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Relevance of airport accessibility and airport competition

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ABSTRACT

Airport accessibility is an important criterion for airport competition. The relevance of airport accessibility and airport competition was studied in this paper based on the panel data collected from nine large airports in Jiangsu province, China from 2005 to 2014. The results showed that the cost of expense, time and fatigue for the arrival at the airport are proposed to quantify levels of fastness, economy and amenity for the passengers to arrive at airport. The airport accessibility is significantly affected by airport passenger traffic and airline frequency. The passenger traffic can be increased by 2% with 1% increase of airport accessibility based on the analysis results of the nine large airports in Jiangsu province.

1. Introduction

In recent years, there seems to be a growing tendency of airport constructions and reconstructions in China. It is estimated that by the end of the 13th five-year plan, there will be 244 airports including 23 newly constructed airports, and 37 reconstructed airports. Within these 244 airports, there will be 30 large-scale airports with 10 million passenger traffic annually. Accessibility is an important indicator which reflects the degree of difficulty that travelers have in accessing to the destination. The higher level of airport accessibility indicates that the airport landside transportation facilities are more perfect and passengers can access to the airport more conveniently. Studies have shown that airport accessibility is one of the important factors that affect whether travelers choose air travel or not. In the same area, airports of high level of accessibility are more competitive. Therefore, accurately measuring the level of the airport accessibility and quantifying relationship between the level of accessibility and airport competitiveness can help the planning department reasonably position airport nature, scientifically plan the airport development scale and can also effectively promote the management department to improve the level of airport external transport service so as to enhance the overall competitiveness of the airport.

Airport accessibility has been studied for quite a long time over the world. The evaluation methodology based on disaggregate theory has been found in various types of applications in recent years. However, there still lacks in depth researches on airport accessibility. It is usually caused by choice of too many competitive models of airports. Series of studies on selective competition of airports in San Francisco was conducted by Skinner, Harvey and Pels E (e.g., Skinner, 1976; Harvey, 1987; Pels et al., 2001). It showed that the cost of time and expense of arrival at airports affected passengers' choices. Some other studies measured airports' accessibility in perspective of spacial scale (e.g., Pels et al., 2003; Hess and Polak, 2005; Zhang and Xie, 2005). For instance, Humphreys studied airport accessibility and regional layout in Britain (e.g., Humphreys and Franccis, 2002). Feighan compared airport accessibility with different spacial scales in Europe (e.g., Fengjun et al., 2010). Few scholars have studied airport accessibility in perspective of transportation cost (e.g., Kim and Kwan, 2003; Bielli et al., 2006). For example, Ying Xiwen and Xu Tao studied the accessibility of hub airport and civil airport respectively (e.g., Xiwen and Jing, 2006; Xu et al., 2008). Although some results had been gained from studies listed above, some deficiencies were still present: (1). Studies on airport accessibility in Europe and North America were mostly focused on the traffic model using automobile, and measurement of time or distance, rather than on integration of different means and tourists' needs of being comfortable. (2). There were quite a number of researches focusing on how to improve the level of airport accessibility, but very few studies have been focused on the relevance between accessibility and competitiveness of airport, especially the airport development scale. Thus,

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it leads to the lack of persuasive data for later studies to refer to.

Proceeding from perspective of convenience, economy and comfort level for passengers, and series of data were obtained by investigating the transportation infrastructure and passenger travel behaviors of the nine large airports in Jiangsu province. In this paper, an airport accessibility model based on cost is proposed to intuitively reflect every airport's level of accessibility by generating a figure which shows the relationship between airport accessibility and range of services. It provides scientific support for airport managers to objectively grasp and evaluate the level of airport external transport services. A panel data model is also applied to study the relation among passenger scale, accessibility, scope of air routes, and economic level. It also analyzes the effect of different indexes on airports of different scales and scientifically quantifies the relationship between the level of airport transportation service and airport competitiveness, thus helping managers have a deep understanding of the importance of airport external transportation system construction and prompting managers to speed up improving the convenience for passengers to access to the airport, so as to enhance the overall competitiveness of the airport.

2. Accessibility model

2.1. Airport accessibility

Airport accessibility refers to the degree of convenience for passengers to arrive at the airport, which can be indicated by the usage of various transportation tools. Given that there exists differences among the airports in technical performance and operational features. The economy of arrival at the airport was measured based on fastness and customer service's amenity (e.g., Matisziw and Grubesic, 2010). In order to define and quantify the accessibility, the cost form was adopted in this paper, as shown in Table 1.

The total cost of airport accessibility can be written as a linear combination including all compositions of accessibilities as the formula listed below:

$$S = F + T + C \tag{1}$$

wherein:

S is the total cost of the passenger's trip to the airport, F and T are the expense cost and the time cost of the passenger on the trip to the airport and C is the fatigue cost of the passenger on the trip to the airport.

2.2. Cost calculation

(1) Cost of expense

Cost of expense refers to the money spent by a passenger on the trip to the airport by a certain transportation tool, which is directly shown in the form of currency.

(2) Cost of time

Cost of time refers to the time spent by a passenger on the trip to the airport, which can be transformed in the form of currency. The cost of time is related with time value of passengers (i.e. labor value of unit time). The higher income the passenger has, the higher time value will be. In this paper, the time value of passengers is indicated as wages unit per hour.

(3) Cost of fatigue

Cost of fatigue refers to the cost yielded by fatigue during the trip to the airport, mainly measured by level of shaking and noise, temperature, and traffic condition. Since the calculation of fatigue cost is too abstract and complicated, it is easier to be indicated in a grading form. In this paper, the indexes of vibration, noise, temperature and congestion are divided into five grades, where the value ranges from 1 to 5. The number 1 means lowest level of discomfort and highest level of amenity, and 5 is the opposite. The cost of time was obtained by multiplying each index by conversion factors. For instance, it takes a passenger 1 h to reach to the airport. During the trip, the indexes of vibration, noise, temperature and congestion are all very high (grade 5). Thus he needs 1 h to refresh. We take 1/20 as the conversion factor. The result of conversion can be understood as the time a passenger need to recover from fatigue after going through a specific environment within unit time.

Cost of airport accessibility through traffic mode m can be expressed as Formula (2):

$$S_m^n = \alpha^n t_m + f_m + \alpha^n t_m \beta^n \sum_{i=1}^{4} c_i^m \tag{2}$$

wherein:

S_m^n is the total cost generated when the passenger n selects the travel mode m to reach to the airport. α^n is the time cost of the passenger n, t_m and f_m are the time and cost generated when the passenger selects the travel mode m to reach to the airport. β^n is the conversion factor of the passenger n's amenity, which needs to be calibrated. c_1^m ,c_2^m ,c_3^m ,c_4^m represent the level of vibration, noise, temperature and congestion accordingly. The recovery time of unit travel time can be obtained after the rank sum multiplies β^n. Then, the corresponding cost is obtained by multiplying the time by the time cost.

2.3. Partaking according to different group of people

The cost of arrival is different if people come to the airport from different areas. Thus, It needs to be classified according to the time cost (a). *logit* model. For people (n) in a certain district, the probability of choosing the travel mode m can be shown as Formula (3):

$$P_m^n = \frac{\theta^n \cdot V_m(\alpha^n)}{\sum_i \theta^n \cdot V_{mi}(\alpha^n)} \tag{3}$$

wherein:

P_m^n is the probability that people (n) select the travel mode m to access to the airport, V_m is the utility function of travel mode m, *which in* here is the reciprocal of travel cost S_m^n and θ^n is the Sensitivity coefficient, needs to be calibrated.

Table 1
Part of the airport accessibility.

Composition of accessibility	Corresponding cost composition	Instruction
Economy	Cost of money (F)	The travel expenses during a passenger on the trip to the airport
Fastness	Cost of time (T)	The time during a passenger on the trip to the airport
Amenity	Cost of fatigue (C)	The degree of comfort and good feelings during a passenger on the trip to the airport