İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi Yıl:19 Sayı:39 Güz:2020/3 s.1309-1326
DOI: https://doi.org/10.46928/iticusbe.831057

Research Article

THE REACTION OF AIRLINE STOCKS IN EUROPE TO THE COVID-19 PANDEMIC: AN EVENT STUDY METHODOLOGY[1]

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ABSTRACT
The COVID-19 pandemic has struck all life, global economy, and financial markets. It stopped airline transportation in Europe and many regions of the world for a certain period as well as affecting many businesses negatively. In this process, naturally, excessive losses occurred in stock markets. Airline stocks were among the most affected by this situation. From this point of view, this study analyzes 38 airline stocks traded in the stock markets of 14 European countries with "the event study methodology". The main purpose is to compare the reaction of the airline stocks traded in the stock markets of these countries to the pandemic and to determine whether a statistically significant cumulative average abnormal return is provided from them. Accordingly, event windows are determined as short and long windows within the scope of the event study. The findings show that a statistically significant cumulative average abnormal returns for airline stocks in all countries occurred in the -50 +50 event window. Besides, in short event windows around the pandemic announcement on March 11, which is accepted as the event date in this study, airline stocks in some countries respond to the pandemic significantly, while others do not.
Keywords: The COVID-19 Pandemic, Event Study, Airline Stocks, Abnormal Return
JEL Classification: G14, G15

Araştırma Makalesi

AVRUPA'DAKİ HAVA YOLU PAY SENETLERİNİN COVID-19 PANDEMİSİNE TEPKİSİ: OLAY ÇALIŞMASI METODOLOJİSİ

ÖZET
COVID-19 salgını tüm yaşamı, küresel ekonomiyi ve finans piyasalarını olumsuz etkiledi. Avrupa'da ve dünyanın birçok bölgesindeki çoğu işletmeyi olumsuz etkilediği gibi havayolu taşımacılığını da belirli bir süre durdurdu. Bu süreçte doğal olarak borsalarda aşırı kayıplar yaşandı. Bu durumdan en çok etkilenenler arasında havayolu pay senetleri de bulunuyordu. Bu açıdan bakıldığında, çalışma 14 Avrupa ülkesinin borsalarında işlem gören 38 havayolu hissesini "olay çalışması metodolojisi" ile analiz etmektedir. Temel amaç, bu ülkelerin borsalarında işlem gören havayolu hisse senetlerinin pandemiye tepkisini karşılaştırmak ve bunların istatistiksel olarak anlamlı kümülatif ortalama anormal getiri sağlayıp sağlamadığını belirlemektir. Buna göre olay pencereleri, olay çalışması kapsamında kısa ve uzun pencereler olarak belirlenmiştir. Bulgular, -50 +50 olay penceresinde tüm ülkelerdeki havayolu hisse senetleri için istatistiksel olarak anlamlı kümülatif ortalama anormal getirilerin gerçekleştiğini göstermektedir. Ayrıca, bu çalışmada olay tarihi olarak kabul edilen 11 Mart salgın duyurusunun etrafındaki kısa olay pencerelerinde, bazı ülkelerdeki havayolu pay senetleri pandemiye önemli ölçüde tepki verirken bazıları vermemektedir.
Anahtar Kelimeler: COVID-19 Pandemisi, Olay Çalışması, Hava Yolu Pay Senetleri, Anormal Getiri
JEL Sınıflandırması: G14, G15

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[1] The abstract of the study was presented on 14 October 2020 at V. International Kaoru Ishikawa Congress.
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Makale Geliş Tarihi/Received: 25.11.2020, Makale Kabul Tarihi/Accepted: 01.12.2020.

1. INTRODUCTION

The year 2020 started with a lot of negativities, and the scariest one was the COVID-19 pandemic. Several cases due to unusual pneumonia in Wuhan were firstly reported on December 31, 2019, to the World Health Organization (WHO) China Office. After one month, the WHO declared a Public Health Emergency of International Concern on January 30, 2020, because of jumping the deaths to 170 and the cases to 7,711. And on February 11, the WHO announced COVID-19 as the name of a new type of coronavirus.

The first case out of China was reported in Thailand on January 13. After this announcement, many countries have started to take precautions, especially in airports. The first death out of China reported in the Philippines on February 2. Many countries suspended the schools, imposed partial quarantine, and released the prisoners due to the coronavirus. At last, the WHO declared a pandemic on March 11. After that, the EU suspended the rules and gave the economic freedom to its members to spend as they need on March 21. President Trump decided to ban the entry of travelers to the USA from 26 European countries. The Oval Office reached an agreement in the US for huge financial support to the households, businesses, and healthcare system. On April 1, Antonio Guterres, secretary-general of the UN, described the coronavirus pandemic as the worst crisis since World War II.

Considering all these things, all countries have suffered from COVID-19 for months. Their priority is, of course, the health of the society, but the economic and financial effects of this compelling process have been felt strongly. We have witnessed the emptiness of shopping centers which were bulging at the seams only a short while ago. Especially the right to travel, which is one of the basic rights of a person, has become impossible with regional or international transportation bans. Airports, hotels, and many other businesses have left without customers. However, some sectors, such as telecommunications and food, have benefited from this process. But, the sectors and businesses which have affected negatively are in the majority. Consequently, people have changed their habits of shopping and eating and restricted their living standards.

Moreover, all the financial markets have been affected by the new compulsory lifestyle. With the pandemic announced by WHO, investors get into a panic. Thus, all the stock markets in the world have lost excessive value on March 11 and the following few days. Almost all stocks caused great losses to investors who held them in the early days of the pandemic. Considered on a sector basis, airline companies are one of the stocks that lose excessive value. As is known, many airlines suffered significant losses due to flight cancellations as they lost their customer base. From this point of view, this study aims to investigate the presence of abnormal returns in airline stocks in European stock markets around the COVID-19 pandemic using the event study methodology. The reason for the evaluation of airline stocks within the scope of the analysis is that one of the sectors most affected by the COVID-19 pandemic is airline transportation.

This paper is organized as follows: Section 2 summarizes the theoretical background of the event study; Section 3 reviews the literature; Section 4 describes data and methodology. Section 5 provides the estimation results and the last section is the conclusion.

2. THEORETICAL BACKGROUND OF THE EVENT STUDY

Event studies have become widespread in financial market researches after the seminal papers of Ball and Brown (1968) and Fama et al. (1969). According to Binder (1998), Fama et al. (1969) make a methodological revolution while Ball and Brown (1968) provide the basics of the event study method. Even though many advances in event study literature the main elements of an event study were provided by these papers. Kothari and Warner (2007) exhibit two main modifications of the event study methodology. These are using more frequent data to capture more precise results and more sophisticated methods.

The emergence of the event study approach (ESA) can be associated with the efficient market hypothesis (EMH). In EMH, while investors are trying to make a profit from buying and selling in the market, they can access all useful information and data costlessly and they consider them. Thus, all these information and data are reflected in the market prices quickly from the moment they are learned. Investors react instantly to all the latest news on the market. The future behavior of market prices is unpredictable, as this last news represents an unexpected and previously unknown component of information. Behind this cumulative theoretical idea is a model that started with Italian mathematician Girolamo Cardano's study in the 16th century (Sewell, 2011) and is known today as the random walk hypothesis (RWH). RHW maintains that prices in efficient markets move randomly. Thus, traders will not have the opportunity to use the available information to make continuous abnormal profits. This is an indicator of market efficiency.

However, Eugene Fama is an economist explaining the modern definition of EMH and creating experimental tools to test it. Fama (1970) mentions that EMH has three forms: weak form, semi-strong form, and strong form. The weak form reflects information based on historical data of securities prices. In the semi-strong form, all publicly available information is reflected in securities prices in addition to historical data. In the strong form, all public information and private information is only known by insiders are reflected in the securities prices. Here it must be noted that Fama, in the essence of his study, does not consider the strong form as an experiment-based possibility but interprets it as a criterion that shows deviations from the market efficiency. As well, Fama provides opinions on testing three market efficiency forms. In the weak form, techniques that make its future price prediction using the historical data of the security are used. Tests of the strong form attempt to measure whether confidential information is reflected in the price. The tests used in the semi-strong measure the response of securities prices to the spread of public information.

The semi-strong form of EMH has attracted the most attention from both theorists and empiricists. ESA is primarily designed to deal with this EMH form. ESA is an advanced and very accessible tool for financial analysis. It has a high potential for researchers and practitioners to measure market efficiency (Kliger and Gurevich, 2014). As Corrado (2011) remarks, numerous studies test the semi-strong form with ESA (i.e. the response of the traders to new news) in the literature. Stocks are mostly located in the center of these studies.

The main purpose of researchers' use of the ESA is to measure the abnormal or unexpected impact of economic and political events (Basdas and Oran, 2014), disasters, or any announcement related to companies on stock prices. The main idea behind ESA is to follow the market prices of the stocks examined within the scope of the research to detect the behaviors of market price as a result of the response of investors to events.

Different social, political, economic, and financial events affect the stock markets as well as different factors. Not only local events but also global developments cause the movements in stock markets by changing the investors' expectations about cash flows.

3. LITERATURE REVIEW

There are plenty of papers that study the effects of different social, political, economic, and financial events on stock market performance. The literature review section would cover only the studies which use the event study methodology. Kothari and Warner (2007) report 565 studies over the period from 1974 to 2000 by taking a census of event studies in five leading finance journals. Corrado (2011) finds the number very conservative due to not considering many studies in other journals. Some of them focus on the benchmark index of a stock market and some of them analyze the individual stock returns. But very few of these studies consider the sector indices.

To begin with, event studies related to social activities include various activities such as celebrity endorsements, football matches, or some international sports activities. Agrawal and Kamakura (1995) examine the effect of celebrity endorsements on stock price performance. According to their result, celebrity endorsement contracts, which positively affect stock returns, seem to be a valuable investment for listed companies. In addition to this study, Scholtens and Peenstra (2009) investigate the performance of football teams' stocks by analyzing 1274 results regarding national and European matches. They indicate that the significant negative relationship for losses and significant positive relationship for wins. The effect of losses and European matches is stronger than wins and national matches respectively. Spais and Filis (2006) have attempted to analyze the effect of Olympic sponsorship on stock markets in terms of stock returns, trading volume, and volatility using 440 daily stock prices from three main sponsors of the 2004 Athens Olympic Games. They aim to find whether an Olympic sponsorship announcement may affect the investors' behavior and stock markets accordingly. They suggest that companies should invest sponsorship programs to make a good impression on investors.

Furthermore, some events such as elections, referendums, international organizations' membership processes are incorporated by the political event studies. Eryiğit (2007) investigate the stock market reactions to the events regarding Turkey's EU membership process. The study considers 17 sector index returns to analyze six important events from 2000 to 2005 and does not determine any statistically significant effect of these events on the stock market. Dangol (2008) examines whether new unexpected political events may affect the Nepalese stock market. They conclude that the stock market reacts positively to good news and negatively to bad news. Their findings also show that the adjustment speed of stock prices to announcements of political events is 2 or 3 days from the event date.

Moreover, central banks' monetary policy or some other economic situations may be accepted as an economic event study. Kholodilin, Montagnoli, Napolitano, and Siliverstovs (2009) investigate how sector indexes react to European Central Bank (ECB)'s monetary policy in the Euro Area. They conclude that the ECB's monetary policy negatively associated with stock markets. 25 basis points increase in the interest rate lead to a decrease between 0.3% and 2.0% in the stock market at the announcement day of monetary policy. Chauhan and Kaushik (2017) focus on the effect of demonetization, the process of withdrawing the money from circulation, on the Indian stock market. They could not find any significant relationship between demonetization and stock market returns.

Additionally, the response of stocks to financial statements is another issue that has been examined via the ESA. They may be company-specific or market-based situations. For example, the effects of mergers and acquisitions on stock prices have been widely studied in finance literature. Duso et al. (2010) provide empirical evidence on the ability of event studies to reveal the stock market performance after the mergers using the data from 482 companies over the period 1990-2002. They conclude that it is more possible to capture the merger effect with a longer window around the announcement date. The effects of earnings announcements on the Chinese stock market are examined by Gao and Tse (2004). Their findings indicate that positive earnings surprise leads to positive excess returns while negative earnings surprise is related to negative excess returns. Cheung (2011) investigate how stock returns react to inclusions and exclusions of corporate sustainable firms using the date form Dow Jones Sustainability World Index from 2002 to 2008. The study indicates that index inclusion leads to an increase and exclusion causes a decrease only on the day of the event temporarily. Sharma (2011) examines the reaction of stock prices to dividend announcements. According to the results of the study, there are no abnormal returns around dividend announcement days in the Indian stock market. The study suggests that the empirical findings give evidence to semi-strong form efficiency of the Indian stock market. Im et al. (2001) analyze the response of stock prices to the information technology (IT) investments of 238 listed companies. Their results show that IT investments cause positive excess returns for smaller companies rather than larger ones.

In addition to all these different examples of event study mentioned, the interaction of different stock markets with each other may also be handled using the ESA. Scholars suppose that the information in the financial market has an impact on a foreign financial market. Unlike most of these studies which use (G)ARCH and/or VAR models to reveal the interaction between stock markets, Dimpfl (2011) introduces the event study method to the spillover effect literature. Dimpfl (2011) works on whether the opening of the US stock market affect the German stock market or not. The results indicate that the opening of the US market does not affect the German stock market, but also reveal that macroeconomic news announcements before the opening affect the German stock market.

Finally, situations such as outbreaks, disasters, or war that affect the entire world or a particular region may also be included in the event study. Nowadays, the COVID-19 pandemic is one of the most striking examples of this. The world has encountered similar events before. Chen et al. (2007) study how the Taiwanese tourism industry influenced by the SARS outbreak using seven publicly-traded companies. They draw attention to the sharp stock price decline in the Taiwanese stock market and especially in the tourism industry (nearly 29 percent) during the SARS outbreak in 2003. They observed no significant abnormal returns before the SARS, statistically significant abnormal returns for seven sectors in 10 days after the outbreak, and statistically significant abnormal returns for only the hotel sector in 20 days after the outbreak. The results indicate that tourism industry stocks are negatively affected by the SARS outbreak significantly. The study suggests that investors will expect negative returns from tourism industry stocks in future outbreaks. Similar to our study, Maneenop and Kotcharin (2020) examining the impact of the pandemic on the airline industry consider 52 airlines globally. They include only UK airline stocks from Europe in their studies. In the whole sample, it is observed that airline stock returns decreased more than market returns after the COVID-19 announcement.

4. DATA AND METHODOLOGY

4.1 Data

This study, which examines the effect of the COVID-19 pandemic, which affects life negatively all over the world, on the airline transportation sector of Europe, covers 14 countries in total. These countries are included in the study by detecting airline transportation companies' stocks in related countries' stock markets. Accordingly, a total of 38 stocks is handled in 14 stock markets, but the criterion for determining these stocks is that the companies are European. On the other hand, 38 stocks do not mean that there are 38 different airline companies. This is because some companies' stocks are traded in more than one stock market. Therefore, all stocks are analyzed in the stock markets where they are traded, and benchmarks of related stock markets are used. Information on countries, stocks and benchmark indexes of the stock markets where they are traded are presented in Table 1.

Table 1. Stocks and Stock Markets

Countries	**Stock Markets**	**Benchmark Indexes**	**Number of Airline Stocks**	**Symbols of Stocks**
Austria	The Vienna Stock Exchange	ATX (Austrian Traded Index)	2	AIRF.VI, IAG.VI
Denmark	The Copenhagen Stock Exchange	OMXC25 (OMX Copenhagen 25 Index)	1	SAS-DKK.CO
Finland	The Helsinki Stock Exchange	OMXH25 (OMX Helsinki 25 Index)	1	FIA1S.HE
France	Euronext Paris	FCHI (CAC 40 Index)	2	AF.PA, MLAAE.PA
Germany	The Frankfurt Stock Exchange	GDAXI (DAX30 Index)	13	32A.F, AB1.F, AETG.F, AFR.F, DG1.F, EJT1.F, FAI.F, INR.F, LHA.F, NWC.F, RY4D.F, SSV2.F, WI2.F
Greece	The Athens Stock Exchange	GD.AT (General Index)	1	AEGN.AT
Iceland	The Iceland Stock Market	OMXIPI (OMX Iceland All Share PI)	1	ICEAIR.IC
Ireland	The Irish Stock Exchange	IETP (ISEQ 20)	1	RY4C.IR
Norway	The Oslo Stock Exchange	OSEBX.OL (Oslo Bors Benchmark Index)	2	NAS.OL, SAS-NAK.OL
Russia	Moscow Exchange	IMOEX.ME (MOEX Russia Index)	2	AFLT.ME, UTAR.ME
Sweden	The Stockholm Stock Exchange	OMX (OMX Stockholm 30 Index)	1	SAS.ST

Switzerland	SWX Swiss Exchange	SMI (Swiss Market Index)	1	PRFN.SW
Turkey	The Istanbul Stock Exchange	XU100 (BIST 100 Index)	2	PGSUS.IS, THYAO.IS
United Kingdom	The London Stock Exchange	FTSE (FTSE 100 Index)	8	AIR.L, DTG.L, EZJ.L, FJET.L, GMAA.L, IAG.L, RYA.L, WIZZ.L

Daily data of 38 airline stocks in Europe are provided using DataStream. In addition to the daily prices of the stocks, their dividends are also downloaded to calculate the adjusted prices.

As it is known, the public holidays of each country and the characteristics of their stock markets may differ from each other. Especially in multi-country event studies, various methods are applied to overlap the trading days of stock markets with each other. Sometimes, some days of a stock may be missing due to a database where the data is provided or a special status of the stock. In case of missing data on some days in this study, stock prices on the missing days are found by calculating the average of the previous and next non-missing prices as suggested by (Peterson, 1989). For each stock, 201 trading days between June 3, 2019 and May 20, 2020 are based on and thus, 200-day returns are calculated. There are 50 trading days between December 31, 2019 and March 11, 2020.

4.2 Event Study Approach

As stated by Mitchell and Netter (1994), the ESA is a statistical technique that developed and refined by financial economists and predicts the stock price effect of some events such as mergers, earnings announcements and it relates changes in stock prices to the dissemination of new information. The starting point of using the ESA is the following question: ‘‘How does a specific event affect the price of a stock?’’. Based on this, the ESA begins with the establishment of a hypothesis related to this question (Serra, 2004). With the establishment of the hypothesis, a particular event is defined for the ESA. Depending on the preferred techniques for modelling expected returns, ESA usually has three components. These are the estimation window, event window and event date (Basdas and Oran, 2014).

Event date can be simply and apprehensibly defined as the moment at which a specific event takes place. Event date that is to say an announcement of any event should be determined as precisely as possible. The short-range measurement of observations, such as daily data, makes it easier to determine abnormal returns (ARs). Besides, using daily data provides more accurate findings (Armitage, 1995). Even though Dyckman et al. (1984) and Brown and Warner (1985) state that the daily return has several obvious problems compared to the monthly return when the event date is known, the daily data produces more signals than the monthly data. Also, using daily data in a standard event study eliminates problems with returns or can easily adjust them (Binder, 1998). Testing stock prices around event dates can be useful to explain the market's response to events and hence market efficiency.

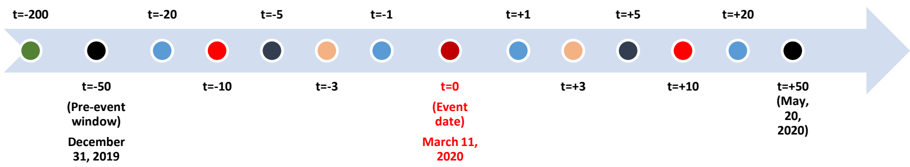
The event window is the potential period in which the impact of the event continues around the moment of the event. And stock prices are tracked during this period. It should be noted that the distribution of the event window around the moment of the event usually varies for each study. There is no rule or consensus in the literature on determining the right period. However, the general view on this issue is to detect ARs at the earliest and the latest time points to the event date. It is much more conceivable to examine a larger event window than a narrow event window (Kliger and Gurevich, 2014). On the other hand, selecting the shorter event period makes it easy to detect ARs (Armitage, 1995).

The period before or after the event window is expressed as the estimation window. It is assumed that the estimation window represents normal returns (NRs) and a period during which unaffected by the event. It is a choice to observe a long or short period for the estimation window for researchers. Nevertheless, even if the ESA practitioners capture higher precision with a longer period, they use outdated data (Basdas and Oran, 2014). If a researcher works with daily data in the event study, the estimation window must be preferred between at least 100 days and at most 300 days Peterson (1989). The fact that the estimation window includes a very long period may cause the alpha and beta coefficients to become out of date, while the very short estimation window may cause their performance to deteriorate (Armitage, 1995).

The various methods used in the ESA are econometric techniques that reveal the findings related to the impact of a particular event over a period or several periods on stock prices (Serra, 2004). The first procedure to be followed in these econometric approaches is to calculate the ARs representing the market reaction for any event. The idea that every new information is easily reflected in stock prices makes the ARs an important part of the ESA.

In this research, the ESA implementation is carried out in seven stages.

(1) First, the event date is defined. The event date in this study is March 11, 2020, the day on which the COVID-19 virus was declared a pandemic by WHO. After determining the event date, the length of the short periods to be observed or the event window is defined. Generally, the event window is expanded to involve a few days before and after the event. If especially daily data are analyzed in the ESA implementations, it is seen that event windows such as -1 +1, -3 +3, -5 +5, -10 +10, and -20 +20 are generally used. It is at the researcher's own discretion how long the event window covers before and after the event date. For this reason, different event windows are examined. In this study, a single event date, six different event windows, and a normal return estimation window are defined.



- **t=0 → Event date: The day on which the COVID-19 virus was declared a pandemic by WHO.**
- **t=-50 → Pre-event window: The day on which the first patient with the COVID-19 virus was announced in China.**
- **-1 +1, -3 +3, -5 +5, -10 +10, -20 +20, -50 +50 → Event windows**
- **-51 -200 → Estimation window**

Figure 1. Event Date, Event Windows, Estimation Window

(2) Secondly, to prepare data for the ESA, target firms in the same sectors are determined and grouped for each country. Then, the stock returns of these firms are calculated. The stock returns are daily returns. In the event study literature, it is seen that two methods are generally used to calculate stock returns. These are the arithmetic returns and logarithmic returns.

$$(1) \qquad R_{i,t} = \left(\frac{ACP_{i,t} - ACP_{i,t-1}}{ACP_{i,t-1}}\right) \qquad (Arithmetic\ Returns)$$

$$(2) \qquad R_{i,t} = \left(\frac{lnACP_{i,t}}{lnACP_{i,t-1}}\right) \qquad (Logarithmic\ Returns)$$

$R_{i,t}$ is the arithmetic or logarithmic returns of stock i at time t; $ACP_{i,t}$ is the *adjusted close price*[2] of stock i at time t; $ACP_{i,t-1}$ is the adjusted close price of stock i at time t-1. In addition to calculating the stock's return, the stock market returns (SMRs) must be calculated for the same time.

$$(3) \qquad R_{m,t} = \left(\frac{ACP_{m,t} - ACP_{m,t-1}}{ACP_{m,t-1}}\right) \qquad (Arithmetic\ Return)$$

$$(4) \qquad R_{m,t} = \left(\frac{lnACP_{m,t}}{lnACP_{m,t-1}}\right) \qquad (Logarithmic\ Return)$$

$R_{m,t}$ is the return of market at time t; $ACP_{m,t}$ is the adjusted close price of the market at time t; $ACP_{m,t-1}$ is an adjusted close price of the market at time t-1.

(3) Thirdly, normal returns or actual returns (Rs) mean the expected stock returns when there is no sudden event. In other words, Rs are the expected stock returns under normal conditions. There are some techniques and models used by researchers to

[2] The stock's price after adding a dividend refers to the adjusted close price.

calculate Rs in the ESA application. Armitage (1995) defends that the Simple Market Model (SMM) is the most preferred expected return model in the ESA and the model is supported by evidence. The SMM is a regression model based on the ordinary least squares (OLS) approach. This model is defined as one-factor OLS regression devised by Sharpe (1963) in the literature related to the ESA (Kliger and Gurevich 2014). The equation of the SMM is below:

$$(5) \qquad R_{it} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$$

$R_{i,t}$ is the actual return of stock i at the time t; α_i is the intercept; β_i is the slope; $R_{m,t}$ is the market return at the time t; $\varepsilon_{i,t}$ is the error term at the time t.

(4) Fourthly, based on the SMM, ARs are the difference between arithmetic or logarithmic returns of stock and normal returns. Namely, the value of abnormal returns depends on a model to estimate normal returns. According to the SMM, ARs are calculated as follows:

$$(6) \qquad AR_{i,t} = R_{i,t} - \left(\alpha_i + \beta_i R_{m,t}\right)$$

$AR_{i,t}$ is the abnormal return of stock i at the time t.

(5) Fifthly, in order to calculate the representative value of each sector, it is necessary to find the average abnormal returns (AARs) of the firms in the group. For this, the average of the abnormal returns of the relevant firms is calculated by aggregating their abnormal returns.

$$(7) \qquad AAR_{s,t} = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}$$

$AAR_{s,t}$ is the average abnormal return of any sector at the time t; N is the number of the firm in a sector.

(6) Sixthly, to test the effects of the predetermined event windows, all AARs within the relevant event window must be summed. The value obtained as a result of this transaction is expressed as the cumulative average abnormal return (CAAR).

$$(8) \qquad CAAR_{s,t}(t_1, t_2) = \sum_{s=t_1}^{t_2} AAR_{s,t}$$

$CAAR_{s,t}$ is the cumulative average abnormal return of any sector at the time t.

(7) In the seventh and final stage, hypotheses are defined and t-statistics are calculated to test statistical significance. The various methods used in the ESA are statistical techniques that reveal the findings related to the impact of a particular event over a period or several periods on stock prices (Serra 2004). For example, Corrado (2011) compares parametric and non-parametric methods and conclude that parametric tests suit well for the data from NYSE. However, if there are normality problems in

observations at other markets, Corrado (2011) recommends nonparametric observations. As can be understood from here, whether the technique to be used is parametric or non-parametric, it should be preferred after examining the normal distribution of the data. According to Gao and Tse (2004), since the results of both approaches are qualitatively similar, only the results for the parametric t-test are reported in this study.

The null hypothesis is that CAAR for each stock and event window is zero. This hypothesis is tested for airline sector in different countries. T-statistics used in this study is formulized as below.

$$t = \frac{CAAR_{s,t}(t_1, t_2)}{\left[(var(CAAR_{s,t}(t_1, t_2))\right]^{\frac{1}{2}}} \qquad (9)$$

5. ESTIMATION RESULTS

The following tables report the results of the event study to examine the impact of the pandemic announcement on airline stock prices at various stock markets in Europe. The tables show the relevant t-statistics of the CAAR for event windows at different lengths.

Table 2. Findings In -1 +1 Event Window Over the Event Date

Countries	CAAR	Variance (CAAR)	t-statistic
Austria	-0,192	0,008	-2,106*
Denmark	-0,101	0,005	-1,493
Finland	-0,129	0,004	-2,000*
France	-0,093	0,021	-0,638
Germany	-0,113	0,004	-1,743
Greece	0,017	0,003	0,313
Iceland	-0,273	0,019	-1,981*
Ireland	-0,026	0,002	-0,604
Norway	-0,228	0,008	-2,570*
Russia	-0,094	0,001	-2,717*
Sweden	-0,063	0,004	-1,036
Switzerland	-0,225	0,017	-1,743
Turkey	-0,203	0,006	-2,732*
United Kingdom	-0,112	0,003	-1,914

Note: "*" refers the critical value of the t-statistic is 1.96 by absolute value. The null hypothesis of the significance of CAAR is rejected at the 0.05% significance level. It covers three trading days.

It is observed that the CAARs of the stocks of the airline companies differ from zero in some of the stock markets within 1 day before and 1 day after the event date. CAARs calculated for airline stocks in 6 of 14 European countries' stock markets are statistically significant in the relevant event window. Airline stocks in these countries provide negative returns to their investors for this event window. According to these results, airline stocks in the Austrian, Finn, Icelandic, Norwegian, Russian, and Turkish stock markets react quickly to the pandemic announcement.

Table 3. Findings In -3 +3 Event Window Over the Event Date

Countries	CAAR	Variance (CAAR)	t-statistic
Austria	-0,351	0,009	-3,689*
Denmark	-0,070	0,004	-1,059
Finland	-0,200	0,002	-4,537*
France	-0,111	0,009	-1,199
Germany	-0,378	0,004	-6,199*
Greece	-0,205	0,011	-1,951
Iceland	-0,464	0,013	-4,045*
Ireland	-0,085	0,002	-1,841
Norway	-0,384	0,006	-4,871*
Russia	-0,135	0,001	-4,465*
Sweden	-0,061	0,004	-0,971
Switzerland	0,228	0,019	1,657
Turkey	-0,302	0,005	-4,264*
United Kingdom	-1,013	0,051	-4,499*

Note: “*” refers the critical value of the t-statistic is 1.96 by absolute value. The null hypothesis of the significance of CAAR is rejected at the 0.05% significance level. It covers seven trading days.

In addition to the countries in the -1 +1 event window, airline stocks in the German and British stock markets respond to the pandemic in the -3 +3 event window. Similarly, they have negative CAARs.

Table 4. Findings In -5 +5 Event Window Over the Event Date

Countries	CAAR	Variance (CAAR)	t-statistic
Austria	-0,563	0,006	-7,553*
Denmark	-0,158	0,003	-2,707*
Finland	-0,300	0,002	-7,734*
France	-0,310	0,006	-3,904*
Germany	-0,509	0,002	-10,332*
Greece	-0,406	0,007	-4,760*
Iceland	-0,583	0,011	-5,526*
Ireland	-0,215	0,002	-5,494*
Norway	-0,283	0,010	-2,842*
Russia	-0,331	0,002	-8,284*
Sweden	-0,164	0,003	-2,979*
Switzerland	-0,189	0,021	-1,302
Turkey	-0,477	0,003	-8,574*

United Kingdom	-1,285	0,033	-7,039*

Note: "*" refers the critical value of the t-statistic is 1.96 by absolute value. The null hypothesis of the significance of CAAR is rejected at the 0.05% significance level. It covers 11 trading days.

Table 4 indicates the -5 +5 event window. When this table is observed, it is seen that CAARs of all countries except Switzerland are statistically significant and negative. Accordingly, airline stocks in the Danish, French, Greek, Irish and Swedish stock markets respond significantly to the pandemic announcement in the -5 +5 event window.

Table 5. Findings In -10 +10 Event Window Over the Event Date

Countries	CAAR	Variance (CAAR)	t-statistic
Austria	-0,190	0,005	-2,627*
Denmark	-0,057	0,003	-0,995
Finland	-0,053	0,003	-1,028
France	-0,050	0,005	-0,685
Germany	-0,157	0,003	-2,685*
Greece	-0,120	0,006	-1,583
Iceland	-0,192	0,012	-1,770
Ireland	-0,096	0,001	-2,520*
Norway	-0,078	0,008	-0,854
Russia	0,0001	0,002	0,002
Sweden	-0,072	0,003	-1,280
Switzerland	-0,001	0,019	-0,004
Turkey	-0,083	0,003	-1,535
United Kingdom	-0,250	0,039	-1,271

Note: "*" refers the critical value of the t-statistic is 1.96 by absolute value. The null hypothesis of the significance of CAAR is rejected at the 0.05% significance level. It covers 21 trading days.

According to the -10 +10 event window, it is surprisingly observed that CAARs are statistically insignificant in most countries. CAARs are statistically significant only in Austria, Germany, and Ireland. It may be a correct comment to say that the effect of the pandemic announcement disappeared in the only -10 +10 event window for the remained 11 countries. However, this particular finding may contain a situation-specific to this event window. If the -5 +5 event window and -10 +10 event window are compared, it is seen that CAARs are closer to zero in the -10 +10 event window. This is an indication that airline stocks provide remarkable positive returns on some days outside the -5 +5 event window. Following the excessive fall in prices, investors' demand for stocks increased and their prices increased. Thus, CAARs for 11 countries are statistically insignificant in the relevant event window.

Table 6. Findings In -20 +20 Event Window Over the Event Date

Countries	CAAR	Variance (CAAR)	t-statistic
Austria	-0,722	0,004	-12,141*
Denmark	-0,558	0,002	-12,590*
Finland	-0,346	0,002	-8,081*
France	-0,222	0,006	-2,926*
Germany	-0,645	0,002	-12,859*
Greece	-0,386	0,003	-6,604*
Iceland	-0,921	0,006	-11,455*
Ireland	-0,345	0,002	-8,797*
Norway	-0,986	0,005	-14,184*
Russia	-0,306	0,001	-9,461*
Sweden	-0,520	0,002	-11,849*
Switzerland	0,007	0,012	0,064
Turkey	-0,424	0,002	-8,499*
United Kingdom	-0,644	0,039	-3,246*

Note: "*" refers the critical value of the t-statistic is 1.96 by absolute value. The null hypothesis of the significance of CAAR is rejected at the 0.05% significance level. It covers 41 trading days.

The findings of the -20 +20 event window report that airline stocks in stock markets of all countries except Switzerland react significantly to the pandemic announcement. Surprisingly, the airline stock in the Swiss stock market is insensitive to the event date in all event windows examined so far. This gives clues that the most efficient stock market among 14 stock markets belongs to Switzerland for airline stocks. In order to say this not only for airline stock but also for the Swiss stock market generally, it is necessary to evaluate all stocks traded in the relevant stock markets.

Table 7. Findings in -50 +50 Event Window Over the Event Date

Countries	CAAR	Variance (CAAR)	t-statistic
Austria	-1,072	0,002	-24,347*
Denmark	-0,654	0,001	-19,139*
Finland	-0,600	0,001	-16,307*
France	-0,222	0,005	-3,275*
Germany	-0,885	0,001	-23,500*
Greece	-0,403	0,002	-8,839*
Iceland	-1,629	0,004	-24,549*
Ireland	-0,330	0,001	-9,688*
Norway	-1,612	0,003	-28,559*
Russia	-0,276	0,001	-12,297*
Sweden	-0,643	0,001	-18,118*
Switzerland	-0,226	0,006	-2,872*
Turkey	-0,456	0,0012	-11,762*

United Kingdom	-0,787	0,016	-6,187*

Note: "*" refers the critical value of the t-statistic is 1.96 by absolute value. The null hypothesis of the significance of CAAR is rejected at the 0.05% significance level. It covers 101 trading days.

Finally, airline stocks of all countries' stock markets are sensitive to the pandemic announcement according to the (-50 +50) event window, which has the widest length. Switzerland and France have relatively low CAARs compared to other countries. On the other hand, Iceland and Norway have relatively high CAARs.

6. CONCLUSION

The main purpose is to compare the reaction of the airline stocks traded in the stock markets of these countries to the pandemic and to determine whether a statistically significant cumulative average abnormal return is provided from them. Accordingly, event windows are determined as short and long windows within the scope of the event study.

Findings from different windows indicate that after the COVID-19 announcement, returns on airline stocks in some European countries fell more than market returns. According to the findings, airline stocks in the Austrian, Finn, Icelandic, Norwegian, Russian, and Turkish stock markets react quickly to the pandemic announcement in the -1 +1 event window. Following this, the German and British stock markets react to the pandemic in the -3 +3 event window. The Danish, French, Greek, Irish and Swedish stock markets respond significantly to the pandemic announcement in the -5 +5 event window. According to the -10 +10 event window, it is surprisingly seen that CAARs are statistically insignificant in most countries. This is because CAARs are closer to zero in the -10 +10 event window. This means that airline stocks provide remarkable positive returns on some days in this window. In addition to this, -20 +20 event window report that airline stocks in stock markets of all countries except Switzerland react significantly to the pandemic announcement. Finally, airline stocks of all countries' stock markets are sensitive to the pandemic announcement according to the -50 +50 event window. The fact that the Swiss stock market reacts to the pandemic later than others is proof that this market is more effective.

Our findings need complementary studies in different stock markets due to the lack of studies on the effect of coronavirus pandemic. Studying with a longer time period will contribute to the comprehension of the effects of the pandemic in the future.

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