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Entry effect of low-cost carriers on airport-pairs demand model using market concentration approach

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ABSTRACT

The trend of open sky policies and growth of low-cost airlines, the topic of airport-pairs demand is gradually being addressed in the golden aviation circle of Northeast Asia. The variety of flight services among the four major metropolises with dual-airport systems leads to a competition-cooperation relationship existing between various airports and airlines. Therefore, this study investigates the causal relationship between the route-level passenger demand and influential factors using aggregate data collected through website observations. The empirical study focuses on direct flights of airport-pair routes among Taipei, Shanghai, Seoul, and Tokyo. Results of the passenger regression model indicate that frequency, code-share, and morning flights have positive impacts on increasing passenger numbers for airlines. Further, the market concentration degree of Herfindahl-Hirschman Index and entry effect of low-cost carriers are important for the route-level passenger demand. In addition, routes with departures and arrivals in hub airports have a considerable attraction relative to other airport-pair routes. Finally, the proposed passenger model performs well in predicting market share, especially for routes with high demand.

1. Introduction

Trends such as open sky policies, low-cost airline growth, and airport financial autonomy accelerate airport competition in the golden aviation circle of Northeast Asia. This has accomplished the goal of single day travel cycle from Taiwan to Shanghai in China, Tokyo in Japan, and Seoul in the Republic of Korea. There are two important airports located in North Taiwan; Taoyuan International Airport (TPE), a large-scale hub airport with frequent flights; and Songshan International Airport (TSA), a city airport with access advantage to CBD. Similarly, the dual-airport system also exists in three destination cities, Shanghai (PVG and SHA airports), Tokyo (NRT and HND airports), and Seoul (ICN and SEL airports). Accordingly, passengers have varied options of airport-pairs routes for each city-pair flight. For example, with city-pairs flight from Taipei to Shanghai, one can choose among three airport-pairs routes: TPE-PVG, TSA-SHA, and TSA-PVG. Multiple airport-pairs routes lead to individuals facing diverse alternatives in air travel and intense competition among airlines. There also exist code-share (CS) flights among airlines. For example, considering the TPE-NRT route, there are CS flights operated by airlines of origin country (China Airlines, EVA Air, and TransAsia Airways), destination country (Japan Airlines and All Nippon Airways), third-party country (Cathay Pacific), and low cost carriers (Scoot and Vanilla Air).

In terms of entry effect of low cost carriers (LCC), most findings in previous research reveal that the entry effect of a LCC decreases the airfares and leads to an increase in the passenger traffic. The most famous case is the Southwest airlines effect; Goolsbee and Syverson (2008) revealed that the incumbents cut fares significantly when threatened by Southwest's entry. Fuellhart et al. (2013) indicated that the "Southwest effect" significantly explained the complexity of air-travel patterns within multiple-airport regions (MARs). Furthermore, the entry effect of LCC on airport competition and market structure has also been recognized by several studies (Fuellhart et al., 2013; Brueckner et al., 2014; Gillen and Hazledine, 2015). Murakami (2011) indicated that averagely, the type of airport, primary or secondary, does not affect the degree of airfare wars when LCCs enter market. Additional entries of LCCs do not affect the degree of airfare wars. Huma (2015) showed that the influence LCC used to exercise is diminishing in recent times. However, in terms of passenger traffic, entry has no direct effect, but indirectly through prices. In summary, most previous studies

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have addressed the effect of entry on LCC through airfare and passenger traffic, however, very few studies focus on entry effect through the influence of market concentration. Not only can this viewpoint be used to investigate airlines competition, but also examine the change of market structure after new LCCs' entries.

From the description of current aviation market, we can know that there exist competition-cooperation relationships between various airports and airlines. A passenger demand model with precise forecast is important to know what influential factors affect passenger demand and to help operating carriers propose a more effective strategy. Therefore, this study used aggregate data, instead of individual-level survey, to investigate the causal relationship between the route-level passenger demand and influential factors, such as flight attributes, airlines types, LCC effect, market power, and holiday factor. This study has three objectives:

1. Constructing a passenger demand model for airport-pairs routes;
2. Identifying those important factors and their effects on passenger demand; and
3. Validating the proposed passenger model with calibrating and validating samples.

2. Literature review

2.1. Dependent and explanatory variables

The units of observation for passenger demand include regions, airports, airlines, city-pairs, airport-pairs, and country-pairs. Since this study aims to investigate the competitions among airlines for direct flights within the Northeast Asia Golden Aviation Circle, we used the number of airlines passengers for airport-pairs routes as dependent variables. There are seven airport-pairs routes departing from TPE and TSA airports to three destination cities. In line with the time period of statistical data published by Civil Aeronautics Administration (CAA) of Taiwan, the total passengers flown monthly by airlines for a specific airport-pairs route was defined as the units of observation.

Regarding influential variables affecting passenger demand, seat supply, flight frequency, and connected cities are fundamental to defining international air passenger transport (Pacheco et al., 2015). Hsiao and Hansen (2011) indicated that airfare and flight frequency are the two most important variables in demand generation and assignment models. The other variables include travel time, schedule delay access time, and measures of attraction (e.g., destination city, population, or income). Furthermore, the level of concentration of air traffic has been addressed in recent studies (O'Connor, 2010; Van Nuffel et al., 2010; Pacheco et al., 2015). Hence, the market concentration approach was considered in this study to examine its impact on passenger demand and also used to examine the entry effect of new LCCs.

Numerous studies have proved that airfare is the most important variable affecting the demand of air passengers in aggregated demand model (Alderighi et al., 2015; Scotti and Dresner, 2015) and individual choice model (Wei and Hansen, 2005; Hsiao and Hansen, 2011). Those studies indicated that this variable has a negative and significant impact on passenger demand across varied units of observation. Except for the specification of airfare, Fuellhart et al. (2013) also adopted the low-fare share ratio to examine the marginal effect of LCC on passenger demand.

Thompson and Caves (1993), and Windle and Dresner (1995) used flight frequency to explore the choice behavior of individual travelers. They indicated that the higher the frequency, more willing were the travelers to choose alternatives of airlines or flights. Regarding the aggregated demand model, Wei and Hansen (2005, 2006) also obtained the same conclusion. These studies not only estimated the impact of flight frequency, but also showed that if an airline provides more morning flights, it will increase its market share with other airlines in the airport-pairs share model. In addition, Coldren et al. (2003) and Hsiao and Hansen (2011) both agreed that the punctuation of flights affected aviation demand. The results of their empirical studies indicated that the on-time performance of flights has a positive impact on the market share of airlines.

2.2. Market concentration index

This study focuses on the entry effect of new LCC using the degree of market concentration, the Herfindahl-Hirshman Index (HHI) (Hirschman, 1964). The method is originally used in income concentration studies and more recently have been used in air transport studies to investigate the competitive effect of market structure (Alderighi et al., 2015; Gillen and Hazledine, 2015; Pacheco et al., 2015; Scotti and Dresner, 2015). The HHI index provides an objective measure of market concentration, as in Equation (1), and equals to the sum of the squared share of seats for all the airlines operating on an airport-pairs route.

$$HHI = \sum_i \left(\frac{x_i}{\sum_i x_i} \right)^2 \tag{1}$$

where x_i can be the number of passengers, seats, and flights flown by airline i. The highest HHI value, 1, represents the monopolistic market. The lower value of HHI index means more carriers with similar shares of passengers/seats/flights compete in this air market.

In the case of a route with three airlines with equal market shares, the HHI would be 0.333. On the contrary, if a leading carrier with a market share of 0.8 competing with the other six carriers, the HHI index would be greater than 0.64. Thus, the index offers an object measure of the market concentration considering the number of carriers and their market shares simultaneously. Hence, this study used HHI index to investigate the effect of market competition on the number of passengers flown by airlines across all routes.

Furthermore, this study used the HHI index to propose a new index for measuring the entry effect of new LCCs. The index is only specified in the first few periods of new LCCs joining the market. The definition of *LccEntry* for period t is formulated as follows.

$$LccEntry_t(\%) = \frac{HHI_{t-1} - HHI_t}{HHI_{t-1}} \tag{2}$$

For convenience in explaining the definition of this new measure index, Table 1 listed the changes of HHI after the entry of a new LCC. Four new LCCs enter the market during our empirical data period. The month of new LCCs joining the market is defined as "Entry month ($t = 1$)" and the previous month of Entry is assumed to be the base period ($t = 0$). LccEnry is calculated with the HHI differences of two adjacent months by Equation (2). For example, when Scoot joined the TPE-NRT route, the LccEntry values of the 1st, 2nd, and 3rd month were 2.655%, 14.899%, and 7.411% respectively. As HHI is determined by the number of seats, the trend of HHI should be decreasing after new LCCs join market. Therefore, two periods with negative LccEntry values are not considered in our empirical data (both the 3rd month LccEntry value for Scoot's entry in TPE-ICN route and Vanilla Air's in TPE-NRT route). This is why the entry effects of new LCCs are only considered within the