



Quantitative evaluation model of air cargo competitiveness and comparative analysis of major Asia-Pacific airports



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ARTICLE INFO

Available online 31 October 2013

Keywords:

Airports

Air cargo

Delphi method

Competitiveness

ABSTRACT

This study develops a quantitative evaluation model for analyzing air cargo competitiveness of airports. First, according to a literature review and expert opinions, quantitative measures for evaluating air cargo competitiveness are derived using the Delphi method. Then the weights and value functions of these measures are obtained through expert questionnaire surveys. Applying the value functions to the operational data of different airports yields the value of each measure. Finally, multiplying the values with their corresponding weights sheds light on the competitiveness of individual and overall measures. Comparison of major Asia-Pacific airports is made in terms of different dimensions of air cargo competitiveness. The analysis results reveal that Hong Kong is the most competitive in terms of airline transport capacity and economic development while Changi is the most competitive with respect to airport facilities and operation. As for overall air cargo competitiveness, Hong Kong ranked top, followed by Changi, Pudong, Incheon, Taoyuan, Bangkok, Narita, Jakarta, Kuala Lumpur and Manila International Airports. Findings of this study can provide airports with useful references for operation management and formulation of development strategies.

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1. Introduction

Airports are gateways between countries. In addition to providing aircraft docking, they also serve as a conduit that connects countries and even have an indirect impact on the economy of the home countries. They play a crucial role in cargo and passenger transport, and in international trading and business activities. In recent years, the air transport industry has experienced rapid growth worldwide. According to the Boeing World Air Cargo Forecast 2009–2028 (Boeing, 2010), “World air cargo traffic will expand at an average annual rate of 5.8% for the next two decades...with domestic China and intra-Asia markets expanding 9.9% and 8.1% per year, respectively.” China has a competitive advantage with its low production costs and enormous consumer markets, and continues to attract funds and technologies. These factors also affect the economic growth of other Asian countries and, to some extent, have an impact on the development of the air cargo industry.

Past research evaluated the operational performance of airports using the following approaches: financial index measurement (Francis et al., 2002; Hamzaee and Vasigh, 2000; Humphreys and Francis, 2002), productivity and productive efficiency analysis

(Abrate and Erbetta, 2010; Oum et al., 2003; Zografos and Madas, 2006), and Data Envelopment Analysis (DEA) (Barros and Dieke, 2007; Fernandes and Pacheco, 2002; Lin and Hong, 2006). However, information provided by financial indices does not include the economic and social aspects of airport performance, nor does it consider quality of service, productivity, or productive efficiency analyses. DEA is a non-parametric method designed to measure the performance of a firm, organization, or program; that is, whatever is produced by decision-making unit.

Previous studies on air cargo examined mainly the prerequisites for airports to develop into logistics hubs, development and strategies of the air cargo industry, air cargo terminals, air cargo forwarders, as well as flight routing and scheduling. Despite continuous rapid growth in air cargo volumes in Asia Pacific (Boeing, 2010), relatively less effort has been devoted to comparing the air cargo competitiveness of Asia-Pacific airports. Airports are characterized by multiple inputs and outputs, such as entry and exit services for passengers entering or leaving countries, as well as transit passengers, and transport and handling of import, export, or transshipment cargo. These aviation and commercial activities generate revenues; hence, there exist many factors that influence air cargo competitiveness of airports. Nevertheless, the literature contains no standard measures for assessing airports in terms of air cargo competitiveness. To eliminate concerns over the lack of impartiality when a small number of experts select particular evaluation indicators and determine their weights

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according to subjective judgments, the Delphi method was chosen for this study because of its ability to efficiently and effectively summarize the opinions of a panel of experts (Geist, 2010; Okoli and Pawlowski, 2004; Rowe et al., 1991).

In this study, quantitative evaluation dimensions and measures of air cargo competitiveness of airports were selected using the Delphi method. First, prior research on air cargo competitiveness of airports was reviewed and the quantitative measures used were summarized. Opinions of a panel of experts on the summarized measures were then solicited through a questionnaire survey. Revisions were then made, thus yielding a final list of measures to be used in the second expert questionnaire survey for obtaining the weights and value functions of all measures. With the operational data of 10 major Asia-Pacific airports collected, calculations were performed to obtain the values of individual measures with which airports were compared in terms of their competitiveness in individual and overall measures, as well as different dimensions. The quantitative evaluation model developed in this study can not only analyze air cargo competitiveness of airports, but can also compare performance among neighboring or competing airports in individual dimensions and measures.

The 10 airports studied were chosen with reference to Lam et al. (2009) and Yang (2010). They are among the top 100 airports in terms of air cargo volume and are the airports with the largest air cargo transport in their respective countries (or special administration region). They are Hong Kong's Chek Lap Kok, Shanghai's Pudong, South Korea's Incheon, Japan's Narita, Singapore's Changi, Taiwan's Taoyuan, Indonesia's Jakarta, Thailand's Bangkok, Philippines's Manila, and Malaysia's Kuala Lumpur International Airport. The comparative results may serve as useful references for airports in managing their operations and devising their development strategies.

The rest of this paper is organized as follows. Section 2 reviews studies on methods for evaluating the operational performance of these airports and measures for appraising air cargo competitiveness. Section 3 introduces competitiveness indices, research methods, and development of a competitiveness evaluation model. Section 4 details the empirical analysis of air cargo competitiveness of major Asia-Pacific airports. Section 5 provides conclusions and suggestions.

2. Literature review

Growth in international transport is primarily driven by industrial development and expansion of foreign trade, which are also important determinants of air cargo volumes. Zhang (2003) presented a conceptual framework for discussing the role of Hong Kong, an international air-cargo hub. He examined Hong Kong's major competitors in an increasingly competitive regional and global market, and analyzed the competitive factors in the industry. Related research in recent years focused mainly on the impact of economic growth on air cargo transport (Chang and Chang, 2009; Yamaguchi, 2008), cargo airlines' choice of airport or transshipment airport (Gardiner et al., 2005; Ohashi et al., 2005; Yaman et al., 2007), as well as fleet flight routing and scheduling (Tang et al., 2008; Yan et al., 2006).

Methods used in past studies for evaluating the operational performance of airports include productivity and productive efficiency analysis, as well as Data Envelopment Analysis (Barros and Dieke, 2007; Fernandes and Pacheco, 2002; Lin and Hong, 2006). With regard to studies on measures for appraising air cargo competitiveness, Hooper and Hensher (1997) gathered relevant literature that evaluated airport performance and came up with 35 measures in four dimensions: total airport performance, airport handling performance, customer service performance, and partial productivity. Park (2003) conducted a comparative analysis of

eight major airports in Northeast and Southeast Asia using 16 measures in five core dimensions: spatial development, infrastructure, demands, services, and management. It was found that airports closer to shippers and with lower total costs and shorter delivery times are, inevitably, strong candidates for the position of a regional air-cargo hub, indicating the importance of geographical location, costs, and delivery times as competitive factors in regional and global competition among airports in terms of attracting cargo traffic.

Competitive factors also include infrastructure, customs, inter-modal transportation, and international aviation policy (Zhang, 2003). Gardiner et al. (2005) pointed out that the factors considered by air freight companies when choosing airports include opening hours, total costs, reputation in cargo transport, demands for local O/D cargo, influence of freight forwarders, transportation from airports, customs clearance times, and financial incentives offered. Reviewing literature on airport performance evaluation shows that there are no uniform criteria for indicators of airport performance (or competitiveness) and measures are usually selected depending on the particular factor to be evaluated.

The Delphi method is a structured process of group communication that allows individual members to fully express their opinions about a complicated issue and opinions are equally valued in order to reach consensus on the issue (Rowe et al., 1991). It aims to obtain from a group of experts their specific experiences with and knowledge of a particular issue, and involves several rounds of questioning and feedback until the group reaches consensus or has minimal disagreement. Since its development by Dalkey and Helmer (1963) and Helmer (1966), the method has been applied to a wide range of disciplines including urban system planning, integration and planning of public policies, market R&D, planning of large projects and development of new products. When using the Delphi method, the first step is to select participating experts. The next step is to design a questionnaire for conducting several rounds of surveys with individual experts until they reach almost unanimous opinions. Following the methodological aspects and essence of the Delphi method and Analytic Hierarchy Process (AHP), this study selected experts with abundant practical experience and expertise from the industry, government, and academia for the questionnaire survey in order to devise measures for evaluating air cargo competitiveness and determining the weights and value functions of individual measures.

3. Methodology

This study selected dimensions and measures using the Delphi method for a quantitative evaluation of air cargo competitiveness among airports. By using both expert questionnaire survey and AHP, the relative weights of dimensions and measures can be obtained. Then with the value function, the actual data of the measures can be converted into values. The competitiveness of individual airports was calculated using the value and weight of each measure. Fig. 1 summarizes the steps involved in the evaluation model with details described in the following.

3.1. Selection of competitiveness measures

A review of related literature revealed that past studies on airports' air cargo competitiveness focused mostly on transport capacity, freedom of the air and fleet routing, infrastructure, general operations, charges, efficiency in cargo clearance and handling of airports, as well as economic development. While many factors influence air cargo competitiveness of airports, the literature contains no standard measures for assessing airports

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