Amed, Mohammed Amed

Impact of COVID-19 on Listed US-Based Airline Companies: Abnormal Returns Analysis

An Event Study Methodology

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Acknowledgment

Writing this thesis has been an educational journey, which marks the end of our Master of Economics and Business Administration at Oslo Metropolitan University.

COVID-19 has shown its affection all over the world and in a way no other crisis had done. It was interesting to investigate and follow the reactions stock markets and indexes had to the impact of COVID-19. During the writing of this thesis, we all got a piece of good news, which was announced by the World Health Organization on 04th May 2023, declaring COVID-19 no longer a pandemic.

We want to thank OsloMet for the opportunities we have been given, and a special thanks to our supervisor Kizkitza Biguri, for providing us with the tools and information which was needed to succeed with our master's and made our writing and analysis very easy and understandable.

Amed, Mohammed Amed

Abstract

The primary goal of the thesis is to examine the impact of the COVID-19 pandemic had on the stock prices and market performance of a sample of 11 listed airline companies in the United States by using the event study methodology. Our findings are based on the data calculated and extracted from Wharton Research Data Services (WRDS). We aim to explore the Abnormal Returns (AR) and Cumulative Abnormal Returns (CAR) of the airlines in the sample during our short event window. The result of our analysis shows that there has been an overall significant negative impact on the stock returns of our sample during our event window, especially after the declaration of COVID-19 as a pandemic by World Health Organization (WHO) on 11 March 2020. However, the demonstration of our results also shows some positive occurrences, which indicates that investors saw an opportunity to invest in the airlines, specifically the airlines with the highest brand values, and take advantage of the lower prices.

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1. Introduction

The COVID-19 pandemic, which emerged in late 2019 and the spread of it across the globe, had a significant impact on the global economy and financial markets. The airline industry, being one of the most affected industries, experienced significant challenges as governments globally imposed travel bans and restrictions, lockdown measurements, and a steep downtrend in demand for air travel to contain and mitigate the spread of COVID-19 which resulted in disturbance of the operations and led to enormous financial losses. The decrease in the market values of different airline companies was also spotted during the pandemic. This thesis's main goal is to examine and analyze the impact of the COVID-19 pandemic on the stock prices and market performance of airline companies in our sample.

The objective of this Thesis is to explore the Abnormal Returns and the Cumulative Abnormal Returns of the airline companies during the COVID-19 pandemic with a focus on the period surrounding the declaration of COVID-19 as a pandemic by the World Health Organization (WHO) on 11 March 2020. Other conducted event studies have revealed that the declaration of COVID-19 as a global pandemic had led to negative stock price reactions for many listed airline companies. However, the impact was depending on factors like liquidity, leverage, size, ownership, concentration, and business models. Also, government interventions and the effectiveness of different COVID-19 vaccines played a significant role in the influence of the impact to the airline industry stock price fluctuations.

This Thesis aims to examine the stock price reactions of airline companies in the United States to analyze how the impact of the pandemic affected the fluctuation in their stock price, by using the event study methodology. Event studies have been a widely used methodology in research papers to analyze the impact of a specific event on a firm's values, introduced by Ball and Brown in 1968. This method has significantly grown in the past decade, with various studies conducted about different events and their impact on financial markets, businesses, and industries globally. The COVID-19 pandemic is one such event that has caught the eyes and attention of researchers.

In this Thesis, with the event study method, we will be analyzing the abnormal returns on different airlines' stock prices within a specific event window for the purpose of seeking a determination of the significance and magnitude of the pandemic's impact on the selected sample. To conduct this study, we will use the data from US-based listed airlines of our sample, and then employ statistical tools such as the market model to estimate the expected returns and calculate abnormal returns. The significance of the impact will be analyzed through the t-tests and p-values obtained from the results.

Our study findings demonstrated the significant negative impact the declaration of COVID-19 as a pandemic had on the stock prices of our sample, resulting in decreased stock prices and market performance during our event window. This also led to a decrease in firm value of the airlines. We also determined that airlines with high brand values, have the resources to cover the losses they experienced because of the pandemic. These findings of our analysis support other event studies conducted regarding COVID-19, such as Martins et al. (2022), that concluded with negative significant affection of COVID-19 on stock prices. This study contributes to the existing literature on the impact of the novel COVID-19 Pandemic on the financial markets, specifically the airline industry. With the conducted analysis we can gain a broad understanding of the market performance during a time of crisis.

1.1 Research Question

The research question that we will focus on analyzing and find an answer to in this Thesis, is as follows:

How did the COVID-19 pandemic impact the US-based listed airlines stock prices?

2. Literature

The event study is a statistical method implemented in research papers to acquire an events effect on a firm's value. The event study method was invented by Ball and Brown in 1968. It has been used commonly as a subject of research for decades, and the literature on the topic has significantly grown (Kothari & Warner, 2007). Kothari et al. mention also that methods for short horizons have been proven to be quite reliable than methods for long horizons despite the improvements in the event study methodology (Kothari & Warner, 2007). The main purpose of an event study is to examine the market reactions to events of interest. It aims to find if there is any correlation between an event and a firm's stock price or value (Ball & Brown, 1968).

The event study method has been used in recent studies to determine the impact of COVID-19 on the stock markets of the major countries that were affected by it. Studies have found that there was a significant negative effect on major stock indices' reaction to COVID-19 (Liu et al., 2020). There are other key findings that have risen from conducted event studies on the effect of COVID-19 on financial markets, businesses, and industries globally. The shipping industry for instance, was one of the most dramatically affected industries by the COVID-19 pandemic, with their values falling and remaining on the same level during the whole pandemic (Gavalas et al., 2022). The impact of COVID-19 on several financial markets are inconsistent, with some businesses which struggled while others flourished and survived the pandemic (Martins & Cró, 2022). Industries where the chance of transmission and spreading of the virus was high, such as entertainment, travel and tourism and hospitality, had been massively hit and affected by the social distancing measures and the compulsory of having facemasks. Meanwhile high-tech and internet-based businesses thrived and adapted well to those social distancing and facemask measures were implemented (Martins & Cró, 2022). When the COVID-19 was declared as a pandemic, it restricted both financial and real sectors (Göker et al., 2020). The sports, tourism and transportation industry have been recognized as the most affected and with highest losses due to the outbreak of COVID-19 (Göker et al., 2020).

The pandemic has had its significant negative impact on the US airline industry according to already published event studies. There has been concluded that 59 listed airline stocks have shown negative stock price reaction to the declaration of the COVID-19 as global pandemic (Maneenop & Kotcharin, 2020; Martins & Cró, 2022). However, there was two important announcements which was studied, the travel ban by Donald Trump, which also resulted for policy changes and implications that was related to COVID-19, that influenced the level of the impact (Maneenop & Kotcharin, 2020). The event studies also resulted in that there was an underreaction to the first announcement and overreaction to the third announcement (Maneenop & Kotcharin, 2020). Furthermore, it was found that firm specific characteristics such as liquidity, leverage, state control, size, ownership concentration and business models influenced the reinforced or mitigated reactions (Martins & Cró, 2022). Most US airlines found themselves downgraded on ratings to junk status, where they experienced the downgrade of their ratings, liquidation, and bankruptcy fillings due to this pandemic. Then the airline industry's stock prices were also affected by the effectiveness of the COVID-19 vaccines that were under production (Martins & Cró, 2022). There were also state aids in place for the airlines to ensure that the industry did not collapse, and the cost of borrowing was also increased which jeopardized the survival of some firms (Martins & Cró, 2022). Studies has concluded that the pandemic had imposed huge losses to the global airline industry and the contribution of governments has been crucial in preventing the collapse of the airline industry (Martins & Cró, 2022).

3. Methodology

The event study technique is a prominent and common statistical approach in quantitative finance and economics research which aims to quantify and measure the impact of a specific event on the value of a firm or corporate value, by studying the stock price movements around the event date. Event study which is recommended by (Fama et al., 1969)**,** will be the primary method we will use in this thesis and to examine the main question that arises during an event study:

Do we observe abnormal returns on the securities of interest when an event is made public? (Reindl, 2022)

An event study typically begins by identifying a specific event to be studied which can have an impact on a firms' stock price or market value. A specific event can for instance be merger announcements, earnings announcements, a policy change or new regulations, issuance of new debt or equity, or any other event that can influence or affect corporate value (MacKinlay, 1997; McWilliams & Siegel, 1997). For this Thesis we have selected the novel COVID-19 as the event. A sample from, for example a firm, a corporation, industry, or indexes should also be determined to measure how its securities are affected by the event. The chosen industry and their stock price fluctuations in this Thesis is the US airline industry. The main goal of this Thesis is to examine if there are abnormal returns, on different airlines' stock price in the US during the selected event declaration.

The next step in this process contains three components which is used to further calculate the abnormal returns:

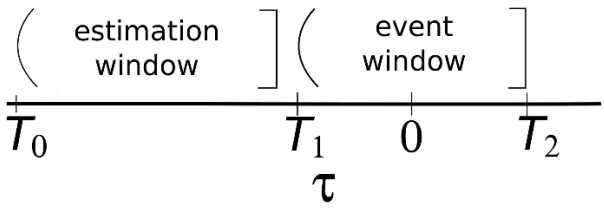

Figure 1: The three components.

1. **The event date (0):** The event date (0) describes the date when an event occurs, and the information gets public. In this case, the event date is 11th March 2020. The

COVID-19 pandemic had a start from December 2019, but the official declaration of the pandemic happened on the 11. March 2020 by WHO. We have chosen this day as the event date because, after the declaration, changes and restrictions occurred globally specially on the airline industry, which could have a huge impact on the economy.

2. **The event window (T1-T2):** The event window is the minimum period over which the securities or the stock prices of firms will be examined. It is the period where the impacts and the consequences of the event was expected to be felt including the event date. The event window chosen for this Thesis is -10+10. "It is customary to define the event window to be larger than the specific period of interest. This permits examination of periods surrounding the event ",(MacKinlay, 1997). Event study allows to test whether the market has anticipated (-10 days, T1-0) the impact of the selected event on the firm value. It tests the market efficiency and any insider trading which may have occurred before the event.
   Event study also takes into account the adjustment window (+10 days, 0-T2) for market efficiency, which allows to test any significant changes to the prices after the event date and after when market has already reacted to the event.

3. **The estimation window (T0-T1):** Describes the normal business days that should be used for the comparison of stock prices and returns during our event date, the anticipation and adjustment window. The longer estimation window is, the better. However, at least a 30-day window is customary. The selected estimation window in our case would be -57 days of business, before the first anticipation date.

After selecting the event and the three components it now makes it possible to calculate the expected return. The expected return is what a security/stock would have received if the event had not happened during the event window. The expected return is calculated by taking in use a market model which estimates the link between the security/stock returns and market returns in general, using their historical returns. We start by calculating the expected returns on our estimation window, the anticipation and adjustment window, and most importantly the returns on our selected event date.

The next step of an event study which is the main goal of event study, is to calculate and measure the abnormal returns. The abnormal returns are the actual returns a security earns over the event window minus the calculated normal returns, which is defined as the expected return if the event had not occurred. For instance, a firm *i* and the event date *t* the abnormal return equation would be:

$$AR(it) = R(it) - E[R(it) \mid X(t)]$$

where the AR(it) is the abnormal returns, R(it) is the actual return and E[R(it)] is the expected/normal return. X(t) is the condition applied because of the event, which in a market model implies a linear relationship between the securities returns and the market returns. (MacKinlay, 1997)

Then to measure the actual impact of the event on the securities, an event study calculates the cumulative abnormal returns over the event window by using the calculated abnormal returns from the previous step. Suppose we have a N firm in our sample, then the CAR equation for firm i from t = T1 to T2 would be:

$$CAR(i, T2) = \sum_{t=T1}^{T2} AR(i, t)$$

with T1 and T2 as the start and end of the event window, which makes CAR the sum of the abnormal returns over the event window. (Basdas & Oran, 2014)

When the CARs are calculated in an event study, then the abnormal returns must be tested for significancy. The statistical test is performed to determine if the abnormal returns and/or the CARs are different from 0, which is also our null hypothesis, it means to check if the event had a significant impact on the securities. The t-test is often used for significancy tests in an event study. It analyzes the abnormal returns in compared to generated abnormal return by the market model.

The final step would be to interpret the results of the event study, by the performed t-tests and p-values. If the t-test and p-values shows significancy on the calculated abnormal returns, that would indicate that the event had a significant impact on the chosen securities.

The level of the impact can also be determined by the size of the abnormal returns.
This kind of approach to measure the impact of an event has gained the attention of the airline industry globally, and is used in different studies conducted before and till date, for instance: (Gillen & Lall, 2003), (Park, 2004), (Ho et al., 2013) and many more.

3.1 Data and Tools

The goal for this Thesis is to analyze the impact of the COVID-19 pandemic on US airline industry. The criteria for our choice of airlines are their origin, they are based and operated in the US. The list of US based listed airlines, extracted from (WRDS, 1993) and segregated, contains 11 airlines and is presented with tickers and the market they are listed in on table 1. Some of the SIC code 4512 airlines are excluded in our sample because we could only extract the data of the companies listed on table 1 from (WRDS, 1993).

Name	Ticker	Market
Alaska Air Group, Inc.	ALK	NYSE
Allegiant Travel Company	ALGT	NASDAQ
American Airlines Group, Inc.	AAL	NASDAQ
Delta Air Lines, Inc.	DAL	NYSE
Hawaiian Holdings, Inc.	HA	NASDAQ
JetBlue Airways Corporation	JBLU	NASDAQ
Mesa Air Group, Inc.	MESA	NASDAQ
SkyWest, Inc.	SKYW	NASDAQ
Southwest Airlines Company	LUV	NYSE
Spirit Airlines, Inc.	SAVE	NYSE
United Airlines Holdings, Inc.	UAL	NASDAQ

Table 1: US Based Listed Airlines

Event studies can be conducted in recent times by using different types of software, such as Eventus and Event Study Tool. The tools can be used through the Wharton Research Data Services (WRDS). By using the Compustat North America function on WRDS, which contains the stock price data of our sample, we can easily have access and be able to extract the historical stock prices of our sample by using different variables. (WRDS, 1993)

The Compustat function extracts data, by different variables, of all companies listed. To segregate and take only the data of our sample, we have been able to locate the airline companies by their SIC code of 4512, then choose the airlines with, their origin as and listed in the US. The list of companies got shorter, and some airlines was excluded, then we could easily choose the companies of our sample and their data. The segregated data of our sample helped us to categories the airlines into different groups to measure the impact of COVID-19 by the chosen variables. This will be explained further in the analysis part of this Thesis.

After the segregation we can finally use the Event Study Tool in WRDS. The tool requires a text file (txt) input which must contain tickers and our event date. After submitting the file, we must choose a statistical model, such as Market Model explained earlier in the section. Then we can choose which variables we want the tool to calculate, such as the Abnormal Returns and CARs. The tool also gives us a graph which shows the CARs movement during our event window (WRDS, 1993). To make the event study easier and understand the meaning of our ARs and CARs, by choosing the variables that can perform the t-tests and p-values as outputs, we can interpret the significancy of the impact by proving that the null hypothesis is different than 0.

3.2 The Timeline

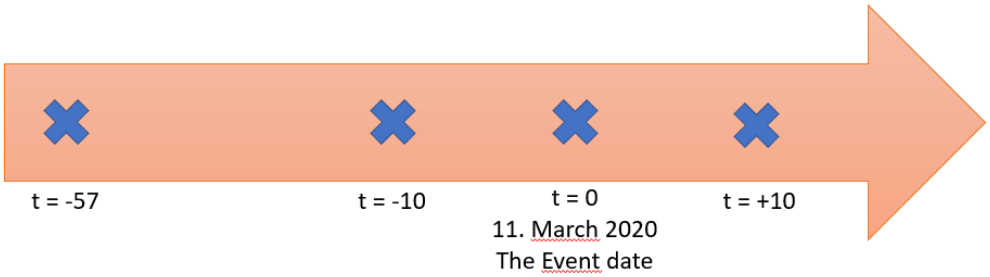

Figure 2: Timeline for the chosen event window

Figure 2 can be explained as follows:

t = -57 until -11 is the estimation window, one day before the anticipation window starts.

t = -10 until -1 is the anticipation window.

t = 0 is the event date chosen for this thesis, which is 11. March 2020

t = +1 until +10 is the adjustment window.

The timeline starts from -57 days to and including -11 days before the event date. This is the estimation window which gives us the expected returns on normal business days. The anticipation window -10 to and including -1 days indicates if the market had anticipated a reaction before the declaration. The event date we have chosen is 11. March 2020, which is the day WHO officially declared COVID-19 as pandemic. Then adjustment window from day +1 to and including +10 is where we can see if the market has adjusted to the news of the declaration.

There are different types of statistical models to estimate the expected return of the chosen sample. Such as Constant return model, market adjusted model and CAPM, but the most common and preferred model for the estimation of expected returns in an event study is the simple market model, according to (Armitage, 1995). The simple market model generally takes the return of the overall market into consideration and any other factors of the chosen sample such as company size, industry, and risks. This explains that the simple market model

is a regression model based on one-factor OLS-regression which is developed by Sharpe (1963) for the literature related to event study methodology (Kliger & Gurevich, 2014). The regression equation for the simple market model is following:

$$R\ (it) = \ \alpha(i) + \ \beta(i)R(m,t) + \ \varepsilon(i,t)$$

where the R(it) is the expected return of a firm *i* at the time of *t,* α(i) would be the constant and β(i) is the slope. In addition the R(m,t) describes the market expected return at the time of t and the ε(i,t) would be the standard error at the time of t.

4. Analysis

For the analysis part we have decided to categories our sample to see if there is any differentiator or context between them. The difference between the categories is the market they are listed in, and those companies with the highest ranked brand value. The market indexes of the categories determine the benchmark against which the stock prices of the companies in our sample are compared with to calculate the CARs and ARs. This is because the choice of the market index influences the calculations of ARs, and then the CARs, as it sets a baseline for the expected returns. The categorization is also done to determine if the market had any influence on the level of impact of our event.

The categories we have chosen to analyze the impact of the pandemic on, is as following:
Category 1: All companies in our sample.
Category 2: Companies in our sample that are listed on NYSE.
Category 3: Companies in our sample that are listed on NASDAQ.
Category 4: Four Most Valuable Airlines in 2019.

As explained earlier we have used the Event Study Tool on (WRDS, 1993), to calculate all ARs and CARs, therefore there is no need to do it the old fashion way, by manually calculating the numbers of each company in Microsoft Excel, together or one by one. The graphs which will be presented are the Mean Cumulative Abnormal Returns (Mean CAR) of companies in our sample and the categories. These show an interval of -10+10, with our event date as 11. March 2020 (0). The data presented in Figures 3, 4, 5 and 6 shows the Mean Cumulative

Abnormal Return (CAR) and Mean Abnormal Return (AR) over our selected interval of -10+10 trading days, with the event date centered. The CARs represent the sum of the Abnormal Returns over our event window. It indicates and measures the abnormal performance of the stock returns of our sample relative to the expected performance. While the ARs indicates the difference between the actual returns of the stock returns and the expected returns based on the market trends. The data on Figure 3, 4, 5 and 6 also presents the t-tests and p-values of both our ARs and CARs. We will interpret and comment on the relevant performed t-test as well. For the p-values we have been given a 1.96 two-tailed confidence interval by the Event Study Tool, as shown on the graphs, with a common 5% significancy level which is used to test our hypothesis. The hypothesis for our sample is that the pandemic did not have any impact on our categorized companies, thus indicating that the abnormal returns are equal to 0. This will be analyzed and interpreted further in this section of this Thesis.

4.1 Category 1: All Companies in Our Sample

Category 1 contains all the companies in our sample listed in table 1, regardless of any criteria and characterization. The market indexes used for this category is both NYSE and NASDAQ.

Our analysis begins by examining the overall impact of COVID-19 on all US based listed airlines of our sample for this category.

	A	B	C	D	E	F	G	H
1	Date	Event window day	CAR Mean	AR Mean	AR t-test	AR P-value	CAR t-test	CAR P-value
2	26.02.2020	-10	-3,08 %	-3,08 %	-5,4537	0,0003	-5,4537	0,0003
3	27.02.2020	-9	-1,39 %	1,69 %	1,6799	0,1239	-1,4171	0,1868
4	28.02.2020	-8	-3,02 %	-1,64 %	-1,9201	0,0838	-3,0033	0,0133
5	02.03.2020	-7	-10,70 %	-7,67 %	-6,7405	0,0001	-6,6735	0,0001
6	03.03.2020	-6	-9,75 %	0,95 %	1,8543	0,0934	-5,3906	0,0003
7	04.03.2020	-5	-12,65 %	-2,91 %	-4,1012	0,0021	-5,7253	0,0002
8	05.03.2020	-4	-18,06 %	-5,41 %	-5,5432	0,0002	-6,1269	0,0001
9	06.03.2020	-3	-12,37 %	5,70 %	7,0893	0,0000	-4,6453	0,0009
10	09.03.2020	-2	-5,59 %	6,78 %	5,2874	0,0004	-2,4332	0,0353
11	10.03.2020	-1	-5,84 %	-0,24 %	-0,2672	0,7948	-2,5176	0,0305
12	11.03.2020	0	-4,10 %	1,74 %	1,1873	0,2625	-1,4528	0,1769
13	12.03.2020	1	-8,68 %	-4,58 %	-2,6110	0,0260	-2,1401	0,0580
14	13.03.2020	2	-12,83 %	-4,15 %	-1,4473	0,1784	-3,0829	0,0116
15	16.03.2020	3	-4,10 %	8,73 %	2,1303	0,0590	-0,6431	0,5346
16	17.03.2020	4	-17,14 %	-13,04 %	-4,5700	0,0010	-2,6175	0,0257
17	18.03.2020	5	-32,08 %	-14,94 %	-5,7028	0,0002	-4,1499	0,0020
18	19.03.2020	6	-35,21 %	-3,13 %	-0,6721	0,5168	-5,7109	0,0002
19	20.03.2020	7	-24,22 %	10,99 %	4,1922	0,0019	-3,7835	0,0036
20	23.03.2020	8	-16,81 %	7,41 %	4,6494	0,0009	-2,6591	0,0239
21	24.03.2020	9	-7,72 %	9,09 %	4,0121	0,0025	-1,3257	0,2144
22	25.03.2020	10	0,12 %	7,84 %	2,7981	0,0189	0,0207	0,9839

Figure 3: Category 1 – Mean CAR, Mean AR, t-tests, and p-values (WRDS, 1993)

By examining the data, we can observe that the negative numbers started already from 26th February 2020, which is the start of our anticipation window. The CAR on that day show a mean of -3.08% which indicates a negative impact on the stock prices of our sample companies. This negative downtrend continues in the following days, with the CAR reaching as low as -35.21% on 19th March 2020. The Mean CAR of our sample on the event date shows us a slightly negative impact, and the negative trend continued the following days after the declaration. These negative CARs can be associated with the announcements about the lockdowns and travel restrictions. The data indicates that the event had a significant negative impact on the stock price fluctuation of the companies in Category 1.

However, the data shows some positive days as well, where the Abnormal Returns were above zero. As an example, we can look at the 12th March 2020, which had a CAR of -8.68%, but the AR was 4.58%. Or, 20th March 2020, where the CAR was -24.22%, but AR was 10.99%. We can also look at the CAR and AR of our samples event date, where Mean CAR is at -4.10% with a negative CAR t-test of -1,4528. The AR, on the other hand, was 1,74% with an AR t-test of 1.1873. These examples of positive ARs, show us a positive deviation from the expected return, which indicates that there were some investors who saw value in the companies and were willing to invest on them at a lower price, despite the negative trend of CARs happening during our event window.

The data also presents the performed t-tests and calculated p-values for both the ARs and CARs and indicates that Abnormal Returns and the Cumulative Abnormal Returns of Category 1 are statistically significant. In other words, the difference between the actual returns and the expected return did not occur by chance, and is likely caused by our selected event, the declaration of COVID-19 as a pandemic. The high level of statistical significancy can also be interpreted from the low p-values of the CAR t-tests.

4.2 Category 2: Companies in our sample that are listed on NYSE

In Category 2, we decided to examine the companies which are listed at New York Stock Exchange (NYSE). The companies of our sample which are listed in NYSE is: Alaska Air Group

Inc (ALK), Delta Air Lines Inc (DAL), Southwest Airlines Company (LUV) and Spirit Airlines Inc (SAVE). The market index used to calculate the CARs and ARs for this category, as the name of the category suggests, is NYSE. This is also the differentiator of the category.

	A	B	C	D	E	F	G	H
1	Date	Event Window day	Mean CAR	Mean AR	AR t-test	AR P-value	CAR t-test	CAR P-value
2	26.02.2020	-10	-1,86 %	-1,86 %	-2,7246	0,0723	-2,7246	0,0723
3	27.02.2020	-9	-1,07 %	0,80 %	0,5531	0,6187	-0,6085	0,5858
4	28.02.2020	-8	-3,17 %	-2,10 %	-2,5346	0,0851	-1,4597	0,2405
5	02.03.2020	-7	-10,13 %	-6,96 %	-3,2986	0,0458	-2,5809	0,0817
6	03.03.2020	-6	-9,98 %	0,15 %	0,1447	0,8941	-2,0962	0,1270
7	04.03.2020	-5	-11,68 %	-1,70 %	-1,9924	0,1404	-2,2565	0,1093
8	05.03.2020	-4	-16,42 %	-4,74 %	-1,7001	0,1877	-2,0802	0,1290
9	06.03.2020	-3	-10,44 %	5,98 %	5,6735	0,0108	-1,5163	0,2267
10	09.03.2020	-2	-2,54 %	7,91 %	5,2653	0,0134	-0,4151	0,7060
11	10.03.2020	-1	-4,35 %	-1,81 %	-1,1052	0,3497	-0,7061	0,5310
12	11.03.2020	0	-1,56 %	2,80 %	2,8476	0,0652	-0,2839	0,7949
13	12.03.2020	1	-8,93 %	-7,38 %	-3,0828	0,0540	-1,1619	0,3293
14	13.03.2020	2	-12,15 %	-3,22 %	-1,0428	0,3737	-1,1511	0,3331
15	16.03.2020	3	-5,87 %	6,29 %	2,1717	0,1183	-0,4648	0,6737
16	17.03.2020	4	-17,29 %	-11,43 %	-3,2070	0,0491	-1,4238	0,2497
17	18.03.2020	5	-28,15 %	-10,85 %	-3,0250	0,0565	-2,0099	0,1380
18	19.03.2020	6	-37,84 %	-9,70 %	-5,5228	0,0117	-2,9397	0,0605
19	20.03.2020	7	-30,02 %	7,82 %	3,7905	0,0322	-2,4085	0,0951
20	23.03.2020	8	-19,51 %	10,51 %	3,6470	0,0356	-1,7234	0,1833
21	24.03.2020	9	-11,60 %	7,91 %	2,0736	0,1298	-1,4149	0,2520
22	25.03.2020	10	-2,91 %	8,70 %	2,4724	0,0899	-0,3515	0,7485

Figure 4: Category 2 – Mean CAR, Mean AR, t-tests, and p-values (WRDS, 1993)

Analyzing the data of Category 2, we can again observe that our anticipation window starts negative with a Mean CAR of -1.86%. This indicates that there has been a decrease in the stock price fluctuations 10 days before our event date. Then the negative Mean CAR trend follows up until 19th March 2020, which shows a downside to the lowest Mean CAR of -37.84% during our event window. It also means that there has been a negative significant impact on the stock prices of our companies in Category 2 throughout our event window.

Further, we can also observe some positive ARs within the negative CARs. For example, on 06th March 2020 the Mean CAR of this category is at -10.44%, but with a positive AR of 5.98%. Or 09th March 2020, the AR is 7.91% despite the negative Mean CAR of 2.54%. The event date shows also a negative Mean CAR of -1.56% with a t-test of -0.2839, thus the AR is positive at 2.80% with a t-test of 2.8476. These positive ARs of Category 2 suggests that there has been potential abnormal performance compared to the expected returns of the companies. The cause for this type of abnormal performance can be specific factors or the sentiments of the investor during the event window.

Again, the performed t-test and p-values are there to help us interpret the statistical significancy of the observed abnormal returns. The data shows generally negative t-tests for both the ARs and the CARs of Category 2, but the p-values of CAR t-tests and some of the ARs t-tests, seems to be retaining our hypothesis at the 5% statistical significance of the returns, which means we must keep our hypothesis. This indicates that the deviations of the actual return from the expected returns may have happened by chance or other factors, and that it may not have been occurred due to the influence our event had on them.

Therefore, we can conclude that the data for Category 2 indicates negative CARs primarily over our event window. This demonstrates a downtrend on the stock prices of the companies in Category 2. However, we can point out some positive ARs, suggesting some abnormal performance but which needs to be tested for significancy. Based on the t-tests and p-values of the ARs and CARs, we can assume that the abnormal returns for Category 2 may be random and should not be associated with the impact of our chosen event. Because of the previous incidents and announcements which already had made its effect on the companies in our Category 2 before the start of our event window.

4.3 Category 3: Companies in our sample that are listed on NASDAQ

In Category 3, we will examine the companies in our sample that are listed on NASDAQ, as the title suggests. The market index used to calculate the ARs and the CARs of this category will also be NASDAQ. This category contains 7 companies, which are: Allegiant Travel Company (ALGT), American Airlines Group Inc (AAL), Hawaiian Holdings Inc (HA), JetBlue Airways Corporation (JBLU), Mesa Air Group Inc (MESA), SkyWest Inc (SKYW) and United Airlines Holdings Inc (UAL).

	A	B	C	D	E	F	G	H
1	Date	Event window day	Mean CAR	Mean AR	AR t-test	AR P-value	CAR t-test	CAR P-value
2	26.02.2020	-10	-3,77 %	-3,77 %	-5,4444	0,0016	-5,4444	0,0016
3	27.02.2020	-9	-1,57 %	2,20 %	1,5806	0,1651	-1,2350	0,2630
4	28.02.2020	-8	-2,94 %	-1,37 %	-1,0596	0,3301	-2,5732	0,0422
5	02.03.2020	-7	-11,02 %	-8,08 %	-5,6491	0,0013	-7,2990	0,0003
6	03.03.2020	-6	-9,61 %	1,41 %	2,6290	0,0391	-6,6688	0,0006
7	04.03.2020	-5	-13,21 %	-3,59 %	-3,8100	0,0089	-5,9112	0,0010
8	05.03.2020	-4	-19,00 %	-5,79 %	-12,7311	0,0000	-8,9038	0,0001
9	06.03.2020	-3	-13,47 %	5,53 %	4,7432	0,0032	-6,3809	0,0007
10	09.03.2020	-2	-7,34 %	6,13 %	3,2928	0,0166	-5,5550	0,0014
11	10.03.2020	-1	-6,68 %	0,65 %	0,6420	0,5446	-3,9340	0,0077
12	11.03.2020	0	-5,55 %	1,13 %	0,4988	0,6357	-1,6520	0,1496
13	12.03.2020	1	-8,53 %	-2,98 %	-1,3010	0,2410	-1,6680	0,1464
14	13.03.2020	2	-13,21 %	-4,68 %	-1,0831	0,3204	-3,6064	0,0113
15	16.03.2020	3	-3,09 %	10,12 %	1,5873	0,1635	-0,3973	0,7049
16	17.03.2020	4	-17,05 %	-13,97 %	-3,3563	0,0153	-2,0359	0,0879
17	18.03.2020	5	-34,33 %	-17,28 %	-5,0301	0,0024	-3,4649	0,0134
18	19.03.2020	6	-33,71 %	0,62 %	0,0885	0,9323	-4,7118	0,0033
19	20.03.2020	7	-20,90 %	12,80 %	3,2750	0,0169	-2,7474	0,0334
20	23.03.2020	8	-15,27 %	5,63 %	3,3475	0,0155	-1,8657	0,1113
21	24.03.2020	9	-5,50 %	9,77 %	3,2409	0,0177	-0,6703	0,5276
22	25.03.2020	10	1,84 %	7,34 %	1,7866	0,1242	0,2366	0,8208

Figure 5: Category 3 – Mean CAR, Mean AR, t-tests, and p-values (WRDS, 1993)

The data for Category 3 again starts our event window with a negative CAR and AR, both -3.77% on 26th February 2020. This can be interpreted as negative impact on the stock prices of our companies. The negative trend continues throughout our event window, with the lowest CAR at -34.33% on 18th March 2020, until 24th March 2020, and turns to a positive CAR on the next day in our last day of adjustment period. Though this one positive CAR is not statistically significant. The Mean CAR on our event date is at -5.55% with a t-test of -1.6520, where the AR shows a positive 1.13% with a t-test of 0.4988. The negative Mean CARs throughout our 21-day event window suggest a negative significant deviation from the expected returns. This is also consistent with the performed negative AR t-tests and p-values for most of the days in our event window, indicating the difference between the actual returns from the expected returns.

The Mean ARs are negative for most days of the event window, except for some days with positive ARs, where the lowest AR is at -17.28% on 18th March 2020, and the highest at 12.80% on 20th March 2020. The t-tests and p-values for the ARs and CARs gives an indication of statistical significancy for most of the days during our event window. It confirms the deviation of the actual return from the expected return. This means that the market did not take in and fully incorporate the news of our event, which led to a significant impact on the returns of the stock prices of the companies in our category.

Overall, the event seems to have had a significant, but temporary impact on Category 3, with a negative deviation on the stock prices and returns of the companies, throughout our event window. At a 5% significancy level, we will reject our null hypothesis if the p-value is less than 0.05. Based on the data in Figure 5, we can see that our null hypothesis is rejected for most days in our event window both for the ARs and CARs. Which means that the abnormal return for this category is not due to chance and is affected and caused by our chosen event.

4.4 Category 4: Four Most Valuable Airlines in 2019

For this category we have chosen to observe the companies of our sample that was ranked as most valuable airlines on the list of "Airlines 50 2019 Ranking" by Brandirectory.com. We wanted to analyze if the impact of our event had any significant effect on those companies with the highest brand values. The companies are as following: Delta Air Lines Inc (DAL), American Airlines Group Inc (AAL), United Airlines Holdings Inc (UAL) and Southwest Airlines Company (LUV). These companies are ranked top 4 most high valued airlines of 2019 in the world, respectively (Brandirectory, 2019).

We have chosen the 2019 ranking because the ranking is done at the end of the year, and because it is ranked right before our event date. The market index for the CARs and ARs are both NYSE and NASDAQ.

	A	B	C	D	E	F	G	H
1	Date	Event window day	Mean CAR	Mean AR	AR t-test	AR p-value	CAR t-test	CAR p-value
2	26.02.2020	-10	-2,05 %	-2,05 %	-2,5649	0,0829	-2,5649	0,0829
3	27.02.2020	-9	1,78 %	3,83 %	3,9065	0,0298	3,0089	0,0573
4	28.02.2020	-8	-0,93 %	-2,71 %	-2,4150	0,0946	-1,0409	0,3744
5	02.03.2020	-7	-8,11 %	-7,18 %	-3,8066	0,0319	-2,9510	0,0600
6	03.03.2020	-6	-6,48 %	1,63 %	2,6155	0,0793	-2,4383	0,0926
7	04.03.2020	-5	-10,06 %	-3,58 %	-2,7698	0,0696	-2,5535	0,0837
8	05.03.2020	-4	-12,79 %	-2,73 %	-1,6122	0,2053	-2,3865	0,0970
9	06.03.2020	-3	-8,26 %	4,53 %	13,4496	0,0009	-1,5665	0,2152
10	09.03.2020	-2	-0,29 %	7,97 %	3,8457	0,0310	-0,0587	0,9569
11	10.03.2020	-1	0,27 %	0,56 %	0,3061	0,7795	0,0854	0,9373
12	11.03.2020	0	4,19 %	3,92 %	1,9519	0,1460	1,4661	0,2389
13	12.03.2020	1	2,97 %	-1,22 %	-0,3458	0,7524	0,5265	0,6350
14	13.03.2020	2	-1,77 %	-4,75 %	-1,0781	0,3600	-0,3929	0,7207
15	16.03.2020	3	16,18 %	17,95 %	2,0413	0,1339	1,5670	0,2151
16	17.03.2020	4	-0,80 %	-16,98 %	-4,2045	0,0246	-0,0681	0,9500
17	18.03.2020	5	-12,49 %	-11,68 %	-2,7773	0,0691	-0,8362	0,4644
18	19.03.2020	6	-22,83 %	-10,34 %	-3,6674	0,0351	-1,8738	0,1577
19	20.03.2020	7	-10,06 %	12,77 %	3,5365	0,0385	-0,9734	0,4021
20	23.03.2020	8	-1,09 %	8,97 %	7,0310	0,0059	-0,1164	0,9147
21	24.03.2020	9	5,27 %	6,36 %	2,5138	0,0866	0,5559	0,6171
22	25.03.2020	10	13,80 %	8,53 %	3,9427	0,0291	1,6430	0,1989

Figure 6: Mean CARs, Mean ARs, t-tests, and p-values (WRDS, 1993)

The data presented above in Figure 6, is almost like the data of Category 2, since both categories contain four companies, but for this category we can see a lot more positive numbers of both CARs and ARs. Looking at the Mean CAR of day -10, we can see that the companies experienced a negative mean CAR of -2.05%, which can indicate that something had happened before the start of our anticipation window, that may have caused the investors to become suspicious about the stock price fluctuations of the companies in Category 4. The companies registered a CAR of -12.79% on day -4 of our anticipation window with an AR of -2.73%. However, on the following day of the anticipation window, we can see that the companies experienced a positive AR of 4.53% which contributed to the CAR to move up to -8.26% from -12.79%. This suggests that the market reacted positively to some news or information that had occurred on day -3. The positive trend continued to and including our event date, with a CAR of 4.19% and AR of 3.92%. Category 4 registered the highest CAR of 16.18% on 16th March 2020 with an AR of 17.95%, and the lowest CAR of -22.83% on 19th March 2020 with an AR of -10.34%.

The companies have experienced a large mix of positive CARs and ARs during our event window, which suggests that the companies may have reacted to some news or information related to our event that were different from the general COVID-19 news, leading to the market's optimism about those companies.

Observing Figure 6, we can see that the p-values for the AR t-tests and CAR t-tests are a mix of both significant and non-significant values. Some days shows a p-value less than 0.05 other days above the 5% significancy level. This indicates that the companies' stock prices in this category had been affected by various news and events, including the event analyzed in this Thesis, during our event window leading to positive and negative abnormal returns. Overall, Figure 6 shows a mixture of negative and positive numbers, which suggests that the impact our event had on the companies of this category, was both positive and negative.

5. Discussion of The Results

To measure the impact of COVID-19 on the companies in our sample, the analysis observes the Mean CARs and Mean ARs that are generated through our event window. The data needed is calculated and extracted through Event Study Tools in WRDS (WRDS, 1993). This section provides an insight and discussion of how the impact of COVID-19 pandemic declaration was on the stock prices of the airlines in our sample.

It is also relevant to mention the influence our market indexes have on the categories. These have an important and dominant role for our analysis because of the determination of the CAR and AR calculations. It provides an insight into how the companies' stock prices in the different categories performed, during our event window, compared to the broader market performance.

Category 1 and 4 uses both NYSE and NASDAQ as indexes, Category 2 uses only NYSE and Category 3 uses only NASDAQ as index. Each category represents a subset of companies listed in them and analyzes their stock price fluctuations in the relation to the chosen index. The findings of our data and analysis reflect how the companies in each category performed relative to the market indexes used for the calculation of CARs and ARs.

The data of Category 1, which includes all the companies in our sample, is provided in Figure 3. By interpreting the data, we can observe the significant negative impact on the stock prices of Category 1 during our event window. This is determined by the consistent downtrend of the CARs, indicating a decrease in the stock prices. The news of the declaration of COVID-19 as pandemic had its immediate effect on the companies of our sample, with introduction of both lockdowns and travel restrictions globally. The graph in Figure 7, shows how the market had anticipated the negative downtrend on the stock prices because of the lockdowns and restrictions. On the other hand, the adjustment window shows a steep drop towards day 6, and much stronger negative effect on the information presented after our event date. This shows that the investors are quick to react on negative news and information. However, the graph shows a small adjustment to this negative news

at the end of our event window which can indicate the optimism and maybe a negative overreaction among the investors.

Overall, the data of Category 1, indicates that the declaration of COVID-19 as pandemic had a significant negative impact on the stock prices of the companies in our sample, as it is shown with the negative CARs on Figure 3. However, some investors were still willing to buy the stocks despite the negative trend, which resulted to some positive ARs in our data. At the end, the statistically significant t-test and p-values confirms this significancy, that the difference between the actual return and the expected return are likely occurred due to the selected event.

The graph in Figure 7 illustrates the Mean CARs of all the companies at the interval of -10 to +10, including our event date at time 0. The significancy level is at 5%, and we can conclude that our null hypothesis is rejected, which means that the abnormal returns are different than 0.

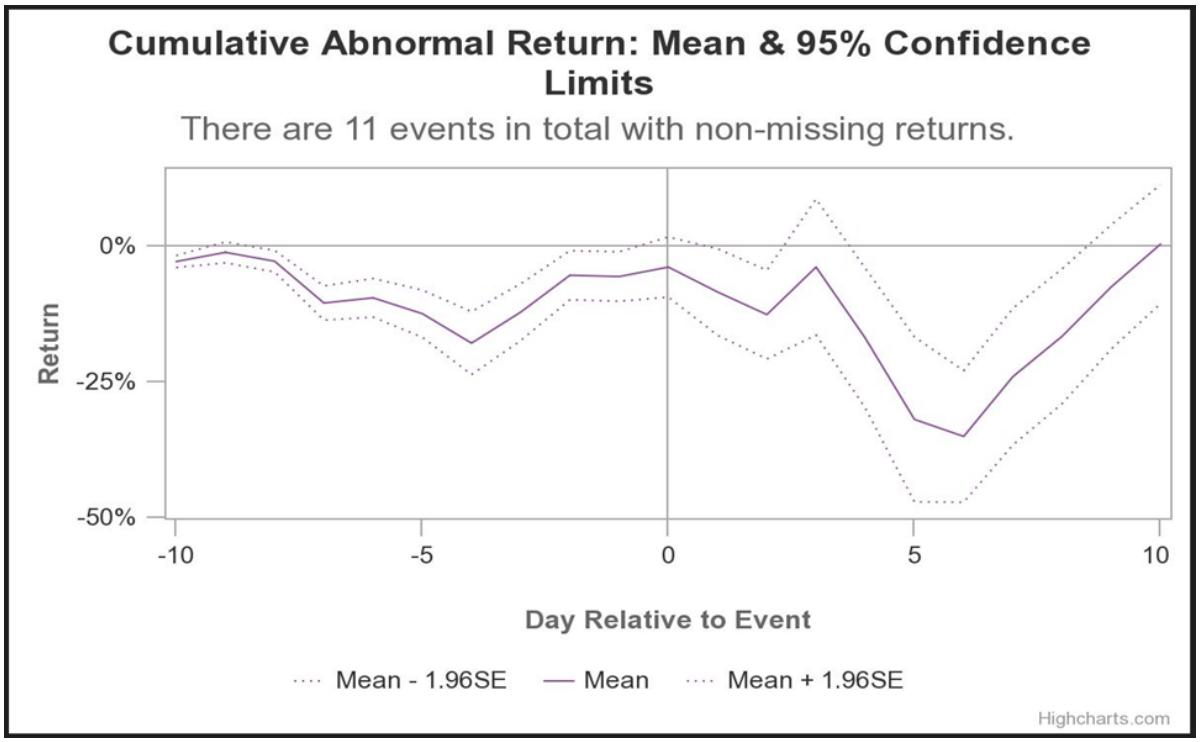

Figure 7: Mean CAR of Companies in Category 1 (WRDS, 1993)

Moving to Category 2, consisting of companies of our sample listed on the NYSE, we again can observe the negative impact on their stock prices during our event window. However, the analysis of the data in Figure 4, revealed that the negative abnormal returns may not be solely caused by the pandemic declaration. The retaining of the hypothesis in this category is caused by the categorization we have made, the NYSE market as a differentiator which plays a crucial role in determining the CAR and AR calculation, and the small sample of four companies we have in it. There are other factors we need to consider which may have triggered the impact before our event date. For example, one factor could be the already spread of COVID-19 which started from December 2019. Other factors may be for instance the first registered case of COVID-19 in Italy and the press release of WHO about it on 24th February 2020, which also resulted in a travel ban from and to US which was announced by Donald Trump on the same day as our event date, on 11th March 2020 (Maneenop & Kotcharin, 2020).

The graph in Figure 8, illustrates the Mean CARs of the companies in Category 2, and shows the downtrend on our event window, -10+10, as analyzed above. The significancy level is at 5%, and we can retain our null hypothesis, that there is observed abnormal returns both positive and negative, but not statistically significant for the impact on Category 2 during our event window.

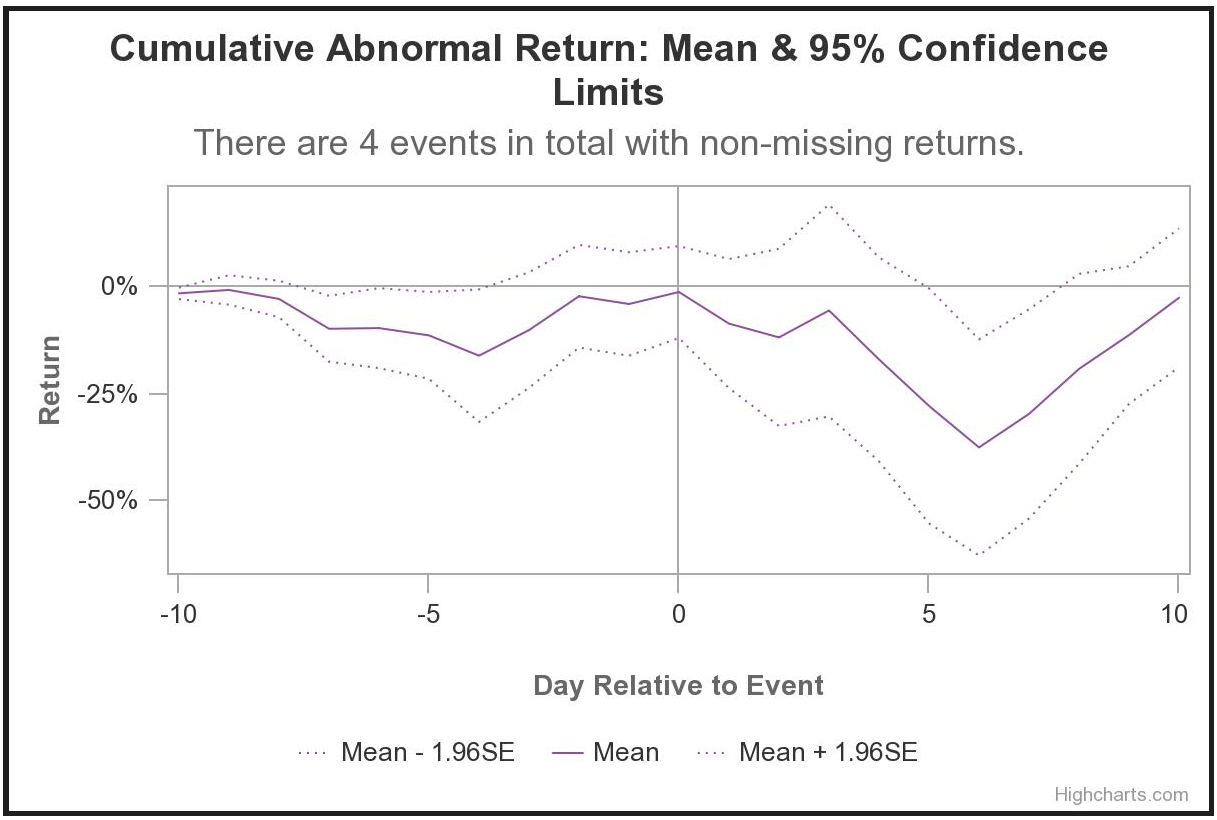

Figure 8: Mean CAR of Companies in Category 2 (WRDS, 1993)

In Category 3, which focused on the companies of our sample listed on NASDAQ, we found a significant negative impact on the stock prices throughout the event window. The CARs consistently show a downtrend, which can be an indication of a negative deviation from the expected returns. The ARs shows a mix of negative and positive returns, suggesting the market sentiments fluctuations during our event window. We can conclude with a statistically significant abnormal return on most days of our event window for the companies in our Category 3.

The graph in Figure 9, illustrates the Mean CARs of the companies in Category 3, with an interval of -10+10, and shows the downtrend which is analyzed above. Again, at the 5% significancy level, we will then reject our null hypothesis, which means that the abnormal returns are different than 0.

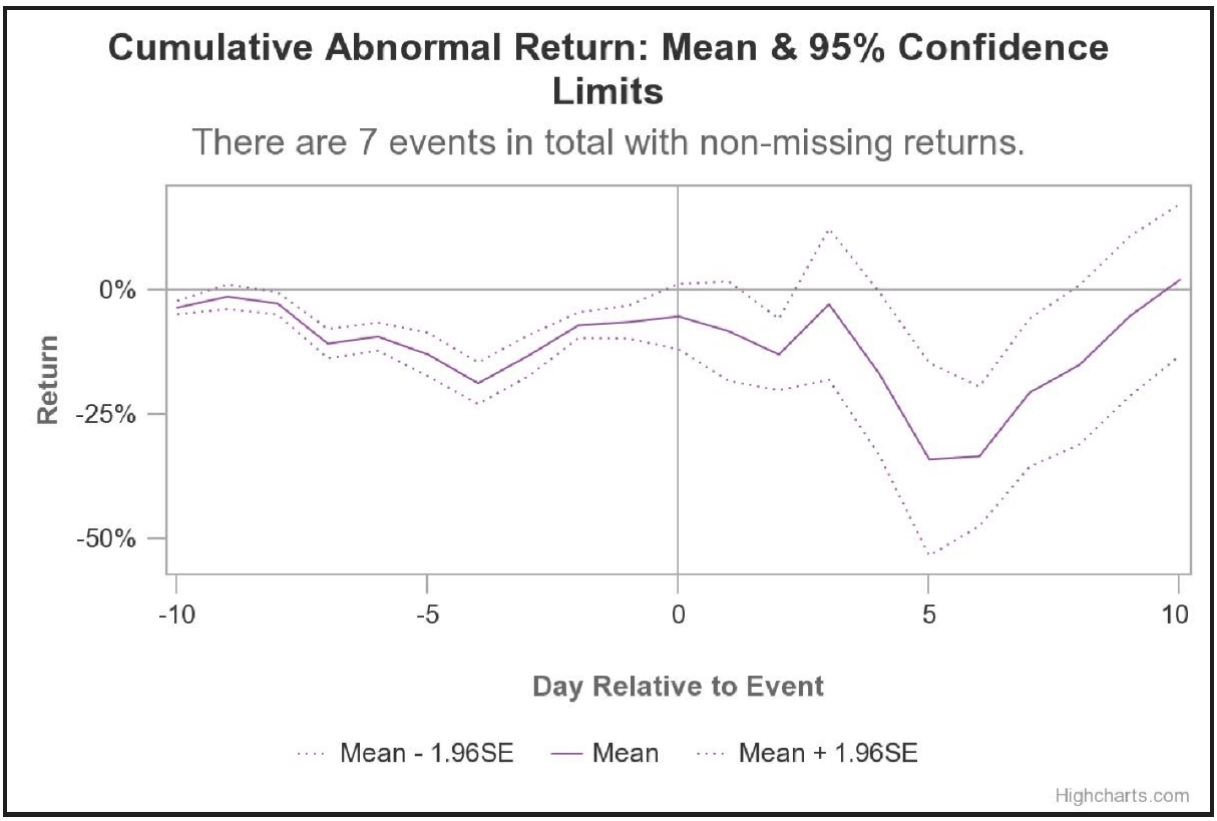

Figure 9: Mean CAR of Companies in Category 3 (WRDS, 1993)

Lastly, in Category 4 we examine the four most valuable airline brands of 2019 in our sample. The analysis revealed a mixture of positive and negative abnormal returns throughout our event window. The brand values of these 4 airlines seems to have controlled and contributed to this mixture of abnormal returns. Therefore, with the t-tests and p-values, we can conclude that the impact of our event on Category 4 is significant some days and not significant other days, indicating that the impact of the event varied across different days. This mixture can be explained by the characterization of this category and the companies ranked as most valuable airlines in 2019. The one important factor for the companies in this category is their brand value. It shows and indicates that they had enough resources to cover the losses that occurred due the impact of COVID-19 during our event window. It means that investor would have preferred to invest in these high value companies and at a low price. The investors believed in the companies' brand values.

The graph in Figure 10, shows the mixture of CARs analyzed above with an interval of -10+10, and 5% significancy level. The graph on Figure 10 also shows the positive Mean CARs,

right before the event date, the event date itself, and shortly after the event date. We can neither reject nor retain our hypothesis, in general, at the 5% significance level.

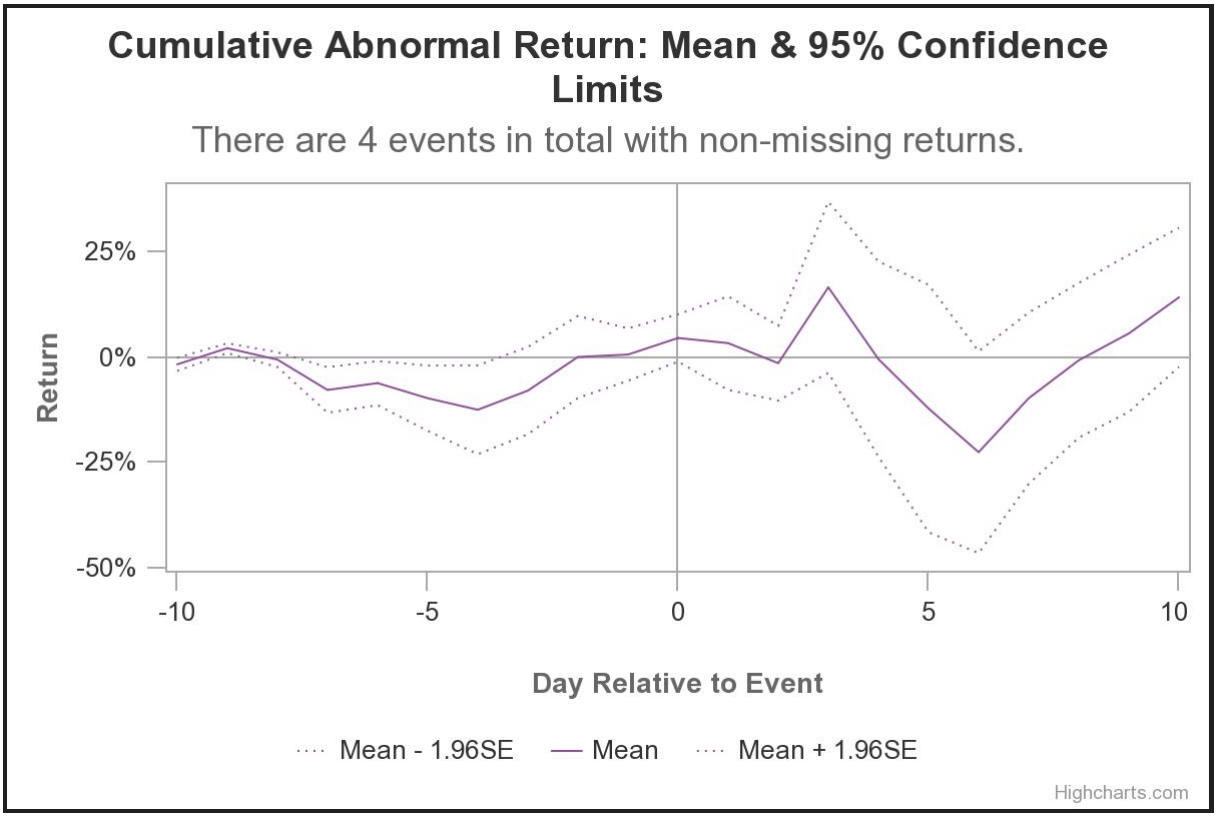

Figure 10: Mean CAR of Companies in Category 4 (WRDS, 1993)

6. Conclusion

Our Thesis aims to measure the impact of COVID-19 pandemic on the stock prices of various categories of companies, by conducting an event study with a chosen event date and event window, that are used to calculate the Cumulative Abnormal Returns (CAR) and Abnormal Returns (AR). The sample we have collected is the airlines which are based and listed in the US. The Categorization was made based on which market index the companies are listed in and the four most valuable airlines in 2019. The market index, such as NYSE and NASDAQ, served as the benchmark for the comparison of the stock prices and calculating the CARs and ARs. COVID-19 had a huge and significant negative impact on the stock market globally, especially the airline industry, as concluded by many studies conducted till day, with some of

the latest event studies being conducted by Martins et al. (2022), Ru et al. (2020) and Ding et al. (2020).

Our findings concludes that COVID-19 announcement as a pandemic had a significant negative impact on the companies of our sample, across all categories. The findings are based on a short and conclusive timeline, which includes an estimation window of -57 days before the start of our event window. The event window includes anticipation window of -10 days, the event date 11th March 2020 and adjustment window of +10 days. The results of this 21-day event window have been analyzed with data and graphs. The data extracted from WRDS (WRDS, 1993), shows us the downtrend which, the Mean CARs and ARs, had during our event window. The significancy of the negative CARs and ARs are shown through performed t-tests and p-values.

The results show us that our event had an overall significant negative impact on the airlines listed in table 1. On category 1 and 3, the impact is seen clearly with negative CARs and ARs throughout our event window, whereas there is some optimism shown on the category 2 and 4. This explains that category 2 and 4 resulted in both positive and negative CARs and ARs, which indicates the contribution of investors making strategic investments at lower prices, and who saw value in the companies. Category 4, which represented the four most valuable airlines in the world, resulted in a mixture of positive and negative CARs and ARs. This suggests that various factors besides our event could have influenced the trend. By looking at the graphs of our categories, we can easily observe the that they are almost at the same pattern. This shows us a small negative trend on the anticipation window and the event date, excluding Category 4 on the event date which resulted in a positive Mean CAR, and then we can observe the downtrend which also reaches their lowest point during our adjustment window until day 5 and 6, before turning the direction around and moving upwards, which shows the adjustment of our samples stock price fluctuations.

In conclusion, our findings demonstrate and illustrates that COVID-19 and its declaration as a pandemic, on 11th March 2020, had a significant negative impact on the airline companies of our sample resulting in decreased stock prices during our event window. The analysis also revealed some occurrence of positive CARs and ARs, which indicated that some investors recognized the value in the companies and them taking advantage of their lower prices. However, we must not forget to mention that the statistical tests performed for this Thesis indicated that not all abnormal returns were influenced by the pandemic announcement directly. The result of our findings shows that some airlines in our sample have the abilities and resources to put in compensation for the incomes they had lost because of the impact, which can be read from the positive CARs and ARs. Such as Category 4, which includes the top four most valuable airlines globally. These airlines are also included in the other categories, which influenced the Mean CAR outputs of each category because of their resources. These results can contribute to our understanding of the market dynamics and fluctuations during an event of crisis and highlights the difficulty of interpretations of the impact a specific event has on stock prices.

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