their competitive edge at all levels of management toward more efficient utilization of their internal resources. Revenue management has been known to be an important tactic for improving profitability. Because of product perishability and demand randomness in the aviation industry, airlines differentiate prices for customers in accordance to time periods and among marketing channels.

Nonetheless, the randomness of customer behavior ensures that airlines can never guarantee that a particular strategy will be successful. It has been reported that nearly 10%–15% of travelers reserved seats but did not actually take their flight. For instance, on flights operated by Lufthansa German Airlines, 4.9 million passengers did not show up for their flight in 2005, which corresponds to 12,500 fully loaded Boeing 747 flights [1]. To prevent vacancy, most of the airlines adopt an overbooking practice by selling more than the actual capacity of their aircrafts. The overbooking policy is a profitable strategy and saved 3%–10% of gross passenger revenue or amounts in millions of dollars in airline business [2,3]. Such overbooking, on the other hand, can result in excess number of passengers, which can lead to chaos and loss of goodwill.

Service providers can join forces in an alliance to create more attractive service products that can benefit customers. A *vertical* alliance can be established among airlines from different geographic regions to offer origin–destination packages to customers [4]. In addition, a *vertical* alliance between airlines and hotel chains can be established to provide a travel package comprising flights and hotel rooms. Alliance strategies have been proven to be beneficial for all of the participants of the alliance.

In recent times, a model of partial *parallel* alliance has emerged to allow service providers to cooperate in a relaxed association. This type of alliance has been widely adopted in Chinese airlines as a new strategy on busy routes. For instance,

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Table 1
Schedule of morning flights from Hong Kong to Beijing.

Airline	Flight code	Departure time	Arrival time	Aircraft model	Day of week of flight
China Air	CA6606	03:25	06:30	330	·2345 · ·
Cathy Pacific	CX2034	03:25	06:35	330	·2345 · ·
Dragonair	KA5034	03:25	06:35	330	·2345 · ·
Cathy Pacific	CX6872	08:05	11:25	330	1234567
Dragonair	KA900	08:05	11:25	330	1234567
China Air	CA118	08:30	11:35	738	1234567
Cathy Pacific	CX6118	08:30	11:35	738	1234567
Dragonair	KA1118	08:30	11:35	738	1234567
Cathy Pacific	CX6888	09:05	12:25	330	1 · · · · · 7
Dragonair	KA990	09:05	12:25	330	1 · · · · · 7
Cathy Pacific	CX6888	09:10	12:25	330	·23456·
Dragonair	KA990	09:10	12:25	330	·23456·
China Air	CA108	10:40	13:55	738	1234567
Cathy Pacific	CX6108	10:40	13:55	738	1234567
Dragonair	KA1108	10:40	13:55	738	1234567
China Southern Airlines	CZ309	11:15	14:20	757	1234567
Cathy Pacific	CX6880	11:55	15:20	330	1234567
Dragonair	KA908	11:55	15:20	330	1234567
China Air	CA102	12:45	16:00	330	123 · 567
Cathy Pacific	CX6102	12:45	16:00	767	1234567
Dragonair	KA1102	12:45	16:00	767	1234567

China Southern Airlines (CZ) and Hong Kong-based Dragonair (KA) recently entered into an agreement in which CZ allows some of the seats on the flights between Hong Kong and Guangzhou to be sold by its direct competitor KA under KA flight-codes. As a result, KA will have more seats to sell and CZ, in turn, will get an opportunity to accept KA's stand-by passengers on the agreed flights by using its available seats without need for ticket endorsement.

This new practice is different from the common code-sharing alliance that allows participating airlines to fully share seats and passengers. The code-sharing strategy can enable two airlines to be in a win–win situation only when they operate on different routes. However, the new alliance that CZ and KA are implementing allows them to cooperate while operating in the same routes. This strategy can, thus, prevent the airlines having to fly two half-loaded airplanes separately and face a loss–loss consequence, and instead, move passengers in a single appropriately loaded flight.

Both CZ and KA operate flights on the route between Hong Kong and Guangzhou under strong demand conditions. Each of these airlines strives to maximize profit by selling as many tickets as they can at high prices. They are direct competitors who only cooperate in agreeable and specific situations. That is, CZ accepts KA's passengers only if there are excess passengers in KA's stand-by list and CZ has empty seats available. This loosely defined alliance divides the air travel market of the Hong Kong and Guangzhou routes into two stages: competition and then cooperation. In the absence of agreeable situations, both airlines are *pure competitors* operating at the competitive stage. These two airlines cooperate in the cooperative stage and divert passengers from one airline to the other when CZ has available seats and KA has excessive passengers on the stand-by list but has no seats vacant. In the *cooperation* stage, the airlines pool their resources together to minimize risks. This mix of competition and cooperation was named *Co-opetition*, originally presented by Brandenburger and Nalebuff [5], and has been defined as "a revolutionary mindset that combines competition and cooperation".

The co-opetition practice implemented by CZ and KA is an inspirational endeavor. The Hong Kong Airport is one of the busiest airports in the world and serves as an important travel hub in the Asian and Pacific regions. Travel along many routes between Hong Kong and other major cities in Asia are operated by several airlines. Some popular routes are operated by several airlines with parallel flights. For example, morning flights from Hong Kong to Beijing are offered by four airlines (China Air, Cathay Pacific, KA, and CZ), as shown in Table 1, and the flights in the schedule include parallel flights on the Hong Kong–Beijing route.

This work aims to (1) model and develop a solution approach for two airlines that enter a co-opetition agreement on a route similar to that between CZ and KA, and (2) extract managerial insights, on the basis of the solution approach and empirical analysis.

The authors attempt to address the following questions with regard to the co-opetition alliance:

a. What are the best overbooking policies for each of the airlines?
b. What type of the profit and improvement in service levels can the co-opetition offer?
c. What is the maximal number of seats that can be spared for the competitor?

The remainder of this paper is organized as follows. Section 2 presents a brief review of airline overbooking from reports published in the literature. In Section 3, the authors propose an analytic model and derive a solution approach. Numerical experiments with real data are presented in Section 4 to study comparative statistics and managerial implications of the co-opetition approach. In Section 5, the findings and results are summarized and the perspective of future research is discussed. The main technical results are appended at the end of this article.