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A study on passengers' airport choice behavior using hybrid choice model: A case study of Seoul metropolitan area, South Korea

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ABSTRACT

Improving explanatory power is significantly important to understand variables that affect attitudes and perceptions in the decision process. This paper estimates not only tangible attributes but also intangible perceptions and attitudes using a hybrid-choice model to study air passengers' flight choice behavior. The empirical study was conducted for the choice behavior of air passengers at Seoul Metropolitan Area, South Korea. The analysis uses a two-level Nested Logit model in order to examine which factors have more effect on passengers' choice of airport and airline simultaneously by using airport and airline choice attributes. The study also estimated the parameters in the equations relating the latent variable by using Structural Equation Model (SEM). The results indicate that the models with latent variables have improved Goodness-of-Fit when compared to classical discrete choice models and effectively capture psychological factors that affect choice behavior of passengers.

1. Introduction

Since 2005, the emergence of Low Cost Carriers (LCCs) in South Korea's aviation industry have brought about a shift in its structure that had previously been dominated by two major airlines. On international routes, LCCs operated 68 flight movements along with 11,360 passengers per annum in 2008and 23,871 flight movements with 652 million passengers in 2014. The market share of LCCs in South Korea's international flights shows continuous growth as it increased from .03% in 2008 to 11.41% in 2014. The lower air fare by LCCs has contributed to significant traffic leakage from full service carriers (FSC). This is because travelers are willing to spend several hours on access to airports in order to take advantage of lower fares and more convenient airport services (Fuellhart, 2007).

The growth of LCCs in multi-airport regions give air passengers more diverse flight alternatives by combining multiple departure airports and flight routes (Yang et al., 2014). Travelers have the option to use different airports to take advantage of lower fares and more convenient airline services rather than using their local airports (Suzuki and Audino, 2003).

Each of South Korea's airports are trying to boost its performance by expanding existing infrastructure to increase potential demand for air travel and by improving the quality of service. With LCCs focusing on increasing international routes, competition among airports in the Seoul metropolitan area will increase significantly. Passengers will have more alternative airports when traveling. For local authorities, airport planners and airlines, it is important to know how passengers decide on their preferred method of travel in such market competition condition (Pels et al., 2003). It is significantly important to improve explanatory power that combines explanatory variables and latent psychological factors that affect attitudes and perceptions in the decision process.

2. Literature review

Metropolitan regions often have more than one commercial airport. Where multiple airports serving a similar market exist, it is important to understand how airlines and air travelers choose their origin and destination airports within a regional airport system. As airports compete with one another for passengers, substitution or market area "leakage" occurs when travelers avoid using the local airports in their regions, and use other (out-of region) airports to take advantage of lower fares and more convenient airline services (Suzuki and Audino, 2003).

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The issue of airport choice in metropolitan areas with multiple airports has been addressed in a number of studies, where the objectives have been to investigate the primary determinants of travelers' airport-choice decisions, such as airport access time, flight frequency, differences in air fare, type of aircraft, and purpose of travel. Many of the papers on airport choice have been studied in multi-airport regions because of the high frequency of service that they offer. Some of these papers adopted more sophisticated choice models to improve statistical power. Pels et al. (2003) recognized that passengers make a number of decisions including which airport and airline and the airport access mode that they can choose from. In this paper, a two level nested logit (NL) model is used for combined estimation of access mode and airport choice model. The authors found that business travelers have a higher value of time (i.e., access time and frequency) than leisure travelers while leisure travelers are more sensitive to fare and airport access cost than business travelers (Pels et al., 2003). Harvey (1987) found that airport access time and flight frequency were significant factors affecting origin and destination airport choice for both leisure and business travelers in a multi-airport urban region, but the access time elasticity seems to be relatively more important in the airport choice model in the business samples. Basar and Bhat (2004) estimated business travelers' airport choice behavior in the San Francisco Bay Area using multinomial logit model (MNL) and probabilistic choice set multinomial logit (PCMNL) model. A PCMNL model can more sensitively estimate the access time effects at its stage. The authors further emphasize that a good understanding of the factors underlying passenger's origin airport choice in multi-airport urban regions is crucial because it can enable airport management and airline carriers to attract passengers, upgrade airport facilities and equipment to meet projected air travel demands, and determine airport staffing needs (Basar and Bhat, 2004). Hess and Polak (2005) adopted a cross-nested logit for a combined choice of airport, airline and access mode. They supported the earlier findings of fare, frequency and access time being significant variables in choice among airports in the same area; and of business travelers being more sensitive to access time than leisure travelers in San Francisco Bay. Ishii et al. (2009) studied the airport choice in the San Francisco Bay area using a mixed logit (ML) model. The results revealed that access time, frequency, airport delays, flight frequency, availability of particular airport-airline combinations, and early arrival times strongly affect choice of airport. Zhang and Xie (2005) used a Logistic Regression model to examine the influences of a few variables on passenger's choice of airports in the Golden Triangle Regional (GTR) airport. The paper found that ticket prices, experience with the GTR airport, and flight schedules were the most important factors influencing choice of airports in small cities. Marcucci and Gatta (2011) explicitly treat both compensatory and non-compensatory decisions in multi-airport regions. The paper used not only MNL but also ML model to improve the explanatory power of the model. Marcucci and Gatta (2012) proposed a structured way to investigate alternative methods to account for preference heterogeneity in airport choice. ML model and latent class models are used for capturing preference heterogeneity as the first way. The NL model represents a partial relaxation of the Independence of Identically Distributed (IID) and IIA assumptions of the MNL model. The NL model is relatively straightforward to estimate and offers more effect of being of a closed-form solution (David et al., 2007). Yoshinori (2007) developed the two-step NL model that includes airport-airline choice. The author mentions that airport and airline choices are seemed to be made simultaneously by travelers in their decision process. The results indicate that the model fit of the two-step NL model is better than that of a one-step nested logit model.

Traditionally, discrete choice models (DCMs) have considered only objective attributes from the alternatives and socio-economic characteristics of the individuals as explanatory variables. Latent variables strengthen traditional DCMs by enabling it to more effectively capture psychological factors that affect purchase behavior of customers and facilitate the understanding of the relationship between customers' desires and product features (Johansson et al., 2006; Chen et al., 2004).

Latent variable modeling is a technique that can capture the customer's perception through the use of psychometric data obtained through conducting surveys. Psychometric survey questions ask consumers to indicate how satisfied or dissatisfied they are with respect to aspects of latent variables (Loehlin, 1998). The psychological factors lead to a more behaviorally realistic representation of the choice process, and consequently, better explanatory power (Johansson et al., 2004).

Some of these papers include Loehlin (1998); Johansson et al. (2004); Yanez et al. (2010). Loehlin (1998) indicates that latent variable modeling is a technique that can capture customers' perceptions through the use of psychometric data, obtained through conducting surveys. Johansson et al. (2004) found that latent variables strengthen discrete choice model to outperform the traditional discrete choice model and that the construct reliability of the attitudinal latent variables is higher than that of the behavioral latent variables. Yanez et al. (2010) indicates that latent variables are intangible attributes, the aim of which is to represent subjective elements in choice behavior. Thus these variables, which normally do not have a measurement scale, try to represent factors that although influencing individual behavior and perceptions, cannot be quantified directly in practice.

Many papers on hybrid choice model have been studied, because the latent variable approach better captures psychological factors that affect purchase behavior of customers and facilitates the understanding of the relationship between customers' desires and product features (Chen et al., 2004). The use of hybrid choice model will improve explanatory power by combining discrete choice and latent variables models that consider the impact of attitudes and perceptions on the decision process (Ben-Akiva et al., 2002). However, there is little study about passengers' airport choice behavior which utilizes a hybrid choice model in South Korea. This paper aims to investigate the air passengers' choice behavior at Seoul Metropolitan Area with latent variables and its influence on the discrete choice model.

3. Research methodology

3.1. Standard discrete choice modeling

The most common approach of discrete choice modeling is based on random utility theory. The utility function indicates the individual preferences where the explanatory variables are the alternative attributes and individual characteristics (Bolduc and Daziano, 2009).

The MNL model is a generalization of the binary logit model and is used to describe how an individual chooses among three or more discrete alternatives. The MNL model indicates independence from irrelevant alternatives (IIA) that enhance proportional substitution across alternatives. However, often researchers are unable to capture all sources of correlation, a major cause of correlation of the unobserved portions of utility, and IIA does not hold. McFadden (1977) proposed the distribution of the NL as a type of Generalized Extreme Value (GEV) distribution which exhibits generalization of the distribution that gives rise to the logit model and a variety of substitution patterns. Both MNL and NL offer closed forms for choice probabilities but rely on restrictive simplifying assumption.