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The airline market efficiency during the corona pandemic

Name student: Tunahan Önal

Student ID number: 423859

Supervisor: Vadym Volosovych

Second assessor: n/a

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Abstract

This paper examines the market efficiency of the airline industry within Europe around the time of the travel ban, implemented by the United States (US) on March 11, 2020. In addition to this, the relationship between the cumulative abnormal returns and the exposure to the US is considered. The data sample consists of the characteristics of 14 airline groups. I apply the event study methodology and a regression analysis. The (cumulative) average abnormal returns from the event study will say something about the market efficiency and the cumulative abnormal returns obtained from the event study are being used in the regression analysis. Results showed the announcement affected the market since there were significant (cumulative) abnormal returns. Furthermore, major drops could be seen days before the event, which gradually continued afterwards. This supports the semi-strong form of EMH. Lastly, the exposure turned out to be significant on the event day, suggesting the market did react accurately.

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1. Introduction

In December 2019, a city named Wuhan in China was infected with the coronavirus Covid-19. It seems like its origin lies in bats, which then passed through another animal before infecting humans. In a short period of time the virus has spread to other parts of the world causing millions of cases. Different stock market indices dropped to a new all-time low since 1987 (BBC News, 2020). Because of fear of the virus disseminating more and faster, different countries including the United States (US) implemented a travel ban. On March 11, 2020 at 9 P.M. EDT (March 12, 1 A.M. GMT), President Donald Trump announced that the countries of the Schengen Area are forbidden to enter the US, because they had the most infections after People's Republic of China. The ban would last for 30 days (The White House, 2020b). However, the official proclamation did not contain that time limit (The White House, 2020a). The Schengen Area consists of the following countries: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and Switzerland. The travel ban applies to non-Americans who have been in the Schengen Area, which abolished their internal borders for free and unrestricted movement of people. On March 14, 2020, the President extended the travel ban to include the United Kingdom and Ireland (The White House, 2020c). On April 14, the President was asked if he wants to reopen the borders to allow travel from Europe again, and he answered with: "At the right time" (The White House, 2020d).

This is not something new as humanity has seen these kinds of crises before. For example, in the period of January 2003-March 2003 and November 2015-February 2016, the S&P 500 dropped almost 13% because of the Severe Acute Respiratory Syndrome (SARS) and Zika outbreak, respectively (Li, 2020). During Ebola's period of December 2013-Februari 2014, the index dropped 5,8%. Economists and public healthcare experts have learned that these epidemics such as the Chinese Outbreak of SARS, the H1N1 influenza, and that of Swine Flu in Mexico in 2009 have in common that the indirect costs of public risk aversion can cause far higher economic damage than the direct cost of healthcare outlays and other containment expenditures. For example, Barker and Bacon (2015) found that the risk adjusted return of stock prices of a sample, consisting of randomly selected airlines, were negatively affected around the date of the Ebola outbreak. The airlines showed minor drops 15 days prior to the event and rapid decrease five days prior to the event which persisted after the event. This reflect a semi-strong form of market efficiency.

Besides the paper of Barker and Bacon (2015), there is further not much research on market efficiency (of the airline market) and pandemics. This paper could therefore add to this field of research by studying the market reaction and market efficiency during the corona pandemic. This paper has therefore the following research question:

"To what extent is the airline market efficient?"

This paper will examine the market efficiency of European airlines to the travel ban implemented by the US on March 11, 2020 and the second announcement on April 14, 2020 by doing event studies and a regression analysis. Maloney and Mulherin (2003) did about the same with the Challenger crash in 1986. They showed that the market was to a moderately high degree efficient because the market reacted immediately and quite accurate to the news. Accurate in the sense that the price decline or loss in equity was equivalent to the lost cash flows and correctly pointed out the culprit of the crash.

Data is mainly panel data since it is a collection of observations of multiple subjects and points in time, and it is acquired from different sources. For the event studies stock (close) prices are used. These are obtained from Yahoo Finance and Investing.com. For the regression analysis, firm specific attributes and traffic statistics are retrieved from Orbis, and annual and traffic reports.

The structure of the paper will be as follows: chapter 2 discusses the existing literature on the subject and the expectations of the research, chapter 3 focuses on the data and methodology, in chapter 4 results will be presented, and in chapter 5 the conclusion of the research.

2. Theoretical framework

This chapter will explain what market efficiency implies and the needed definitions, which are used in the airline industry. Furthermore, hypotheses will be formulated using existing literature.

2.1 Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) is a hypothesis that states current prices reflect all available information and expectations, and that these prices are the best approximation of the intrinsic value of assets (Fama, 1970). This theory implies that it is impossible to get returns, which are above normal or market return except by luck. Fama (1970) suggested three forms of efficiency: the weak form, the semi-strong form, and the strong form. The weak form states that current prices reflect all historical information, and therefore it is not possible for investors to get an above normal return based on this information. If it is possible, then the market is said to be inefficient.

The semi-strong form states that prices adjust immediately to information that became publicly available (e.g. announcements of mergers and acquisitions, share repurchases, etc.). In this case, it is not possible to get expected above normal returns apart from having private information. Fama, Fisher, Jensen, and Roll (1969) found this form of efficiency to be extant in the case of stock splits, where the information concerning future dividend payments was on average fully reflected by the price at the time of the split, and that other researches have made similar findings as to information in annual earnings announcements and new issues and large block secondary issues of common stock (Ball and Brown, 1968, and Scholes, 1969). This means if an investor happens to buy stock on the date of the announcement and does not make an above normal return, the market is considered as semi-strong efficient.

The strong form states that it is impossible without exceptions to get expected above normal returns with any kind of information, regardless if it is public or private. The idea is that people with access to private information immediately act upon this, and the price therefore changes to its intrinsic value. This act is also called insider trading and is nowadays illegal and considered as a crime, so it should not occur.

2.2 The stock market on the announcement day of the travel ban

On the day of the announcement of the travel ban, the stocks of the airlines reacted differently to the announcement as shown in Table 1. The airlines with exposure to the US, that is Air France – KLM, Lufthansa Group, International AG, Scandinavian Airlines, Norwegian Airlines, Icelandair, Finnair, Aeroflot and Turkish Airlines, had 1-day returns ranging from -9,06% to -25,88%. These returns were from -2,38 to -6,96 standard deviations greater than the average from the prior three months. The airlines without exposure to the US, Ryanair, easyJet, Jet2, Wizz Air and Aegean Airlines, had on average slightly less 1-day returns ranging from -7,54% to -15,81%. These differed from -1,77 to -5,43 deviation from the preceding three months.

As for the trading volumes, the airlines without exposure to the US experienced trading volumes not greater than two standard deviations from the prior three-month average trading volume. However, several airlines with flights to the US faced trading volumes, which were around 3 standard deviations greater than the preceding three-month average.

Variable	Air France - KLM	Lufthansa Group	International AG	Scandinavian Airlines	Norwegian Airlines	Icelandair	Finnair
Daily stock returns							
March 12th, 2020	-13,58%	-15,12%	-17,22%	-9,54%	-24,92%	-25,88%	-11,82%
3-Month average	-1,15%	-0,79%	-0,51%	-0,87%	-2,20%	-0,90%	-0,54%
3-Month standard deviation	3,48%	2,93%	3,62%	3,64%	6,87%	3,59%	2,78%
Z-score	-3,57	-4,89	-4,61	-2,38	-3,31	-6,96	-4,06
Daily trading volume ('000)							
March 12th, 2020	16.933,7	34.502,2	21.657,8	7.451,0	17.158,9	31.784,9	844,4
3-Month average	5.097,7	8.737,6	12.635,2	4.178,4	4.467,9	19.699,9	379,5
3-Month standard deviation	4.190,8	6.827,5	8.300,8	3.548,9	5.134,6	14.682,5	290,8
Z-score	2,82	3,77	1,09	0,92	2,47	0,82	1,60

Variable	Aeroflot	Turkish Airlines	Ryanair	easyJet	Jet2	WizzAir	Aegean Airlines
Daily stock returns							
March 12th, 2020	-9,06%	-16,19%	-7,54%	-14,62%	-13,32%	-15,81%	-9,10%
3-Month average	-0,45%	-0,50%	-0,36%	-0,58%	-0,64%	-0,35%	-0,97%
3-Month standard deviation	2,34%	2,57%	2,74%	3,52%	3,93%	2,85%	4,59%
Z-score	-3,68	-6,09	-2,62	-3,99	-3,23	-5,43	-1,77
Daily trading volume ('000)							
March 12th, 2020	41.626,5	77.819,8	6.958,8	5.312,5	807,5	952,5	213,7
3-Month average	12.244,8	122.498,3	2.938,8	2.698,3	582,5	777,9	93,5
3-Month standard deviation	10.496,5	47.614,8	2.205,1	1.906,3	410,7	1.940,4	79,9
Z-score	2,80	-0,94	1,82	1,37	0,55	0,09	1,50

Table 1. Comparison of the stock returns and trading volumes on the day of the announcement of the travel ban and their averages from the prior three months.

2.3 Airline market during earlier epidemics

Although the SARS epidemic had a relatively short-term, but severe impact on the international airline market in 2003, and it affected especially Asian markets. While it is difficult to find out the actual impact of the virus to the industry's financial situation, the "Official Airline Guide" shows that between June 2002 and 2003, flights to China dropped by 45%, flights between Europe and Hong Kong by 36%, flights between the US/Canada and Hong Kong by 69%, and globally by 3% (Button, 2009).

Barker and Bacon (2015) examined if the market did react to the Ebola outbreak in September 2014, and if the information within the event was significant. If this was the case, the (cumulative) average abnormal returns would differ from zero, and this would mean the released information had an impact on the firm's stock price, as hypothesized. Their results supported the alternative hypotheses, meaning the risk adjusted returns of the stocks were significantly affected around and on the event date. The rapid decrease before the event date could indicate the presence of insider trading.

Based on the above-mentioned studies, it is expected that the announcement of the travel ban will have a significant negative effect on the return of the airlines on and around the event date:

$H_{1,0}$: the return of the sample of airlines is not significantly affected on the day of the announcement of the travel ban.

$H_{1,\alpha}$: the return of the sample of airlines is significantly negatively affected on the day of the announcement of the travel ban.

$H_{2,0}$: the return of the sample of airlines is not significantly affected around the day of the announcement of the travel ban.

$H_{2,\alpha}$: the return of the sample of airlines is significantly negatively affected around the day of the announcement of the travel ban.

The first hypothesis will reveal whether the market reacted immediately to the news by showing abnormal returns on the announcement day which significantly differ from zero. If they do, it means the released information was incorporated in the stock prices and the market is considered as semi-strong. If the abnormal returns on the announcement day do not significantly differ from zero, it means the market did not incorporate the information in the stock prices, and therefore not to be considered as semi-strong. Likewise, it could mean that the released information was not that important to the market to make an impact.

The second hypothesis will indicate whether there were signs of insider trading before the event and the presence of (cumulative) abnormal returns after the event. If the (cumulative) abnormal returns significantly differ from zero prior to the announcement, it implies investors did the act of insider trading and therefore the market is not considered to be of the strong-form. As to the presence of (cumulative) abnormal returns following the event day, it implies investors who happen to buy the stock on the announcement day could generate abnormal returns. In this case, the market is not considered to be of the semi-strong form.

2.4 Effects of the terroristic attacks on September 11th

In the morning of September 11th, 2001, known as 9/11, a series of terrorist attack took place in the US. Osama bin Laden and his terrorist organization Al-Qaida were responsible for almost 3000 unfortunate deaths that day. These attacks drove the US airline industry into financial crisis, after the recession that began in the first quarter of 2001. The air travel dropped 20% over the period of September until December 2001 compared to the same period the year before, and the question that rose as a result of this event was whether the damaging impact of these strikes was temporary or permanent (Blunk et al., 2006). Their findings suggest that the impact of the event have had a permanent effect since the domestic air travel did not get back to the level where it would have been if the attack did not happen, and it will persist this way until enhanced airport security measures do not necessitate earlier passenger arrival times than existed prior to the attacks.

In accordance with the findings of Blunk et al. (2006), it is likely that the market's reaction to the first announcement of the travel ban was of a magnitude that it anticipated for the long-term, meaning the second announcement will not significantly affect the return of the stock prices. Therefore, the followings hypotheses are used:

$H_{3,0}$: the return of the sample of airlines is not significantly affected on the day of the second announcement.

$H_{3,\alpha}$: the return of the sample of airlines is significantly negatively affected on the day of the second announcement.

$H_{4,0}$: the return of the sample of airlines is not significantly affected around the day of the second announcement.

$H_{4,\alpha}$: the return of the sample of airlines is significantly negatively affected around the day of the second announcement.

The third and fourth hypotheses will reveal whether the market's reaction to the first announcement of the travel ban was of a magnitude that it anticipated for the long-term. If the market reacted immediately to the news by showing abnormal returns on the second announcement day and cumulative abnormal returns prior and following the event which significantly differ from zero, it means the released information was incorporated in the stock prices and the market possibly anticipated for the short-term during the first announcement day. If the (cumulative) abnormal returns preceding, on and following the second announcement day do not significantly differ from zero, it means the market did not incorporate any information in the stock prices. This could indicate that the market's reaction to the first announcement of the travel ban was of a magnitude that it anticipated for the long-term.

2.5 Performance measures in the airline industry

This paper will contain several terms or metrics, which are used in the airline industry. The first one is Revenue Passenger Kilometers (RPK), which represents the number of kilometers traveled by paying passengers and is calculated as the product of revenue passengers and the traveled distance. For example, consider an airline which operates one aircraft in which can fit two hundred people, but the number of revenue passengers is only 190 passengers for a flight from Amsterdam to Paris, which is about 450 km. The product, in other words the result of multiplying these two numbers, is 85.500 RPK.

The second term is Available Seat Kilometers (ASK), which refers to the total passenger capacity of an airline in kilometers. It is the product of the number of available seats and the traveled distance. If we consider the prior example, the ASK will therefore be 90.000 kilometers. The RPK is often compared to the ASK. The ratio of these two represents the load factor and indicates how efficient the airplane's capacity is used.

2.6 Routes and exposures

For this study, only listed airlines are used in order to be able to do the event studies. For the exposure to the US the most recent annual or traffic reports (2019) are used as these give the most correct numbers. For the destinations, Flightconnections (n.d.) is used.

2.6.1 Air France – KLM

With its base in Paris Air France flies to Atlanta, Boston, Chicago, Dallas (from 2019), Detroit, Houston, Los Angeles, Miami, Minneapolis, New York, San Diego, San Francisco, Seattle, and Washington. In 2019 Air France had a RPK and ASK of 38,6 billion and 43,2 billion, respectively, for the region North America. This represents respectively 25,0% and 24,4% of their total.

With its base in Amsterdam – Schiphol, KLM flies to Atlanta, Boston, Chicago, Houston, Las Vegas, Los Angeles, Miami, Minneapolis, New York, Salt Lake City, San Francisco, and Washington. RPK (% of total) to North America in 2018 and 2019 were 23,7 billion (21,6%) and 23,0 billion (21,4%), respectively. The ASK showed the same numbers (KLM, 2020).

As a whole, Air France – KLM has a RPK and an ASK of around the 23% for North America (Air France-KLM, 2020). These numbers are not very different for the months March and April, namely around 21% and 23% (Air France-KLM, 2019a, 2019b).

Air France, KLM and Delta Air Lines are cooperating more than ten years now. Together they have a network of seven hubs of which five in the US and two in Europe. Their cooperation covers Canada, the US, Mexico, and Europe (Air France-KLM, 2020).

On March 4, the two airlines announced their first code share agreement with airline Virgin Atlantic. Code sharing is an agreement between two or more airlines to offer seats under their own flight number in another one's flight. This act allows airlines to generate more revenues, to be more efficient (load factor), and reduces the competition on that flight. This agreement meant additional flights, which were not available before, with 24 new routes between the United Kingdom (UK) and North America on flights via London-Heathrow and Manchester, and more options between Paris and New York via Manchester (Air France-KLM, 2020).

2.6.2 The Lufthansa Group

The Lufthansa Group is the leading airline group of Europe, which is composed of the segments Network Airlines, Eurowings and Aviation Services. The Network Airlines segment is made up of Lufthansa German Airlines, SWISS and Austrian Airlines. Their international hubs are based in Frankfurt, Munich, Zurich, and Vienna. In 2019, the percentages RPK and ASK for the region of the continent America were respectively 38,9% and 37,6% of total traffic (Lufthansa Group, 2020). For the months March and April, RPK was 37,8% and 37,5% and ASK 36,1% and 36,3%, respectively (Lufthansa Group, 2019).

Lufthansa German Airlines (Frankfurt and Munich) flies to the destinations Atlanta, Austin, Boston, Charlotte, Chicago, Dallas, Denver, Detroit, Houston, Los Angeles, Miami, Newark, New York, Orlando, Philadelphia, San Diego, San Francisco, Seattle, Tampa, and Washington. In 2019, the airline had a share of almost 70% of total traffic.

Austrian Airlines, with its base in Vienna flies to Chicago, Los Angeles, Miami, Newark, New York, and Washington. The airline had a share of about 10% of total traffic.

SWISS has Boston, Chicago, Los Angeles, Miami, Newark, New York, San Francisco as US destinations. Edelweiss Air is a subsidiary of SWISS. Together, they represented about 20% of total traffic.

The Eurowings segment is about the operations of Eurowings and Brussels Airlines (Annual Report, 2019). Brussels Airlines is the flag carrier of Belgium with its base in Brussels. The airline has only two destinations in the US, namely New York and Washington. RPK and ASK for the long-haul flights represented respectively 34,4% and 34,1% of total traffic in 2019 (Lufthansa Group, 2020). In March and April 2019, RPK was 40,6% and 36,6% and ASK was 39,6% and 36,2% (Lufthansa, 2019).

2.6.3 International Airlines Group

The International Airlines Group (IAG) is composed of the leading airlines Aer Lingus in Ireland, British Airways in the UK, and Iberia, LEVEL and Vueling in Spain. While the first four are doing short- and long-haul operations, Vueling does only short-haul by focusing on Europe. Together, they have a fleet of 598 aircraft. Both in March and in April in the past two years the share of North American traffic of the Group was around 29% (IAG, 2019a, 2019b), which also applies for the full year (IAG, 2020).

Aer Lingus with its hub in Dublin, Ireland has a fleet of 57 aircraft. In terms of traffic, Aer Lingus has a share of about 10% of the group total. The airline is connected to the US via Boston, Chicago, Hartford, Los Angeles, Miami, Minneapolis, New York, Newark, Orlando, Philadelphia, San Francisco, Seattle, and Washington (IAG, 2020).

British Airways with its base in London, UK has a fleet of 302 aircraft. The airline makes up almost 60% of the group's total traffic. Their network with the US is enormous as the airline's destination are: Atlanta, Austin, Baltimore, Boston, California, Charleston, Chicago, Dallas, Denver, Florida, Houston, Las Vegas, Los Angeles, Miami, Nashville, New York, New Orleans, Orlando, Philadelphia, Phoenix, Pittsburgh, Portland, San Diego, San Francisco, San Jose, Seattle, Tampa, Texas and Washington (IAG, 2020).

Iberia with its base in Madrid, Spain has a fleet of 107 aircraft. The airline makes up about 20% of the group's total traffic. Iberia flies to Boston, Chicago, Los Angeles, Miami, and New York.

LEVEL with its long-haul bases in Paris and Barcelona has a fleet of 13 aircraft, of which seven are meant for the long-haul. In 2019, LEVEL extended their route network by adding the Barcelona-New York and Paris-Las Vegas routes to their long-haul flights. The airline is therefore now connected to the US via Boston, Newark, New York, San Francisco (IAG, 2020). However, due to unknown reasons the Paris-Las Vegas and Paris-Boston routes are halted from January (Bewicke, 2020).

2.6.4 Scandinavian Airlines System

The Scandinavian Airlines System (SAS) is the flag carrier of Denmark, Norway, and Sweden. The SAS flies from their bases in Copenhagen, Oslo, and Stockholm to the US. Their destinations in the US are Boston, Chicago, Los Angeles, Miami, Newark, San Francisco, and Washington D.C.. Intercontinental traffic made up about 25% of their total passenger traffic in 2019 (SAS, 2020).

2.6.5 Norwegian Air Shuttle ASA

The Norwegian Group is made up of the parent company Norwegian Air Shuttle ASA (NAS) with its base in Fornebu, outside Oslo, Norway, and its fully owned subsidiaries Norwegian Air International Ltd. (NAI), Norwegian Air UK Ltd. (NUK), Norwegian Air Norway AS (NAN), Norway and Norwegian Air Sweden AB (NSE).

NAI is based at the Dublin Airport, Ireland and operates routes within Europe. At the end of 2019, the airline was operating 44 Boeing 737-800 aircraft. NUK with its base near London Gatwick, UK, operates routes between the UK, USA, and South America. At the end of 2019, the airline was operating 13 Boeing 787 Dreamliners and had operated all Norwegian long-haul routes from London Gatwick. NSE, the Swedish subsidiary with its base in Stockholm, operates routes in Europe and between Europe and the USA. At the end of 2019, NSE was operating 27 Boeing 7373-800 aircraft, 6 Boeing 737 MAX aircraft (all grounded) and 3 Boeing 787-9 Dreamliners (Norwegian Shuttle Air ASA, 2020). The US destinations are Austin, Boston, Chicago, Denver, Fort Lauderdale, Los Angeles, New York, Orlando, and San Francisco.

2.6.6 Icelandair

With its hub in Iceland, Icelandair connects 19 cities in North America with 24 in Europe. The destinations in the US are Anchorage, Boston, Chicago, Denver, Minneapolis, Newark, New York, Orlando, Philadelphia, Portland, Seattle, and Washington. In 2019, international traffic made up about 99% of the total – international, regional and Greenland excl. charter flights. The percentage of passengers who traveled between North America and Europe was 43% (Icelandair, 2019).

2.6.7 Finnair

With its hub in Helsinki, Finnair flies to the US destinations: Boston, Chicago, Dallas, Las Vegas, Los Angeles, Miami, New York and San Diego and Seattle. These routes are operated solely or together with partner airlines. In March 2019, the share of North American traffic was about 6% and in April 2019, it was about 10%, which also applies to the full year 2019. The North American share of total passenger revenue was 7,2% in 2019 (Finnair, 2019).

2.6.8 Aeroflot Group

The group is made up of four airlines: Aeroflot, Rossiya, Pobeda and Aurora. Aeroflot represents 64% of the Group's passenger traffic, Rossiya 20%, Pobeda 13% and Aurora 3% (Annual report, 2018 – 2019 is missing). Aeroflot is the only airline of the four which goes to the US and its destinations are Los Angeles, Miami, New York, and Washington. The passenger revenues for the Americas in 2018 and 2019 were respectively RUB 29,7 billion and RUB 29,6 billion, representing respectively 6,0% and 5,3% of the total. Americas' RPK was 8,7 billion and its ASK was 10,7 billion, resulting a load factor of 81,3%. These represented 6,7% of their total (Aeroflot, 2020).

2.6.9 Turkish Airlines

With its hubs in Ankara and Istanbul, Turkish Airlines' destinations in the US are Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Miami, San Francisco, and Washington (Flight Network – Website). In 2019, RPK and ASK for North America were 14,4% and 13,1% of the total traffic in 2019 (Turkish Airlines, 2020).

Because of the different exposures to the US, some airlines will be more affected than others, and this is also visible in Table 2, which illustrates the returns of the airline stocks at the end of the announcement day with their corresponding exposures to the US. Therefore, the following hypothesis:

$H_{5,0}$: the return of the sample of airlines is not significantly affected by the exposure to the US.

$H_{5,\alpha}$: the return of the sample of airlines is significantly negatively affected by the exposure to the US.

This hypothesis will be tested with a regression analysis in which the exposures will have to explain the cumulative abnormal returns, obtained from the event studies. If the exposure turns out to be affecting the returns, it means the stock market reacted accurately to the announcements. In order to be as accurate as possible for the results, other variables will be added to the model as well to serve as control variables.

Otherwise, they could affect the relationship (outcome) of the exposure and the returns. To increase the amount of observations, airlines without exposure to the US are added (Appendix A).

Group	Exposure	Return on event day
Ryanair	0,0%	-7,54%
easyJet	0,0%	-14,62%
Jet2	0,0%	-13,32%
WizzAir	0,0%	-15,81%
Aegean Airlines	0,0%	-9,10%
Aeroflot	6,7%	-9,06%
Finnair	7,2%	-11,82%
Turkish Airlines	14,4%	-16,19%
Air France - KLM	23,6%	-13,58%
Scandinavian Airlines	25,4%	-9,54%
International AG	29,2%	-17,22%
Lufthansa Group	38,9%	-15,12%
Icelandair	43,0%	-25,88%
Norwegian Airlines	n.a.	-24,92%

Table 2. The exposure to the US with its corresponding return at the end of the event day per airline group.

3. Data and Methodology

3.1 Methodology

3.1.1 Event study

For a long time, event studies have been in use to assess the impact of a particular (unexpected) event on a firm's stock price, and have that way become the standard method to measure the stock price reaction to a particular event (Binder, 1998). The event study methodology has numerous applications among which mergers and acquisitions, share repurchases, and legal purposes. The rationale behind this methodology is that the effects of an occurred event will immediately be incorporated in the stock price, because of (investor) rationality (MacKinlay, 1997). McWilliams & Siegel (1997) state that the standard approach is based on estimating a market model for each firm and subsequently calculating the abnormal returns. It is assumed that these abnormal returns reflect the stock market's reaction to new information that has become available to the market. The rate of return on the stock price of firm i on day t in this method is:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$$

where

$R_{i,t}$ is the rate of return on the stock price of firm i on day t (see section 3.2 for further explanation)

α_i is the intercept term

β_i is the systematic risk of stock i

$R_{m,t}$ is the rate of return of the market or reference index on day t.

and

$\varepsilon_{i,t}$ is the error term, with $E(\varepsilon_{i,t}) = 0$.

By estimating the above equation, estimations of the daily abnormal returns (AR) can be derived for the ith firm using:

$$AR_{i,t} = R_{i,t} - (a_i + b_i R_{m,t})$$

where a_i and b_i are the ordinary least squares (OLS) parameter estimators, obtained from the regression of $R_{i,t}$ on $R_{m,t}$ over an estimation period (T) preceding the event. Different studies have investigated the sensitivity of results to varying estimation periods and suggest that results are not sensitive to this. The length of this period, also known as the estimation window, does not matter as long as the window length exceeds 100 days (Armitage, 1995). These abnormal returns can be cumulated over the number of days (k) of the event window. Event windows can vary in their length between 1 and 11 days with the event day as its center (Holler, 2014). This way the cumulative abnormal returns are obtained, which will be used in the regression analysis.

$$CAR_{i,t}(t_0, t) = \sum_{j=t_0}^{k} AR_{i,t}$$

where

$CAR_{i,t}$ is the cumulative abnormal return of stock i on day t

t_0 is the first day of the event window.

Once the abnormal returns are derived, the average abnormal return for each day can be calculated by taking the sum of abnormal returns of the airlines and dividing it by the number of airlines N. By taking the average, idiosyncrasies are eliminated.

$$AAR_t = \frac{1}{N} \sum_{j=1}^{N} AR_{i,t}$$

At last, the cumulative average abnormal returns are calculated by summing the average abnormal returns over time period (t_0, t):

$$CAAR = \sum_{j=t_0}^{t} AAR_t$$

3.1.2 Regression analysis

The following model will be used in the regression analysis:

$$CAR_{i,t} = \beta_{1,i} Exposure_i + \beta_{2,i} Second_i + \beta_{3,i} Exposure_i * Second_i + \beta_{4,i} \ln(assets_i)$$

$$+\beta_{5,i} Solvency_i + \beta_{6,i} ROE_i$$

- The cumulative abnormal return of the airline group stock prices is the dependent variable and consists of the values over the period of the event window $[0, +2]$ of both event days.
- The exposure of the airline groups to the US is the independent variable and comprises the values of the year 2019.
- The dummy variable $Second$ is made up of 0 or 1, with 0 for the cumulative abnormal returns on the first announcement day and 1 for the second the announcement day. This will control for the day of the announcement.

- The third independent variable is the interaction of the exposure and the above-mentioned dummy variable. This will show whether the exposure affected the returns differently on the second event day and therefore the accuracy of the market's reaction on that day.
- The fourth independent variable is the firm size, measured in the natural logarithm of the assets. This variable will control for the fact that external investors are better informed about large firms than small firms. Therefore, firm size positively affects shareholder wealth (Rajan and Zingales, 1995).
- There will also be controlled for solvency since it could have a significant impact on the returns (Zalewska & Nehrebecka, 2020).
- Lastly, ROE could have a significant impact on the returns according to the study of Hatem (2015). While it would be expected from ROE to have a positive effect on the abnormal return, it actually affected the abnormal returns negatively in his study.

Table 3 shows the summary statistics of the data. The means of the cumulative abnormal returns are just around 3,5%. However, the variances are very large since the minimums are around 50,0% and the maximums around 13,5%. The average exposure is 14,6%, with a minimum of 0,0% and a maximum of 43,0%. Because of the large numbers and large variance, the firm size was comprised as the natural logarithm of the assets, and it has a mean of 16 (e^{16} US dollar). Solvency and ROE have a mean of 21,3% and 62,6%, respectively.

Variable	Obs.	Mean	Std. Dev.	Min	Max
CAR[0]	28	-.0401242	.1188538	-.5612158	.1253335
CAR[0,+1]	28	-.027549	.1040539	-.4666916	.1281864
CAR[0,+2]	28	-.0420369	.1387944	-.434701	.1470812
exposure	26	.1463077	.1540765	0	.43
second	28	.5	.5091751	0	1
expsec	28	.0679286	.1284987	0	.43
assets	28	15.99375	1.155445	14.21964	17.68511
solvency	28	21.33357	10.54482	.21	36.57
roe	28	62.64571	183.2915	-40.91	707.85

Table 3. Summary statistics

Table 4 shows the correlation matrix of the data. The exposure has one of the highest correlations with the cumulative abnormal returns on the event day. Correlation becomes drastic low afterwards. Assets and ROE seem to have a very low correlation for every cumulative abnormal return. However, solvency shows some correlation after the event day.

	CAR[0]	CAR[0,+1]	CAR[0,+2]	exposure	second	expsec	assets	solvency	roe
CAR[0]	10.000								
CAR[0,+1]	0.7297	10.000							
CAR[0,+2]	0.5523	0.7075	10.000						
exposure	-0.3160	-0.0339	0.0860	10.000					
second	0.4296	0.1254	0.2309	0.0000	10.000				
expsec	0.1731	0.1132	0.1725	0.5834	0.5650	10.000			
assets	-0.0663	-0.1007	0.0642	0.2632	0.0000	0.1535	10.000		
solvency	-0.0857	-0.2238	-0.3308	-0.1924	0.0000	-0.1122	-0.2366	10.000	
roe	-0.0265	-0.0672	0.0543	-0.1838	0.0000	-0.1072	0.1399	-0.6801	10.000

Table 4. Correlation matrix

3.2 Data

The purpose of this study is to evaluate the market efficiency by doing event studies, and to determine if there is a relation between the CAR's and the exposure of the airlines to the US by doing a regression analysis. For the event studies, there has been made use of historical data on daily stock (close) prices and volumes of the stocks in their most traded market (Appendix A) from March 1, 2019 till April 21, 2020. These are obtained from Yahoo Finance, except for Aegean Airlines. In their case Investing.com was used because it was not available on Yahoo Finance. The index STOXX Europe Total Market Airlines served as the reference index since it reflects the business environment of the airlines and was also obtained from Investing.com. The daily stock prices are then used to calculate the daily returns by taking the natural logarithm of the quotient of two consecutive days and multiplying it with 100 percent:

$$R_t = \ln{(P_t/P_{t-1})} * 100\%$$

where

R_t is the rate of return on day t

P_t is the stock price on day t

and

P_{t-1} is the stock price on day $t-1$.

For the regression analysis, cumulative abnormal returns of the 11 days event-centered windows are used as the dependent variable. These are retrieved from the event study. The exposure to the US is the independent variable and is acquired from annual reports and traffic reports. The exposure is mainly in the form of the percentage RPK to the US of total RPK in 2019, because most airlines only distribute their traffic results. For Norwegian Airlines, both were missing. Firm size (assets), solvency, and return on equity (ROE) served as control variables. These date from March or December 2019, depending on the airline's start of the year, and are obtained from Orbis.

4. Results

4.1 The first event

The first hypothesis stated that the return of the sample of airlines would be significantly negatively affected on the announcement day of the travel ban. The second hypothesis stated that the return of the sample of airlines would be significantly negatively affected around the announcement day of the travel ban. To test this, an event study has been done to obtain the (cumulative) abnormal returns and (cumulative) average abnormal returns. In order to be able to say the return of the sample of airlines is significantly negatively affected on and around the event day, the average abnormal returns need to differ from 0. Table 5 shows the average abnormal returns with underneath their corresponding t-values over three different window lengths, and as it can be seen the return on the event day ($t = 0$) differs significantly from 0, supporting the alternative hypothesis. This means that the announcement had a significant effect on the returns of the airline stock prices. However, the average abnormal return on the days around the announcement day did not significantly differ from 0, supporting the null hypothesis.

Event window	-5	-4	-3	-2	-1	0	1	2	3	4	5
Abnormal return (%)				-0,52	-0,53	-4,80	2,79	-3,34			
P-value				0,35	0,35	0,02	0,06	0,23			
t-statistic				-0,45	-0,46	-2,71	2,04	-1,02			
Abnormal return (%)	-2,06	-3,12	-3,31	-0,53	-0,61	-4,99	2,80	-3,59	-0,16	1,01	-0,44
P-value	0,05	0,12	0,08	0,35	0,34	0,02	0,06	0,21	0,39	0,37	0,38
t-statistic	-2,07	-1,53	-1,85	-0,45	-0,52	-2,78	2,04	-1,11	-0,06	0,31	-0,20

Table 5. The P-values with their corresponding t-values of average abnormal returns over different window lengths.

In addition to this, if the cumulative average abnormal returns are considered, it is apparent that based on the event windows $[0, +2]$ and $[0, +5]$ in Table 4 there is no case of significant abnormal returns after the event day. This indicates the semi-strong form of market efficiency since it means that investors could not generate significant abnormal returns if they would buy the stock on the event day. Figure 1 shows major drops before the event day and Table 6 shows the drops are significant from the third day before the event day ($t = -3$). This could indicate the presence of insider trading, rejecting the strong form of market efficiency. The slight increase on $t = 1$ could indicate that the market was recovering from an overreaction on the event day, which then again returned to its initial value of around -15% on $t = 2$ after the President extended the travel ban to include the United Kingdom and Ireland.

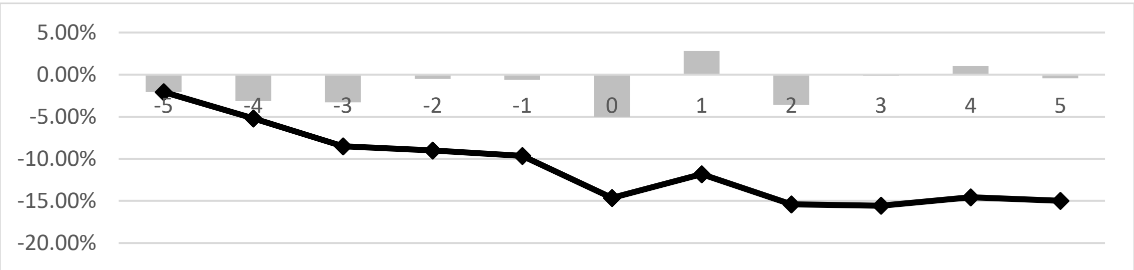

Figure 1. CAAR's (line) and AAR's (bars) over event period.

Event window	-5	-4	-3	-2	-1	0	1	2	3	4	5
Abnormal return (%)						-4,77	-1,99	-5,28			
P-value						0,02	0,20	0,18			
t-statistic						-2,68	-1,13	-1,23			
Abnormal return (%)				-0,52	-1,05	-5,85	-3,07	-6,41			
P-value				0,35	0,28	0,04	0,20	0,15			
t-statistic				-0,45	-0,80	-2,25	-1,15	-1,38			
Abnormal return (%)						-7,37	-4,91	-6,94	-7,98	-2,41	-1,32
P-value						0,02	0,15	0,15	0,21	0,36	0,38
t-statistic						-2,61	-1,39	-1,37	-1,10	-0,37	-0,19
Abnormal return (%)	-2,06	-5,19	-8,50	-9,02	-9,64	-14,63	-11,83	-15,41	-15,57	-14,56	-14,99
P-value	0,05	0,06	0,04	0,02	0,03	0,01	0,02	0,02	0,03	0,06	0,09
t-statistic	-2,07	-2,01	-2,27	-2,60	-2,36	-2,81	-2,60	-2,66	-2,40	-2,01	-1,77

Table 6. The P-values with their corresponding t-values of cumulative average abnormal returns over different window lengths.

4.2 The second event

The third hypothesis stated that the return of the sample of airlines is significantly negatively affected on the day of the second announcement. The fourth hypothesis stated that the return of the sample of airlines is significantly negatively affected around the day of the second announcement. The results as in table 7 show no sign of cases in which the average abnormal return differ from 0, on and around the second announcement day. These outcomes support the null hypotheses, suggesting that any in this period revealed information did not affect the return of the sample of airlines. This could confirm the findings of Blunk et al. (2006), meaning the market's reaction was for the long-term.

Event window	-5	-4	-3	-2	-1	0	1	2	3	4	5
Abnormal return (%)				-0,24	1,53	-3,26	-0,28	0,40			
P-value				0,37	0,06	0,29	0,37	0,34			
t-statistic				-0,28	2,04	-0,78	-0,29	0,54			
Abnormal return (%)	0,08	-2,26	0,79	-0,26	1,52	-3,23	-0,20	0,40	-1,02	0,88	1,26
P-value	0,39	0,07	0,29	0,37	0,06	0,29	0,38	0,34	0,23	0,18	0,20
t-statistic	0,13	-1,87	0,74	-0,30	2,02	-0,77	-0,20	0,54	-1,01	1,24	1,16

Table 7. The P-values with their corresponding t-values of average abnormal returns over different window lengths.

In addition to this, the cumulative abnormal returns do not show major drops either (Figure 2). As regards to the significance of these returns, none of the event windows show significant returns (Table 8). This means there is no indication of insider trading, or investors who generated abnormal returns after the event day.

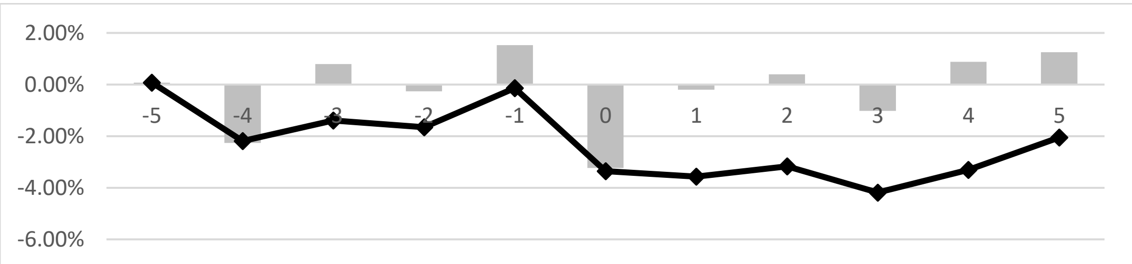

Figure 2. CAAR's (line) and AAR's (bars) over event period.

Event window	-5	-4	-3	-2	-1	0	1	2	3	4	5
Abnormal return (%)						-3,26	-3,52	-3,13			
P-value						0,29	0,24	0,23			
t-statistic						-0,77	-0,98	-0,99			
Abnormal return (%)				-0,24	1,29	-1,97	-2,25	-1,86			
P-value				0,37	0,26	0,36	0,33	0,34			
t-statistic				-0,28	0,89	-0,40	-0,55	-0,49			
Abnormal return (%)						-3,23	-3,43	-3,03	-4,05	-3,17	-1,91
P-value						0,29	0,24	0,24	0,13	0,21	0,30
t-statistic						-0,77	-0,96	-0,97	-1,47	-1,11	-0,73
Abnormal return (%)	0,08	-2,18	-1,39	-1,65	-0,13	-3,36	-3,56	-3,17	-4,18	-3,31	-2,05
P-value	0,39	0,14	0,28	0,30	0,39	0,33	0,31	0,31	0,26	0,30	0,35
t-statistic	0,13	-1,45	-0,78	-0,69	-0,05	-0,56	-0,69	-0,66	-0,89	-0,72	-0,46

Table 8. The P-values with their corresponding t-values of cumulative average abnormal returns over different window lengths.

4.3 Regression analysis

The fifth hypothesis stated that the return of the sample of the airlines is significantly negatively affected by the exposure to the US. Regressions 1 and 2 (Tables 9 and 10) show the relation between $CAR[0]$, containing the cumulative abnormal returns of both events, as the dependent variable and the independent variables. Exposure turned out to be significant with a negative coefficient. The dummy variable 'second' (0 or 1) turned also to be significant accompanied by a positive coefficient, implying a recovery in returns over time. However, the dummy became insignificant when the interaction of exposure and second is added to the regression. This means a higher exposure to the US results a higher negative cumulative abnormal return. Solvency turned out to be significant at 10% with negative coefficients, both times. ROE was just above 0.10. This could indicate that an airline firm which is more solvent and profitable will experience higher negative cumulative abnormal returns. Assets turned out to be heavily insignificant, suggesting firm size does not affect the returns.

CAR[0]	**Coefficient**	**SE**	**t**	**P**	**[95% Conf.**	**Interval]**
exposure	-.194065	.0799147	-2.43	0.025	-.3607642	-.0273659
second	.0510168	.0206896	2.47	0.023	.007859	.0941745
assets	.0006174	.0093203	0.07	0.948	-.0188245	.0200592
solvency	-.0029645	.0016352	-1.81	0.085	-.0063755	.0004464
roe	-.0001437	.0000854	-1.68	0.108	-.0003218	.0000344
intercept	.0527539	.1566479	0.34	0.740	-.2740079	.3795156

Table 9. Regression 1

CAR[0]	**Coefficient**	**SE**	**t**	**P**	**[95% Conf.**	**Interval]**
exposure	-.2713309	.1044757	-2.60	0.018	-.4900011	-.0526607
second	.0284076	.0285927	0.99	0.333	-.0314376	.0882528
expsec	.1545318	.1359517	1.14	0.270	-.1300184	.4390819
assets	.0006174	.009253	0.07	0.948	-.0187494	.0199842
solvency	-.0029645	.0016234	-1.83	0.084	-.0063623	.0004333
roe	-.0001437	.0000848	-1.70	0.106	-.0003211	.0000337
intercept	.0640584	.1558343	0.41	0.686	-.2621066	.3902235

Table 10. Regression 2

In Regression 3 (Table 9), the dependent variable was $CAR[0,+1]$, containing the values of both events of the event window $[0,+1]$. Exposure turned out to be insignificant, but the AVPLOT command in Figure 3 however shows some downward trend. The dummy and interaction were both insignificant. This means that the exposure to the US had probably no role in de cumulative abnormal returns the day after the announcement day. Solvency turned out to be significant at 5% and ROE at 10%, again with negative coefficients. The assets variable was also insignificant again.

CAR[0,+1]	Coefficient	SE	t	P	[95% Conf.	Interval]
exposure	-.1316304	.1201301	-1.10	0.287	-.3830656	.1198047
second	.0026224	.032877	0.08	0.937	-.0661899	.0714346
expsec	.0828952	.1563223	0.53	0.602	-.2442912	.4100816
assets	-.0060687	.0106395	-0.57	0.575	-.0283373	.0162
solvency	-.0040895	.0018666	-2.19	0.041	-.0079964	-.0001825
roe	-.000175	.0000975	-1.80	0.088	-.000379	.000029
intercept	.2042599	.1791841	1.14	0.268	-.1707769	.5792966

Table 11. Regression 3

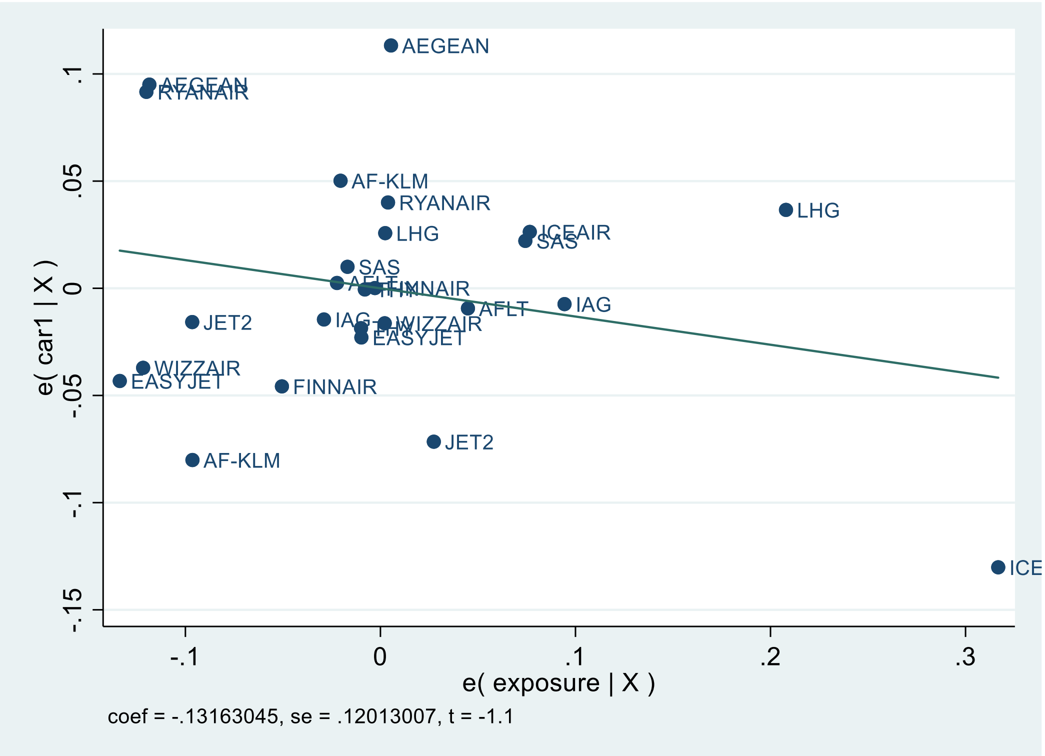

Figure 3. AV Plot 1

In Regression 4 (Table 12), the dependent variable was $CAR[0,+2]$, again consisting of the values of both events. Exposure turned out to be insignificant, once again. Solvency was again significant at 10%. However, in this regression (Regression 4), Jet2 seemed like an outlier. Hence, another regression (Table 13) was done without the airline. All variables, including solvency, resulted insignificant.

CAR[0,+2]	Coefficient	SE	t	P	[95% Conf.	Interval]
exposure	-.0678154	.2463705	-0.28	0.786	-.5834749	.4478441
second	.0586304	.0674262	0.87	0.395	-.0824943	.199755
expsec	-.0222654	.320596	-0.07	0.945	-.6932805	.6487497
assets	-.0000282	.0218201	-0.00	0.999	-.0456982	.0456418
solvency	-.007534	.0038282	-1.97	0.064	-.0155466	.0004786
roe	-.0002444	.0001999	-1.22	0.236	-.0006628	.0001739
intercept	.1408873	.3674825	0.38	0.706	-.6282624	.910037

Table 12. Regression 4

CAR[0,+2]	Coefficient	SE	t	P	[95% Conf.	Interval]
exposure	-.2164921	.2062179	-1.05	0.308	-.6515737	.2185895
second	.0042917	.0596979	0.07	0.944	-.1216599	.1302433
expsec	.1574707	.2727141	0.58	0.571	-.4179057	.7328472
assets	.0087939	.018186	0.48	0.635	-.0295752	.047163
solvency	-.0038536	.003473	-1.11	0.283	-.011181	.0034739
roe	-.0001575	.0001671	-0.94	0.359	-.0005101	.000195
intercept	-.037257	.3119748	-0.12	0.906	-.6954663	.6209523

Table 13. Regression 5 (Regression 4 without Jet2)

In short, the exposure to the US seemed only significant for the cumulative abnormal returns on the event day of the first announcement. This significance came with a negative coefficient, meaning airlines with more exposure to the US had higher negative cumulative abnormal returns. Solvency and ROE showed also a certain significance accompanied with a negative coefficient, meaning airlines which are more solvent and profitable experienced higher negative cumulative abnormal returns. The result of the ROE is in line with the findings of Hatem (2015).

5. Conclusion

In this paper the market efficiency of the European aviation industry on and around two announcement dates, March 11 and April 14, 2020, of President Donald Trump is examined. Furthermore, the relation between the exposure to the US and the cumulative abnormal returns is analyzed to see if the market reaction was accurate. To test for the market efficiency an event study has been done for each date with the 14 listed European airline groups.

To find an answer to the research question, several hypotheses has been formed. The first hypothesis tested for the market efficiency on the first announcement day with no significant return as the null hypothesis and the alternative otherwise. The results showed a significant average abnormal return for every event window, which supports the alternative hypothesis. The second hypothesis tested for the efficiency preceding and following the first announcement day. There were no significant average abnormal returns on the days prior and after the event day. This could mean there was no case of major information revealing, which could affect the market. However, if the cumulative abnormal returns are considered, these were significant for the event window $[-5, +5]$ in the period $[-3, +3]$. This could indicate the presence of insider trading, which would reject the strong form of the EMH. If the cumulative abnormal returns for the windows starting from $t = 0$ are considered, they showed no significance after the event day, which means an investor could not generate significant abnormal returns if they bought the stock on the event day. This supports the semi-strong form of the EMH.

The third and fourth hypotheses tested for the market efficiency preceding, on and following the second announcement day. The results showed that none of the days generated (cumulative) abnormal returns, for all event windows. This supports the null hypotheses, and it could be the result of the market assuming the travel ban would last longer than 30 days since this time limit was not mentioned in the official proclamation and acted accordingly after the first announcement.

For the last and fifth hypothesis, it was stated that the exposure to the US would have a significant negative effect on the sample of airline stock returns. To test this, a regression analysis has been done and it appeared that the exposure was only significant on the event day of the first announcement. This is consistent with the findings of the event study.

To conclude, the market did react to the initial announcement of the travel ban, and it reacted quickly. There were major drops days before the announcement day, which continued gradually after the announcement. This reflects the semi-strong form of EMH. The market did also react reasonably accurately since the relationship between the exposure to the US and the returns on the announcement day is significant. For future research, it is recommended to use bigger (and more complete) samples of data since the number of observations affects the significance.

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Appendices

Appendix A

Stock	Most traded market	ISIN-code	Retrieved from
Air France-KLM	Euronext Paris	FR0000031122	Yahoo Finance
The Lufthansa Group	Xetra Deutschland	DE0008232125	Yahoo Finance
International Airlines Group	London Stock Exchange	ES0177542018	Yahoo Finance
Scandinavian Airlines	Nasdaq Stockholm AB	SE0003366871	Yahoo Finance
Norwegian	Oslo Stock Exchange	NO0010196140	Yahoo Finance
Icelandair	Nasdaq Iceland	IS0000013464	Yahoo Finance
Finnair	Nasdaq Helsinki	FI0009003230	Yahoo Finance
Aeroflot	Moscow Exchange	RU0009062285	Yahoo Finance
Turkish Airlines	Borsa Istanbul	TRATHYAO91M5	Yahoo Finance
No exposure			
Ryanair	Euronext Dublin	IE00BYTBXV33	Yahoo Finance
easyJet	London Stock Exchange	GB00B7KR2P84	Yahoo Finance
Jet2	London Stock Exchange	GB00B1722W11	Yahoo Finance
Wizz Air	London Stock Exchange	JE00BN574F90	Yahoo Finance
Aegean Airlines	Athens Stock Exchange	GRS495003006	Investing.com
Reference index			
STOXX European Airline Market			Investing.com