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AIR PASSENEGERS DISTRIBUTION – FACTORS OF AIRPORT CHOICE IN WARSAW METROPOLITAN AREA

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This is an abridged version of the paper presented at the conference. The full version is being submitted elsewhere. Details on the full paper can be obtained from the author.

13th World Conference on Transport Research

www.wctr2013rio.com

15-18 JULY 2013
Rio de Janeiro, Brazil

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ABSTRACT

Airport choice is of great importance to transport researches, airport authorities and public authorities. This paper investigates the factors of airport choice and distribution of passenger origins at Warsaw airports. In 2012 in Warsaw metropolitan area new airport was opened – Modlin Airport, which is an alternative for passengers to the only airport in the area – Chopin Airport. The newly opened Modlin Airport creates an opportunity for passengers to choose, having regard to different accessibility of the airports, different available destinations and different air ticket prices. The objective of the paper is to examine using regression model to what extent the above factors influence the airport choice depending on the passenger profile. The paper finds that airport choice in Warsaw appears to be dominated mainly by air ticket price and available destinations, with small impact of airport accessibility. The research suggests that new airport generated new demand, since large proportion of passengers at Modlin Airport claim to use air transport for the first time. This might be the result of low-cost carrier offer available at new airport.

Keywords: airport choice, air passenger distribution, regression

INTRODUCTION

Aviation market in the European Union is deregulated, and after the process of air transport routes liberalisation the airlines can operate any route they prefer, they are also free to choose airports having regard to the expectations of passengers. The growth in air

transport demand enhances the development of existing airports and the creation of new ones. In large metropolitan areas multi-airport systems are created. On the one hand, new airports created in metropolitan areas are the answer to growing demand, on the other hand their existence creates new market conditions with broader opportunities for passengers. Airports within one metropolitan area can have different characteristics, different level of services, different accessibility indicators and different airline profile.

Warsaw metropolitan area is located in the center of Poland with about 3 million inhabitants. Before the year 2012 there was only one international airport – Fryderyk Chopin Airport, which served as main international hub in Poland. Passengers originating from Warsaw and travelling to international destinations had to use Chopin Airport as there was no other airports in the area. In June 2012, in Warsaw metropolitan area, new airport was opened and it was named Modlin Airport. New airport attracted new airlines (e.g. Ryanair). One airline (WizzAir) changed its base from Chopin Airport to Modlin Airport. The reason for building new airport was capacity expansion as a response to forecasted strong growth of passenger traffic. The newly opened Modlin Airport creates an opportunity for passengers to choose now between the airports having regard to different accessibility of the airports, different available destinations and different air ticket prices.

The objective of the paper is to examine to what extent the above three factors influence the airport choice in Warsaw metropolitan area and how the new airport expands air travel opportunities as perceived by passengers. This is based on detailed analysis of passengers' profile of each airport. The analysis distinguishes business and tourist travelers with regard to their income distribution. Also their origin is taken into account to assess the importance of accessibility factor and passenger catchment area. Similar studies have been conducted in other countries (e.g. Innes & Doucet, 1990; Hess & Polak, 2005, 2006; de Luca, 2012) and can serve as an important tool of traffic forecasting for each airport. The originality of this paper comes from three-dimensional conceptualization of airport choice described in regression based on survey done at the airports. Such approach can lead to better accuracy of the model. Also, as airport choice in Warsaw is a new problem due to recent airport opening, the airport choice in Warsaw metropolitan area was not yet investigated and could be of great practical policy importance.

Airport choice is the result of a passenger's perceived utility of different factors (de Luca, 2012). Travelers choose among the available parameters (e.g. air ticket price, airport accessibility) of services that allow them to make air travel. In recent years significant number of studies focused on investigating and simulating the problem of airport choice. Different models were used basing on different mathematical structures (linear regression, Multinomial Logit, Cross-Nested Logit) models. There are also different approaches presented basing either on models that investigate airport characteristics only, models of combination of airport and airline or three choice dimensions (airport, airline and access mode). Given the long-term planning of airports development process, the generation of reliable forecast of passenger levels based on airport choice factors is an important tool (Kroes et al. 2005). It can also be used to stimulate airport choice heaving known which choice dimensions are most influential.

Airports within one multi-airport area, depending on its' characteristics, can have different catchment area and attract different types of passengers. Determining catchment area of an airport is an important field of research in the context of formulating the forecasts of passenger traffic. It is crucial component of practical transport planning and policy having regard to fact that geography of air transport needs to be understood against local context (Graham, 1998; Marciszewska, 2009).

LITERATURE REVIEW

Airport choice has been investigated in several metropolitan areas taking into account different choice factors. From literature investigation three main areas influencing airport choice can be described: level of service, airline characteristics and airport characteristics. For these areas three factors are included in the investigation in this paper, respectively: available destinations, the level of ticket price and airport accessibility. One of the first studies was empirical analysis of three airports in Washington-Baltimore multi-airport area done by Skinner (1976). The study implemented Multinomial Logit model to find that accessibility was more important than flight frequency. Innes and Doucet (1990) used a binary logit structure for airport choice in the New Brunswick, Canada. Their binary structure focused on level of service and found that type of aircraft plays a significant role in airport choice, and that air travellers are willing to travel long distances in order to have access to jet service. Furuichi and Koppelman (1994) studied departure and destination choice and found that two most important factors are access time and flight frequencies. Pels et al. (2001) and Hess & Polak (2005) investigated the San Francisco Bay area. This area is one of mostly studied due to accessible and systematic passenger survey data collected by Transport Commission in San Francisco. Pels analysed the choice of airport and the choice of airline and found that the choice of airport depends on choice of airline. Hess & Polak introduced the Mixed Multinomial Logit model of air travel choice and found that ticket price is also an important factor affecting the choice in addition to access time and flight frequency. Important contributions have been implemented by Hess et al. (2007) to investigate jointly airport and airline. De Luca and Di Pace (2012) investigated different airport choice modelling solutions. With a set of random utility discrete choice models they estimated that the most significant factors were airfare, frequency and access time.

Within the literature airport catchment area is used to analyse airports' passenger base by estimating the geographic area from which airport's departing passenger originate and their distribution within the area (CAA 2011). In multi-airport areas it is common that catchment areas overlap, therefore analysis of the geographic distributions of passengers can give important evidence of the potential of competition between the airports. In literature there are various methods of implementing catchment area indicators into the research. One of the possibilities is to use surface access travel time to assess the accessibility potential basing on value of time of different passengers. Such approach was applied for example by Thompson and Caves (1993) who studied airport choice in

north England and found that distance to the airport was important for both, business and leisure travellers. Another way of measuring accessibility is binary modelling of perceived quality of transport to the airport (Mamdoohi et al. 2012). Acceptable airport access time is a factor determined by passenger profile as different passengers groups are willing to accept different access times. Groups such as business travellers might have a higher thresholds compering to those using low-cost carriers. There are studies showing that presence of LCC at an airport contributes to widening of its catchment area (Dobruszkes 2009). Therefore it can appear that opening of new airport in Warsaw metropolitan area can widen overall catchment area of Warsaw airports due to broader offer of LCCs present at Modlin Airport.

Airport accessibility is often differently perceived in researches done in countries with different level of vehicle ownership. For example in studies done in USA access to the airports is mainly influenced by time of car access. Unlike in many European countries, and especially in Poland, airport accessibility is determined by both, car and public transport, as many passengers would rather use public transport than leave the car at the airport. According to Kouwenhoven (2008) passengers have a strong preference to use their own car when going on a short business trip, but for long business trips the share of this mode is lower. Pels et al. (2000) studied the effects of changes in accessibility on competitive position of the airports. It was found that improvement in accessibility of an airport leads to a redistribution of traffic due to changes in attractiveness of an airport.

The way how passengers trade off the airport attributes depends on whether they travel for business or leisure purpose (Ishii et al. 2009) but also on their income distribution. Therefore willingness to pay the certain level of ticket price is determined by income but also by purpose of trip. Also the choice is based on travellers demographics, Basar and Bhat (2004) found that women traveling alone are more sensitive to access time to the airport. De Luca (2012) finds for Italy that younger users prefer airports with low ticket prices and high flight frequency, also users with higher income are less affected by accessibility cost.

From the above literature overview, following observations can be made. Firstly, the ticket price, availability of destinations and airport accessibility were considered to be factors of key importance to airport choice but their influence on choices were different in different market and geographical conditions. It is therefore necessary to assess the level of importance of those factors for particular multi-airport area, what hasn't yet been done for Warsaw metropolitan area airports. Airport and airline characteristics also determine the range of air travel opportunities for residents of multi-airport area. The choice is made on subjective perceived utility of given characteristics with regard to constraint factors. New airport present new offer which can widen the range of travel opportunities for passengers (e.g. lower fares, new destinations). Therefore from passenger's point of view, for a given budget constraint, the new fares that fit in the budget constraint can be considered as widening the range of travel opportunities. In the paper three constraint factors have been chosen that affect overall perceived by passengers range his travel opportunities: willingness to pay the air fare, desired connection, airport accessibility.

DESCRIPTION OF DATA

Poland is an emerging air market with strong growth forecast in passenger air traffic. According to Civil Aviation Office (2012), until 2020, the average annual growth in passenger traffic in Poland will maintain 6-7%. The reason for such high forecast is the economic status of Poland, which is an emerging economy with stable positive economic growth, catching up the EU average income per capita.

The Warsaw metropolitan area is inhabited by about 3 million people out of which 1,7 million live in Warsaw – the capital city of Poland. The Chopin Airport located at the South-West part of Warsaw has been a main international airport with annual traffic of 9,3 million passengers in 2011 what gives 43% share in total air passenger traffic in Poland, which annually is 21,7 million passengers. With constantly growing air passenger traffic in Poland, despite modernization, the capacity of Chopin Airport is becoming more scarce. Warsaw metropolitan area needed alternative airport to handle the traffic growth and to create alternative for passengers. The new Modlin Airport was opened in 2012 at north suburbs, 40 km from the city centre. Although Modlin Airport is new, there are some facts already known, that allow to make simple comparison (Tab. I).

Table I – Comparison of the airports of Warsaw metropolitan area

	Chopin Airport	Modlin Airport
Distance from the city center	9 km	40 km
Travel time from the city center by car	17 min	45 min
Travel time from the city center by train	20 min	60 min
Annual passenger traffic	9,3 million	2 million (forecasted)
Airlines type	General	Low-cost

Despite the locations (one in the city, other outside of the city) the catchment areas of both airports overlap what makes potential for competition especially when it comes to Warsaw city market. Market power of each airport is a complex issue and it's difficult to assess as airport offer a differentiated products comprising of aviation and non-aviation services (Graham 2003). Having regard to this, transport users make their choices basing on perceived perception on how such airport products meet their needs and expectations.

In order to investigate the aim of this paper a stated preference method survey was conducted at both airports for international departing flights. It was done by professional face-to-face interviewers. Chopin Airport offers international and national connections and Modlin Airport offers only international ones. Therefore at Chopin Airport only passengers departing on international routes were surveyed. As both airports have limited number of flights at night, the survey was conducted in day time in the period of two weeks to include in the research all days of the week and to avoid day-of-the-week

bias. The main limitations were technical difficulties and administration procedures which didn't allow to conduct the survey at both airport in the same period of time but it was done one after another.

THE METHODOLOGY AND THE MODEL

The analysis of airport choice is necessary to understand passengers' behaviour and their future decisions. The methodology follows an approach aiming to describe the relation among the variables identified in the survey done in 2012 at F. Chopin and Modlin airports. Therefore two major issues were undertaken in the research: analysis of the passengers' distribution at two airports and formulation of a model describing the perceived influence of new airport on the range of air travel possibilities for passengers departing from Warsaw metropolitan area. To investigate this, a stated preference interview questionnaire was used among passengers of two airports: Chopin Airport and Modlin Airport. Respectively 389 and 347 successful answers were collected. Cronbach's alphas were calculated to measure reliability of the scale items for all the scales used within this study. Alphas were found to be acceptable ranging from .81 to .92 for all scales. The questions in the survey were formulated in a way that allowed to reduce the hypothetical bias. Stated preference was chosen as best method in the investigation. Hess et al. (2007) finds that influence of some factors like ticket price can be better retrieved through stated preference method. Also Loo (2008) states that under dynamic institutional and regulatory settings and changing market conditions past behavior of passengers from revealed preference data may not indicate well their future choices.

Air passenger distribution in Warsaw metropolitan area

As it was mentioned before, two airport have different characteristics when it comes to accessibility from city center and type of air carriers. Therefore it was important to investigate what are the differences in the passenger profile when it comes to such characteristics as age, gender, income and frequency of flying. The results are presented in Table II.

The results show that Modlin Airport's passenger profile is characterized by higher share of lower age (e.g. for age 18-24 it is 28,8% comparing to 20,8 at Chopin Airport), lower income (i.e. 16,3 for income <1000 PLN comparing to 12% at Chopin A.) and leisure as a prevailing purpose of a trip. Also, at Modlin Airport it can be seen, that there is much higher share of passengers who make an air travel for the first time (19%) comparing to 7,3% at Chopin Airport. It is important to understand that due to level of economic development of Poland, which is an emerging market, air travels are less popular than in developed countries. Therefore new airport with wide offer of low-cost carriers influences the air travel possibilities of substantial number of Warsaw metropolitan area residents.

Table II – Characteristics of the passengers

Characteristics		Chopin Airport	Modlin Airport
Number of respondents		389	347
Gender			
	Male	249 (64%)	202 (58,2%)
	Female	140 (36%)	145 (41,8%)
Age			
	18-24	79 (20,8%%)	98 (28,8%)
	25-39	158 (41,7%)	119 (35,0%)
	40-60	120 (31,7%)	107 (31,5%)
	>60	22 (5,8%)	16 (4,7%)
Monthly income per person in household (in PLN – Polish currency)			
	<1000	46 (12%)	55 (16,3%)
	1000-1500	129 (34%)	136 (40,4%)
	1500-2000	140 (37%)	96 (28,5%)
	>2000	65 (17%)	50 (14,8%)
Purpose of the trip			
	Leisure	109 (28,9%)	178 (52,8%)
	business	268 (71,1%)	159 (47,2%)
Frequency of air travel			
	First time	27 (7,3%)	57 (19%)
	Once in several years	89 (24,1%)	81 (27%)
	Once in a year	180 (48,8%)	117 (39%)
	Several times per year	56 (15,2%)	33 (11%)
	More often	17 (4,6%)	12 (4%)

Having regard to above characteristics, survey results allow to create a catchment area map for both airports. Due to availability of data, this has been done for all districts of Warsaw city. In the research it was assumed that there are three important factors that influence the airport choice: airport accessibility, air ticket prices and availability of certain destination. Catchment map in graphic sense somehow relates to the question of airport accessibility as a factor of airport choice.

Spatial distribution of passengers (see Fig. 1) for both airports reveals only slight difference between the areas from which passengers of both airports originate. Chopin Airport is located in the South-West part of the Warsaw city and Modlin Airport is located 40 km North of the city. In case of both airport (Fig 1a and 1b) the biggest share of passengers comes from southern districts of Warsaw which is the area inhabited by household with higher than average income. There is slight difference showing higher share of northern districts using Modlin Airport comparing to those using Chopin Airport.

a)   b)
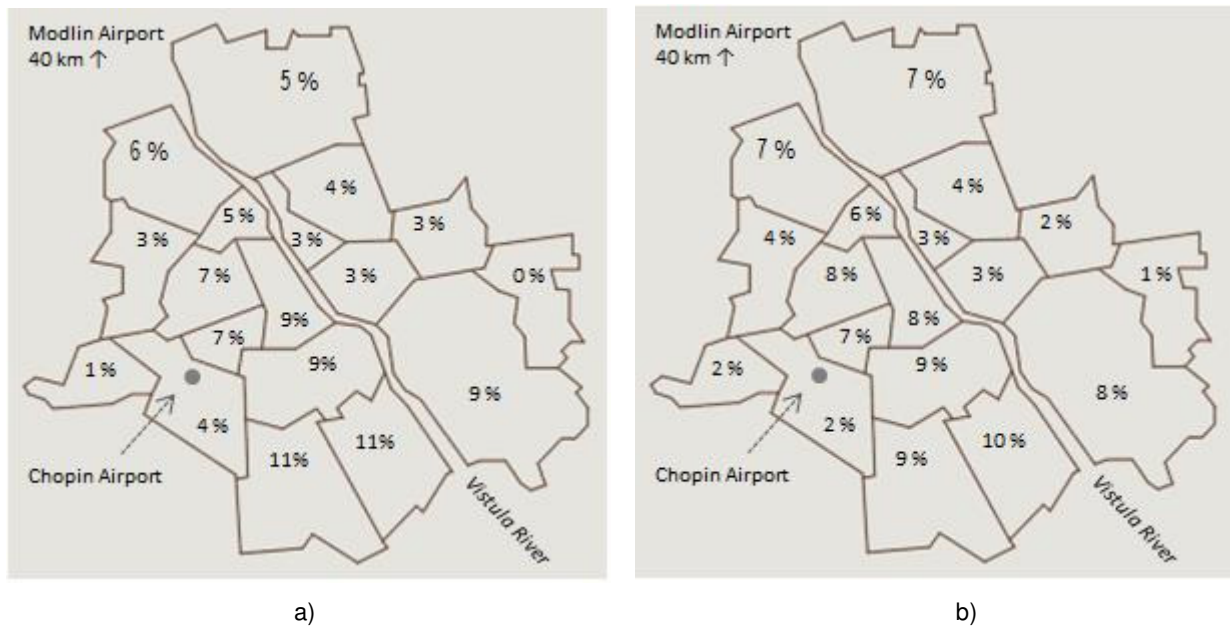
Figure 1 – Spatial distribution (by districts of Warsaw city) of passengers departing from Chopin Airport (a) and Modlin Airport (b) originating from city of Warsaw

Graphical illustration of catchment area of both airports allows to preliminarily assume, before creating a model, that airport accessibility factor has moderate impact on airport choice. That is way the model includes also other factors like difference in ticket prices and availability of desired connection.

Model of factors of airport choice

Following part consisted of stated preference question regarding the perceived relationship between opening of the new airport and perceived possibility of air travel. In the survey passengers of both airports were asked: "*does new airport influences the range of opportunities of your air travel?*" The answers could be given on a Likert-type scale in a range from 1 to 5 points, where 1 means that the range of air travel opportunities does not depend at all on opening of new airport, and where 5 means that it completely depends on new airport. Second question was: "*what is a main factor determining the choice of airport?*": a) proximity of the airport and ease of accessibility (x_1), b) ticket price (x_2), c) connection not available at the other airport (x_3). To each answer respondents could mark yes or no, what was calculated as 1 or 0 in the model. The reason to focus on these three parameters is that they cover three most important aspect of airport choice including airport characteristics, airline type and level of service.

These questions give an insight to the perceived utility of new air travel possibilities among the passengers of two airport. The model investigates how particular factors change utility of passengers who perceivably and subjectively value three analyzed

parameters. In multi-airport area consisting of two airports wider ticket prices may be available, air travels may be easier accessible, and wider range of destinations may be available. Passengers will choose the airport witch will provide higher utility level out of given alternatives. Therefore following equations can be formulated, U_{Modlin} for Modlin Airport and U_{Chopin} for Chopin Airport:

$$U_{Modlin} = \beta_{0M} + \beta_{1M} x_1 + \beta_{2M} x_2 + \beta_{3M} x_3$$
$$U_{Chopin} = \beta_{0C} + \beta_{1C} x_1 + \beta_{2C} x_2 + \beta_{3C} x_3$$

Individual utility of each alternative depends on the attributes of the alternatives with regard to personal characteristics of passenger.

Table III – Model outcome summary

Model	R	R^2	Adjusted R^2	Std. error	Constant
Chopin Airport	0,912	0,793	0,721	0,812	1,7
Modlin Airport	0,936	0,876	0,753	0,716	1,1

In the model predicted for the passengers surveyed at Chopin Airport (Tab. III), the dependent variables explain 79.3% of total changes in the range of possibilities of air travel. For passengers surveyed at Modlin Airport the model explains 87,6% of total changes. The values are high because predictors chosen in the experiment in various studies (eg. Pels et al. 2001; Hess and Polak 2005) have been found as main factors of airport choice. What the investigation was trying to find out was the strength of each predictors in the case of Warsaw metropolitan area. There are possibly other factors influencing airport choice decisions among passengers (like flight frequencies, airport services, airline characteristics, etc.) but the three applied in the model were considered as the most important for the experiment described in this paper. The predicted coefficients are presented in Table IV.

To formulate the subjective linear relationships for both airports the estimates are inserted into the regressions:

$$U_{Modlin} = 1,1 + 0,204x_1 + 0,632x_2 + 317x_3 + \varepsilon$$
$$U_{Chopin} = 1,7 + 0,175x_1 + 0,573x_2 + 344x_3 + \varepsilon$$

Two equations represent situation perceived by passengers of two airports. The predicting variables are binary, therefore the group of the respondents who didn't find any given factor to be important in extending their air travel possibilities is represented by the constant (for Modlin Airport, 1,1; for Chopin Airport, 1,7). Regression equations present the predicted change in subjective utility resulting from changes of values (from 0 to 1) of dependent variables. This represents the perceived changes in utility resulting from opening of new airport. Looking into the results it can be stated the predicted perceived changes in utility is higher (two out of three predictors have higher coefficients) for passengers from Modlin Airport. From the questionnaire (Tab. II) it can be seen that at this

airport an important share of passengers are people who make an air travel for the first time. New market conditions, presumably prices and offer on the supply side (new destinations), are strongly influencing their air travel opportunities.

Table IV – Coefficients of the model

	Unstandardized coefficients		Standardized coefficients
	β	Standard error	Beta
	Chopin Airport		
Constant	1,7	0,062	
proximity of the airport and ease of accessibility (x_1)	0,175	0,053	0,104
ticket price (x_2)	0,573	0,079	0,327
destination not available at the other airport (x_3)	0,344	0,068	0,198
	Modlin Airport		
Constant	1,1	0,060	
proximity of the airport and ease of accessibility (x_1)	0,204	0,055	0,113
ticket price (x_2)	0,632	0,081	0,432
destination not available at the other airport (x_3)	0,317	0,066	0,178

There are differences between the value of the coefficients in the two regressions but generally all values are positive and allow to formulate similar description. At both airports, for those who chose factor of better accessibility of the airport, the model predicts that the perceived utility in this group for passengers surveyed at Modlin Airport is 0,204 higher and for those at Chopin Airport 0,175 higher. The results shown for this coefficient are in line with spatial distribution of passengers of both airports showing little significance of airport location, as shown at Fig. 1. Investigation revealed the significant difference in importance of airport accessibility factor which was more important for business travellers rather than for those traveling for leisure purpose. It was in line what found Loo (2008) investigating Hong-Kong multi-airport area. Similar dependence occurred for income distribution, passengers with higher income are more influenced by accessibility factor than those with low incomes. The highest importance in the model has ticket price predictor; for passengers at Chopin Airport the value of the coefficient is 0,573 and for the Modlin Airport it is 0,632. This means that passengers served at both airport perceive that their range of possibilities of travel is wider due to lower ticket prices at new airport, although the coefficient is stronger for passengers surveyed at Modlin Airport. This may be related to the fact that at Modlin Airport there is a large share of passengers making air travel for the first time. Lowest prices of LCCs generated new effective demand which before was only potential. Finally, the third predictor - availability of destinations is slightly stronger for passengers surveyed at Chopin Airport (0,344) than at Modlin Airport (0,317)

but shows in case of all passengers positive relation between the offer of new airport and the range of air travel opportunities.

Taking all the results together it becomes clear that investigated predictors are factors of key importance to the process of airport choice. This paper was aiming at investigating exact impact of each factor what was presented separately for passengers surveyed at two airports. Most important output of the model is that at certain economic conditions of the region, like in emerging country which Poland still is, where air travel is a superior good, the most important factor of airport choice is ticket price. Contrary to that, studies done in London (Hess and Polak, 2006) show that in multi-airport area passengers chose airport basing mostly on ease of accessibility to the airports. In Poland middle-income class is not yet well developed and air travels can be afforded by smaller share of society than in developed country. Air travels are perceived to be superior goods and significant changes in prices creates significantly new demand. It is how the range of air travel possibilities growth. This research suggests that new airport generated new demand, since large proportion of passengers at Modlin Airport claim to use air transport for the first time. This might be the result of new low-cost air travel possibility from new airport.

SUMMARY AND DISCUSSION

The paper is a first attempt of investigating the airport choice behaviour at Warsaw metropolitan area and the overall results of presented investigation are generally consistent with findings at other multi-airport systems in the world. In particular, passengers' answers at both airport revealed that new airport positively influenced the range of air travel opportunities and that ticket price, availability of destinations and airport accessibility are important factors affecting passenger choice. Nevertheless, there are interesting differences determined by the specificity of local conditions. In particular, passengers were found to be putting much stress to ticket price rather to other factors in their airport choice. This means they are not so much reluctant to accept increase in access time. This is due to role which air transport has in an emerging economy which Poland still is. Air ticket prices in relation to average income are relatively high. Therefore passengers will eager to accept increase in access time rather than higher fares. Furthermore, interesting insights about passenger's behaviour have been obtained through passenger profile survey. At Modlin Airport there was significantly higher share of passengers flying for the first time. This might be related to the fact that LLCs with low ticket prices have widened the range of air travels which became affordable to new passengers who wouldn't have travelled before new airport was opened.

When it comes to catchment area of analysed airport it has been found that competition for passengers is highest for those originating not in central districts of Warsaw, but for those originating from districts with higher average income. For all airports, southern districts are the main source of passengers. These districts are among the top districts for each airport individually. Chopin Airport is key airport for business travelers and Modlin Airport is widely used by tourists.

It is important to stress that using any technique in isolation may not provide accurate results, therefore it is required to implement different conceptualizations to obtain complementary information on the choices made by passengers when it comes to air travel. Passengers distribution and factors of airport choice is a complex issue and further research is required to fully understand the problem. The analysis often require some judgment when it comes to quantitative methods, as they rely on availability and quality but also to better understand local specifics. It is especially important when comparison with other multi-airport areas are made. Important factor of bias in presented research may be fact, that survey was done several months after Modlin Airport was opened. This may incline bias resulting from the fact, that information about the offer of new airport might not yet be available to all residents of Warsaw metropolitan area. Therefore it is important to further analyze the Warsaw metropolitan airport market.

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