



Mode choice behavior modeling of ground access to airports: A case study in Istanbul, Turkey



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ABSTRACT

The increase in air transportation mode share, thereby the passenger traffic at airports has made the ground access to the airports more important in recent years. The aim of this study is to analyze the ground access mode choice to airports by using Multinomial Logit (MNL). In particular, our focus is on how transit areas of influence affect the mode choice for travelling to airports. Atatürk International Airport (IST) in Istanbul, Turkey was selected for the analyses and the investigated modes to access IST were automobile, drop-off, public transit, and taxi. The results showed that significant factors and variables included the trip distance to access IST, type of destination, trip cost to IST, automobile ownership status, employment status, travelling group size, location of the trip origin with respect to public transit influence, and time difference between the flight time and departure time to IST. It is also concluded that if the trip origin to IST was inside the influence areas of public transit, then public transit would be more likely to be chosen over other modes for accessing IST.

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1. Introduction and background

There has been a rise in international and domestic air travel (or mode share of air travel) over the past ten years with a growth rate of 5.6 per cent (IATA: International Air Transport Association, 2015). This was due to the surge in number of airlines and the decrease in ticket prices due to the competition among them. Similarly, in Turkey, in terms of the number of passengers, the overall increase in 2015 was 9.4 per cent and the increases in domestic and international traffic were 14.1 and 4.4 per cent, respectively. Also, an increase with 8.2 per cent was observed in the overall commercial aircraft traffic. The percentages of the increase in this category for domestic and international traffic have been recorded as 10.7 and 5.6, respectively (General Directorate Of State Airports Authority of Turkey., 2016).

The growth of passenger traffic in air travel causes an increase in the ground traffic to airports. Therefore, understanding the issues in ground access traffic to airports and providing solutions for related problems are important. In this study, the ground access mode choice of Atatürk International Airport (IST) in Istanbul,

Turkey was analyzed. IST is the largest airport in Turkey and the international hub for Turkish Airlines (THY). In 2015, passenger movements increased in IST by 8.0, 4.0 and 10.0 per cent in overall, domestic and international traffic categories, respectively. In terms of commercial aircraft traffic in IST, the increases for the same categories were 6.0, 0.3 and 9.0 per cent (General Directorate Of State Airports Authority of Turkey., 2016).

In the studies regarding mode choice for airport access, discrete choice models (Ben-Akiva and Lerman, 1985) were used to estimate the shares. Among them, the most widely used model was Multinomial Logit (MNL), yet a small amount of studies used Binary Logit (BL) and Mixed Logit (ML) as well.

The main concerns of passengers for selecting the mode for airport access are time and cost of travel to the airports (Harvey, 1986; Monteiro and Hansen, 1996; Psaraki and Abacoumkin, 2002; Hess and Polak, 2006; Gupta et al., 2008; Tam et al., 2008; Alhussein, 2011; Jou et al., 2011; Akar, 2013; Choo et al., 2013). Harvey (1986) and Tam et al. (2008) reported that sensitivity to travel time is higher for passengers travelling for business purposes; i.e., business passengers. Hess and Polak (2006) developed a simultaneous airline, airport and airport access mode choice in Bay Area, United States, and reported that travel time was a crucial factor for the choices.

Demographics of passengers are also essential for airport access

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mode choice though the demographic properties considered in each study vary (Harvey, 1986; Gupta et al., 2008; Tam et al., 2008; Alhussein, 2011; Akar, 2013; Choo et al., 2013). Harvey (1986) reported that gender and income level were important factors for airport access mode choice of non-business passengers. However, the same could not be said for business passengers. Tam et al. (2008) had only considered the age of the passengers in their choice model for Hong Kong International Airport (HKG). Gupta et al. (2008) had found out that gender, age and income level had affected airport access mode choice in New York City. Alhussein (2011) used only income level and nationality of the passengers as demographic properties in the choice model between automobile (auto) and taxi. Akar (2013) used the age of the passengers in addition to their incomes as a demographic property. However, Choo et al. (2013) had the most extensive demographic variables including age, gender, occupation and income level of the passengers in their airport access mode choice models for Gimpo (GMP) and Daegu (TAE) International Airports in Korea.

Separation of passengers in terms of trip purposes as business and non-business were considered to be essential in several studies (Harvey, 1986; Psaraki and Abacoumkin, 2002; Pels et al., 2003; Hess and Polak, 2006; Gupta et al., 2008; Tam et al., 2008; Akar, 2013; Choo et al., 2013). Tam et al. (2008) and Akar (2013) applied this separation by including separate variables for business passengers in their models. Harvey (1986), Psaraki and Abacoumkin (2002), Hess and Polak (2006), Gupta et al. (2008), and Choo et al. (2013) developed different mode choice models for business and non-business travelers.

Safety margin is one of the fundamental factors for airport access mode choice, especially for passengers travelling for business purposes. Passengers usually prefer to arrive earlier to the airports in order not to arrive late and miss their flights. Thus, safety margin is described as the time difference between the preferred and expected arrival time of passengers (Tam et al., 2008). Tam et al. (2008) also revealed that each access mode had different safety margin measures. This is due to the fact that different access modes have different travel time reliability. Koster et al. (2011) determined the factors affecting preferred arrival time to the airport, which also has an effect upon safety margin. Those factors were listed as the number of luggage to be checked-in, purpose of the trip, age (elderly or not), the number of flights per year, flight time, check-in type (online or not), expected travel time to the airport and flight duration.

Other factors affecting airport access mode choice can be listed as the number of luggage each passenger is carrying (Harvey, 1986; Akar, 2013; Budd et al., 2014) and the travelling group size (Tam et al., 2008; Akar, 2013). Harvey (1986) stated that carrying luggage would make passengers avoid public transit. Likewise, Akar (2013) also explained that the number of luggage was an important factor in choosing other transportation modes than automobile for airport access. However, Budd et al. (2014) found a contradictory result. In their study, the group which used public transit more often to access airports was made of passengers with checked-in luggage. In terms of group size, both Tam et al. (2008) and Akar (2013) revealed that an increase in group size would discourage passengers from using non-automobile transportation modes.

Use of public transit for airport access has been recommended or its evidence has been presented by several studies (Monteiro and Hansen, 1996; Gupta et al., 2008; Budd et al., 2011). Monteiro and Hansen (1996) had recommended the local authorities to extend the Bay Area Rapid Transit (BART) network to San Francisco International Airport (SFO), and it was indeed extended to SFO in 2003. Similarly, Gupta et al. (2008) had revealed that there was a tendency to use AirTrain to connect rail stations from airports in New York City. Budd et al. (2011) explained that share of private car trips

to airports, both as drop-off and as auto, should be reduced and this strategy could be implemented with the help of airport managers. Similarly, Merkert and Beck (2016) explained that integrated air bus services in Australia would reduce the private car usage for regional travel, especially by leisure travelers.

Taking public transit use for airport access as a starting point, it was observed that there was a research gap about the effects of transit areas of influence (or catchment areas) on mode choice access to airports, and that has been covered in this study. Specifically, transit areas of influence is defined as the area around a given public transit station which has the potential to generate trips on the corresponding transit line (APTA Standards Development Urban Design Working Group, 2009). The concept of transit area of influence has been used in literature, such as walking distances to/from transit stations (O'Sullivan and Morrall, 1996). In that study, it was found that pedestrians preferred to walk more for light-rail stops than for bus stops.

Hence, it was aimed to obtain the following:

- (1) Effects of transit areas of influence on mode choice for airport access;
- (2) Estimation of the airport access mode choice for the passengers departing from IST, and determination of the factors affecting the mode choice.

2. Data and methodology

2.1. Data

Data was collected via a passenger survey conducted at IST. IST was opened in 1953, and has expanded since then. In 2015, the airport handled 41,947,327 international and 19,375,402 domestic passengers, more than its annual capacity (25,500,000 international and 12,800,000 domestic passengers per year) (General Directorate Of State Airports Authority of Turkey., 2016). It is located at the west of central Istanbul, in Bakırköy district of the European side of the city. The distance between IST and Beyoğlu district, which is the city center, is 22 km.

There are 99 districts in the data, with varying distances to IST. 19 of these districts are located on the Asian side of the city and have longer distances to IST. This is because passengers coming from the districts on the Asian side and using highways need to access the bridges first (15th July Martyrs' Bridge or the Fatih Sultan Mehmet Bridge); and therefore, the length of the trip to IST increases. Alternatively, those passengers can also use ferries and Marmaray rail to cross the Bosphorus.

Different studies have considered different ground modes since the alternatives of access mode varied among the airports. In this study, the types of access modes considered were automobile, drop-off, public transit, and taxi. In auto mode, passengers drive on their own and drop-off mode is the case where they are driven to IST by others. There is direct access by public transit to IST via semi-rapid rail, which is the M1A line. It runs from Yenikapi district to IST and passengers can connect to this line from other semi-rapid rail lines at several stations. It should be noted that the transit modes investigated in this study are the semi-rapid transit lines in Istanbul. Furthermore, Istanbul transit network is provided (Fig. 1) to clearly show the transit network structure and location of IST for the convenience of the reader. The final mode considered in this study is the regular taxi service. Given the limited budget for this study, the percentage of passengers who have taken shuttle services to IST was not high enough to obtain a choice model for that mode (4.2%). There is also the option of renting a car to/from IST, but none of the respondents in data used that service.

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