

Terrorist Attacks Influence on Air Transport Demand at International Airports in Europe

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Abstract

The paper deals with air transport demand in Europe. Possible events that might influence air transport demand are explored. Specifically the influence of terrorist attacks is examined because number of attacks is constantly increasing worldwide. Effects on air transport demand at international airports in London, Paris, Frankfurt, Amsterdam and Istanbul are explored in a short-time period after the terrorist attacks at international airports Zaventem in Brussels and Atatürk in Istanbul. To verify the influence of terrorist attacks on transport demand is used the one-way analysis of variance (ANOVA).

KEY WORDS: air transport demand, international airports, terrorism, ANOVA

Článek se zabývá poptávkou po letecké dopravě v Evropě. Jsou prozkoumány vybrané události, které by mohly ovlivnit poptávku po letecké dopravě. Konkrétně se zkoumá vliv teroristických útoků, jelikož se jejich počet na celém světě neustále zvyšuje. Účinky na poptávku po letecké dopravě na mezinárodních letištích v Londýně, Paříži, Frankfurtu, Amsterdamu a Istanbulu jsou zkoumány krátce po teroristických útocích na mezinárodních letištích Zaventem v Bruselu a Atatürku v Istanbulu. Pro ověření vlivu teroristických útoků na poptávku po dopravě se používá jednosměrná analýza rozptylu (ANOVA).

poptávka po letecké dopravě, mezinárodní letiště, terorismus, ANOVA

1. Introduction

Air transportation is the fastest growing type of transport and it has a significant share in the amount of transported passengers and cargo, especially over long distances. Air transportation offers its users a considerable amount of benefits, for example quick, convenient and safe way to travel or transport goods. On the other hand there are also disadvantages among which is possible to include especially its dependence on external factors.

This paper deals with terrorism as actual issue that may have significant negative effect on air transport demand and air transportation performances.

Terrorism is defined as politically motivated violence or threat of violence which is raised mainly against the civilian population with the intent to cause fear [1]. The purpose of terrorism is to induce psychological effects not only on victims of terrorist acts, but also on wider population, and especially their intimidation [2]. Number of various crisis situations and terrorist attacks is increasing with the development of tourism [3].

Terrorist attacks have emerged in recent years in many countries in the world and have a significant impact on transport demand, because people do not want to risk their lives, whether traveling to destinations that are the targets of terrorist attacks or they are afraid of traveling itself because vehicles (especially airplanes and trains) are targets for terrorist attacks as well [2].

Because of the growing activity of terrorists and terrorist groups it is important to answer the question whether is demand for air transport influenced by the terrorism or not?

In the last five years many terrorist attacks happened. In Europe were carried out seven attacks by the terrorists [4]. Four of these attacks happened in Turkey, the most actual of them was aimed directly to the Atatürk airport on June 28th, 2016 and claimed 45 dead and 240 injured people. Another two attacks happened in France, one in Paris and the other one in Nice during mass celebrations of the national holiday. These two attacks together claimed over 200 victims and more than 350 injured people. Last attack that happened in Europe was aimed at the international airport Zaventem in Brussels, Belgium on March 22th, 2016 and claimed 32 dead and 340 injured people. Based on the above sheets can be argued that terrorists select areas that are frequented by people, whether local or foreigners, who move in large numbers.

The authors of the paper will investigate whether the terrorist attacks at airports Zaventem in Brussels and Atatürk in Istanbul affected demand for air transport on the most important airports in Europe. The major international airports by number of passengers in Europe are Heathrow in London, Frankfurt in Frankfurt am Main, Charles de Gaulle in Paris, Schiphol in Amsterdam and Atatürk in Istanbul.

2. Methods and Procedures for Calculating

To verify the influence of terrorist attacks on air transport demand at international airports was used analysis of variance (ANOVA). The examined airports are Heathrow, Frankfurt, Charles de Gaulle, Schiphol and Atatürk.

Analysis of variance is used for data statistical significance testing of various factors. The analysis of variance is one-way, two-way or multi-factor, so the number of examined factors may differ [5]. The authors have used one-way analysis of variance and examined factor is influence of terrorist attacks at Zaventem airport and Atatürk airport.

Before execution of the ANOVA calculation it is necessary to clean the identified data from seasonal section. Then it is possible to make a calculation of total dispersion F , which is determined as the ratio of variance between groups and within group variance [5].

$$\begin{aligned} & \text{Between group variation} \\ S_{y,m} &= \sum_i n_i (\bar{y}_i - \bar{y})^2 = \sum_i n_i \bar{y}_i^2 - \frac{1}{n} \left(\sum_i \sum_j y_{ij} \right)^2 \end{aligned}$$

here y_{ij} - a single score for an individual j within a particular group i ; \bar{y} - the mean of the full sample; \bar{y}_i - sample mean from group i ; n_i - the number of observations in each group; n - total number of observations

$$\begin{aligned} & \text{Within group variation} \\ S_{y,v} &= \sum_i \sum_j (y_{ij} - \bar{y}_i)^2 \end{aligned}$$

This method is based on the assessment of relations between the variances of the compared samples [6]. ANOVA calculation was stated via the following formula.

Verifying the null hypothesis (H_0)

$$F = \frac{\frac{S_{y,m}}{k-1}}{\frac{S_{y,v}}{n-k}}$$

here F - Anova coefficient; $S_{y,m}$ - between group variation; $S_{y,v}$ - within group variation; k - total number of population; n - total number of observations

By use of this formula can be tested that the terrorist attacks have no impact on demand for air transport (H_0) or they have influence (H_1). The results of the test criteria F can be then recalculate by MS Excel on p -values, which determine if there is influence or not.

To execute the calculation of the relationship between the number of passengers on above mentioned airports and the terrorist attacks was necessary to obtain data about monthly traffic performances of the airports since 2012 to 2016. These data were cleaned from seasonal influences to prevent distortion of the results due to normal seasonal variations, which occur annually. The dependence was calculated 3 and 6 months after the attacks.

First, the influence of terrorist attack in Brussels on transport performances at other airports was examined [7], [8], [9], [10], [11]. The results are shown in the Table 1.

Table 1
Influence of terrorist attack in Brussels on the number of passengers at selected international airports

	Airport	ANOVA	p value	Result
3 months after attack in Brussels	Heathrow	10,14	< 0,05	significant influence
	Frankfurt	2,14	0,15	no effect
	Atatürk	1,95	0,18	no effect
	Charles de Gaulle	2,03	0,16	no effect
	Schiphol	0,71	0,40	no effect
6 months after attack in Brussels	Heathrow	8,73	< 0,05	significant influence
	Frankfurt	6,86	< 0,05	significant influence
	Atatürk	10,68	< 0,05	significant influence
	Charles de Gaulle	4,81	< 0,05	significant influence
	Schiphol	0,91	0,35	no effect

In the top of the Table 1 is shown that there is only one case of dependence in three months after the attacks. Decrease of number of transported passengers was proven only at the Heathrow airport in London.

There are much more cases of dependence six months after the attacks. Negative influence of attacks is proven in four out of five cases. Passengers were by the time probably more worried about another attack that could now be directed at them.

Second, the influence of terrorist attack at Atatürk airport on transport performances was examined [7], [8], [9], [10], [11]. The results are shown in the Table 2.

Table 2
Influence of terrorist attack in Atatürk on the number of passengers at selected international airports

	Airport	ANOVA	<i>p</i> value	Result
3 months after attack in Atatürk	Heathrow	0,41	0,52	no effect
	Frankfurt	5,27	< 0,05	significant influence
	Atatürk	15,09	< 0,05	significant influence
	Charles de Gaulle	2,85	0,10	no effect
	Schiphol	0,25	0,62	no effect
6 months after attack in Atatürk	Heathrow	2,04	0,16	no effect
	Frankfurt	7,89	< 0,05	significant influence
	Atatürk	19,88	< 0,05	significant influence
	Charles de Gaulle	2,23	0,14	no effect
	Schiphol	1,45	0,23	no effect

It is no surprise that the attack led to decrease of number of passengers at the Atatürk airport. Immediate drop in the number of passengers can be explained by the fact that the attack was aimed directly at the airport, so it was necessary to recondition and remove damages. People were also more afraid to use this airport for their journey and that is the reason why there is decrease six months after the attack as well. The decrease of transportation performances was also proven at the Frankfurt airport in both examined periods of time.

Due to a peculiar development at Schiphol airport the whole calculation process was made once again for this airport with number of passengers in years 2015-2016 [11]. This control calculation was made because the previous results could be influenced by the reduction of airport charges. The results are described in the Table 3.

Table 3
Influence of terrorist attacks in Atatürk and Brussels at Schiphol airport

	Period of time	ANOVA	<i>p</i> value	Result
After attack in Brussels	3 months	7,15	< 0,05	significant influence
	6 months	19,98	< 0,05	significant influence
After attack in Atatürk	3 months	16,97	< 0,05	significant influence
	6 months	29,76	< 0,05	significant influence

Even if there was a reduction of airport charges by almost 7 percent in April 2015 which led to a ticket prices reduction [12] the negative influence of terrorist attacks was proven in all examined cases.

3. Conclusions

Aim of the paper was to examine how terrorist attacks could affect demand for air transport. Paper introduced a series of terrorist attacks that have occurred in Europe in last five years and examined those that may have

a significant impact on air transport demand because they occurred in major European capital cities, or even at the airports.

The authors of paper have previous experience with modeling demand for air transport in relation to terrorist attacks. It is therefore interesting to compare the results obtained from the previous research with the results obtained in this paper.

It may be noted that the decrease in volume of transported passengers in this paper varies from 1,6 to 3,7 percent, which is not considered as a significant decrease.

Based on the previous research it is possible to compare these results with decline of passengers which occurred after the terrorist attack at the airport Zaventem in Brussels on March 22th 2016. The attack happened at the end of March, however, there was immediate significant decrease in number of transported passengers, in March about 28,5 percent compared to the trend and in April by 45,9 percent compared to the trend. It is obvious that the terrorist attack at the airport Zaventem had much bigger impact on demand for air transport [13].

The question is why there is such a big difference in number of transported passengers at the examined airports. This phenomenon might serve as a subject of another paper. It would be interesting to investigate travel behavior of people by some kind of questionnaire survey and uncover on what basis people decide whether to execute the journey or not in a short time period after such an emergency events.

Acknowledgements

The work was created in connection with the scientific research project of the University of Pardubice no. SGS_2017_009. The author is grateful for their support.

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