Do High ESG Scores Mitigate Crisis Impacts? A Difference-in-Difference Analysis of Airline Profitability During COVID-19

Joel Czocherra

Dissertation written under the supervision of professor Jörg Rolf Stahl

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Abstract

The thesis aims to explore the effect of ESG performance on the airline industry with a focus on profitability during the COVID-19 crisis. In order to do so, the thesis uses a difference-in-difference approach to determine how airlines with high ESG ratings affected profitability during the pandemic. Moreover, the analysis includes a global panel data set of 81 airlines from 2017 to 2022.

The significant results reveal that the profitability of all airlines in the dataset declined sharply at the beginning of the pandemic. However, the thesis found evidence that treated airline companies experienced a smaller drop in profitability, measured in return on assets. In addition, the results remain significant for several adjusted analyses, such as different cutoff levels for classifying a high ESG score, winsorized data, and a subsample to ensure robustness. However, in the parallel trend analyses, the thesis couldn't present a clear parallel trend. However, the findings show that the increase in profitability is more pronounced for the treated airline companies, particularly after 2020. These findings thus suggest that high levels of ESG performance might provide a form of protection during an economic downturn or a crisis. This thesis provides supporting evidence to the literature on ESG and its relationship with the profitability of a carbon-intensive industry during an unanticipated event.

Keywords: ESG rating, difference-in-difference, airline industry, profitability, COVID-19

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Resumo

A tese pretende averiguar o impacto do nível de ESG no setor aéreo com ênfase na lucratividade durante a pandemia de COVID-19. Para isso, busca-se o efeito da pandemia de COVID-19 nas companhias aéreas de alta classificação ESG usando um modelo de diferenças em diferenças. Além disso, o estudo inclui um painel de dados de 81 companhias aéreas em todo o mundo entre 2017 e 2022.

As evidências coletadas indicam que o lucro de todas as companhias aéreas na amostra pesquisada foi altamente afetado no início da crise da COVID-19. Porém, a tese conseguiu conseguir evidências estatísticas de que as companhias aéreas tratadas sofreram menor redução nas medidas de lucro, na forma de retorno sobre ativos. Adicionalmente, os resultados continuam a ser significativos para numerosas análises que foram ajustadas, por exemplo, para várias diferentes cortes para considerar uma pontuação ESG alta, winsorizadas de dados, e uma subamostra a fim de proporcionar robustez ao estudo. Entretanto, nas análises de tendências paralelas, a tese não conseguiu proporcionar uma tendência paralela clara. No entanto, os achados evidenciam que a lucratividade aumenta mais com as companhias aéreas tratadas, em especial após o ano de 2020. Esta dissertação auxilia a literatura sobre ESG e o lucro de uma indústria intensiva em carbono em um evento não esperado.

Palavras-chave: Pontuação ESG, diferença na diferença, sector das companhias aéreas, rentabilidade, COVID-19

Autor: Joel Czocherra

Titulo: As pontuações ESG elevadas atenuam o impacto das crises? Uma análise da diferença na diferença da rentabilidade das companhias aéreas durante a COVID-19

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List of Acronyms

CO_2	Carbon dioxide
COVID-19	Coronavirus Disease 2019
CSR	Corporate social responsibility
ES	Environmental & Social
ESG	Environmental, Social & Government
G20	Group of Twenty
IndiGo	Interglobe Aviation
PPE	Property, Plant, and Equipment
ROA	Return on Assets
S&P	Standard & Poor's
Sig.	Significance
UK	United Kingdom
US	United States of America

1. Introduction

The climate change is the biggest threat to humankind and has already begun to affect the environment (NASA, 2024). Furthermore, climate change impacts companies, especially those whose business model involves the production of fossil fuels or relies on these fossil fuels, such as the airline industry (Kolk & Pinkse, 2004). Therefore, companies must deal with it and try to prevent the worst-case scenario. This led people to pay more attention to climate change effects because of huge amounts of information about natural disasters, which are linked to the changing environment due to climate change. Moreover, financial investors also show a clear interest in the threat of climate change and closely observe companies' attitudes toward sustainability (Aliano et al., 2023). Therefore, companies constructed a report about their environmental, social, and governance initiatives to meet stakeholders' information demands and demonstrate transparency regarding their sustainability engagement (Raghavan, 2022).

In 2020, the world suffered from the coronavirus disease. The outbreak of the newly developed coronavirus, which had its origin in China, expanded rapidly around the globe (Baloch et al., 2020). For the global economy, the COVID-19 pandemic represents a crisis that could not have been foreseen and led to one of the biggest depressions in the global economy in this decade. Moreover, restrictions such as self-isolation or quarantine in most countries around the world disrupt the operations of companies. This led to the dismissal of employees and, in general, fewer business activities. Overall, the growth rates for the gross domestic product decreased by a lot, and the outbreak also affected poverty and inequality (Clemente-Suárez et al., 2021).

One sector that suffered greatly during the COVID-19 pandemic was the airline industry (Dunn, 2020). Countries decided to cut international flights or not allow people from certain countries to enter. Those restrictions led to a huge decline in revenue for airline companies, causing many of them to fail to meet their financial obligations. The sector delved into a monopoly situation for certain airlines in some regions, which were more robust than other airlines (Suk & Kim, 2021). In addition, the pandemic affected the stock volatility of airline companies significantly, as well as their stock performance (Nguyen et al., 2022; Carter et al., 2022).

Furthermore, the airline industry is known as one of the major emitters of CO_2 gases, which results in the tightening of climate change. Therefore, airline companies' stakeholders force them towards sustainable transformation because they assume that a more sustainable airline can lead to better operational performance. Airlines have incorporated this demand of their stakeholders and tried to become greener with several initiatives, such as onboard recycling or renewing their fleet (Leamon et al., 2019).

Previous studies have examined the effect of companies' environmental, social, and governmental performance on their stock performance during the COVID-19 pandemic. These studies imply that companies with better environmental, social, and governmental performance are better protected against unforeseen shocks and build more resilience (Abou Tanos et al., 2024; Gianfrate et al., 2024). This implication also holds for airline companies (Chen et al., 2022). However, the majority of studies focused on stock performance rather than on companies' financial performance respectively profitability.

Therefore, this study attempts to build more evidence in this less-explored field and focuses on answering the question of how the profitability of airline companies with higher ESG performance differs from that of their counterparts during the COVID-19 pandemic. To measure profitability in this thesis, I chose the return on assets, which has been widely used in previous research.

Moreover, to answer the research question, this thesis utilizes a difference-in-difference approach to examine the research question of the thesis. The dataset comprises 81 airlines from various regions of the world. Furthermore, the study employs several alternative analyses, including the use of a subsample, various cutoff levels, data winsorization for the difference-in-difference regression, and finally, parallel trend analysis to ensure the robustness of the results. Thus, this thesis's findings contribute important evidence on how ESG performance is linked to profitability in the presence of economic shocks. The results are particularly interesting for the airline industry, as they are directly linked to the environment and economic downshifts. Furthermore, for airline companies, it's essential to invest in their ESG disclosures, as their stakeholders are increasingly focusing on sustainable transformation. Therefore, with the implications provided by this thesis, airlines can proactively investigate their environmental, social, and governmental initiatives.

The thesis has the following structure to investigate the research question: Chapter 2 displays the literature, which focuses on ESG characteristics and their link to the performance of companies. Additionally, this chapter describes literature that focused on the performance of companies with high ESG performance during the pandemic, specifically on the airline industry's performance and its link to ESG characteristics during the COVID-19 pandemic. Chapter 3 describes the methodology of the research and presents descriptive statistics of the variables that were used for the difference-in-difference regression. Furthermore, Chapter 4 presents the results while outlining the findings for the base scenario and two additional scenarios. In addition, I discuss the results of the scenarios with winsorized data and conclude the findings of the parallel trend analysis. Lastly, Chapter 5 summarizes the key findings of this

study and provides several implications for these findings. Moreover, this chapter presents limitations that occurred while examining the research questions and how future research could address them to ensure even more evidence on this research topic.

2. Literature Review

The literature review provides an overview of the relevant topics that are further discussed in this thesis. Moreover, it outlines the key outcomes of several important papers to gain knowledge about the airline industry, ESG, and the COVID-19 pandemic, how they intertwine, and how this led to the research question and the hypothesis of this work. Furthermore, it will help to delve into the methodology which examines the research question of this study.

2.1. ESG characteristics and their link to firm performance

ESG is a crucial aspect of daily human life and the economy. Every industry is affected by climate change, so industries must address ESG to ensure that they work against climate change and transform into environmentally friendly businesses. As ESG gained importance, science addressed it and established the first papers regarding ESG and financial performance. Theodoulidis et al. (2017) examined how corporate social responsibility relates to the financial performance of companies in the tourism sector, including airlines, casinos, hotels, and restaurants. Moreover, their research examines whether CSR initiatives have a positive or negative impact on the financial performance of these companies.

Furthermore, the study incorporates the stakeholder theory, which states that companies must consider the needs and interests of multiple stakeholders to achieve long-term success (Vávrová et al. 2024). However, the results showcase that corporate social responsibility activities positively impact the financial performance of the investigated companies in the sample.

According to the model of Fatemi et al. (2009), who investigate the relationship between firm valuation and corporate social responsibility. It turns out that corporate social responsibility can reduce firms' capital costs and their probability of survival. Furthermore, investments in corporate social responsibility activities lead to higher long-term cash flows and shareholder value. However, their study also states that excessive corporate social responsibility expenditures may decrease firms' returns or valuations. Next, Flammer (2015) examined if adopting corporate social responsibility initiatives impacts firm financial performance. The study includes 2.729 corporate social responsibility proposals from US firms between 1997 and 2021. Moreover, results show that corporate social responsibility proposals lead to positive abnormal returns on the day of the shareholder meeting, implying that markets react positively

to adopting corporate social responsibility initiatives. This study also documented that companies experience improvements in operational performance over the long term, where measures for operational performance have been labor productivity and sales growth.

In addition, Horváthová (2010) examined how environmental performance influences financial performance in her meta-analysis study. The study's results underline a positive relationship between higher environmental performance and the financial performance of firms, especially in countries with stronger environmental regulations and enforcement. Furthermore, the analysis shows that a longer time horizon tends to have an even higher positive relationship between environmental performance and financial performance, which indicates that it takes time for the benefits of environmental improvements to materialize in financial metrics. As well as Horváthová (2010), Busch and Friede (2018) also conducted a meta-analysis of the relationship between corporate social performance and corporate financial performance. The results of this study indicate a highly significant and positive correlation between corporate social performance and corporate finance performance.

The Inamdar (2024) study uses a panel data regression model to analyze the relationship between ESG disclosures and financial performance in 50 Indian companies. Generally speaking, the paper also concludes that significant positive relationships exist between ESG disclosures and financial performance measures, such as firm value, price-earnings ratio, cost of capital, and measures of financial strength of companies. Also, Bird et al. (2007) showed in their paper that corporate social responsibility activities impact firms' equity performance, as their research found that the market reacted positively to those initiatives. In addition, Leite & Usyal (2023) emphasize that firms with high ESG scores experienced abnormal stock price responses when positive ESG information occurs for a specific firm. Furthermore, Crespi & Migliavacca (2020) underscore the positive relationship between high ESG scores and company profitability, though their analysis is limited to firms in the financial sector.

In contrast, Humphrey et al. (2012) hypothesized that ESG factors do not significantly affect risk-adjusted financial performance as they research if high corporate social performance firms in the UK incur financial costs or showcase better returns to companies with lower corporate social performance ratings. However, the authors could emphasize that firms with a high corporate social performance score have no significant difference in financial cost or benefit, though some industries are more sensitive to corporate social performance than others. Martins's (2022) paper also examined the link between competition and ESG performance in emerging markets with a difference-in-difference approach. The profitability result for the

investigated firms didn't show any significant relationship between ESG Scores and the firm's profitability.

2.2. Covid-19-Pandemic, ESG characteristics and firm performance

When crises occur worldwide and harm the economy, ESG characteristics can affect the performance and value of companies during that crisis. The literature finds evidence for this. For example, Yahya (2023) identified, in his difference-in-difference approach, how the financial performance of companies from Scandinavia differs during COVID-19 regarding their ESG performance. Firms with higher ESG performance demonstrated maintaining and improving their financial outcomes compared to their counterparts. Furthermore, those companies showed a quicker recovery in their financial and non-financial metrics during the post-lockdown period in 2021. In addition, Broadstock et al. (2021) documented how ESG performance could play a significant role in mitigating financial risk during the COVID-19 pandemic in China. They found evidence that firms with a high ESG performance outperformed their counterparts as they had smaller stock price declines during the early stage of the pandemic and exhibited lower stock price volatility. Liu et al. (2023) also provide evidence for this in the Japanese stock market. In addition, Lee & Lu (2021) focused their study on the Taiwanese stock market and included 941 firms, 86 of which were classified as corporate socially responsible firms. Moreover, corporate socially responsible companies showed a higher resilience during the pandemic, which is underlined by the smaller decline in their stock price.

Furthermore, Lu et al. (2024) also demonstrated in their paper the positive impact of CSR during the COVID-19 pandemic, as they showed a smaller stock price decline and maintained better financial performance compared to companies with lower corporate social responsibility. Albuquerque et al. (2020) used, as well as other papers, the COVID-19 pandemic to examine the firm performance and resilience during exogenous shocks in the interaction of ES rating performance. They included daily stock returns and accounting data for US firms. As a result, the paper documented profit margin stability as the operating profit margins of high-ES firms were higher than those of low-ES firms. Besides the significant profit margin, the authors couldn't find any significant intertwining between return on assets and high ES firms. In addition, Gregory (2022) states that the positive effect of high ESG performance during the COVID-19 pandemic on stock performance for S&P1005 firms holds.

Moreover, the profitability measure in this paper is also positively and significantly associated with abnormal returns. Khoury et al. (2022) focused on over 4,500 companies from G20 countries and financial performance measures such as Return on Assets, Return on Equity, and

Total Returns. The results suggest a positive impact of ESG performance on accounting-based financial performance. However, the results negatively impacted stock returns during the COVID-19 pandemic, as the authors underlined the lower total returns of high ESG companies. Furthermore, Ellul et al. (2020) focused on the financial implications of the COVID-19 pandemic for corporations, and they also show in their results that a higher ESG performance leads to less severe stock price declines for these companies.

In contrast, Buchanan et al. (2018) showed how companies' values changed during the financial crisis in 2008 regarding their corporate social responsibility characteristics. Despite the results of other papers, Buchanan et al. (2018) point out that companies experienced a significant decline in firm value during the 2008 crisis. Next to this result, they also found that corporate social responsibility activities did not significantly enhance the firm's value recovery after the 2008 crisis. Besides, Bae et al. (2021) investigated whether corporate social responsibility matters in times of crisis or not. They put their focus on the COVID-19 pandemic and collected stock return data from 1,750 US firms. Contrary to their expectations, the study found that overall corporate social responsibility scores don't have a significant relationship with stock returns during the examined crash or recovery periods.

2.3. Airline industry during the COVID-19 pandemic and its link to ESG

As previously discussed, the airline industry suffered more than other industries during the COVID-19 pandemic because of wide-ranging restrictions, such as lockdowns and travel restrictions. Furthermore, airlines' business models are highly carbon-intensive, so they are strongly related to ESG topics to prevent climate change. The literature deals with this specific sector. For example, Kuo et al. (2021) conducted a study investigating whether corporate social responsibility activities lead to better financial performance of airline companies. Moreover, they used data from 30 different airlines from 2012 to 2016 for the multi-quadratic growth model to examine the impact of corporate social responsibility activities on the return on assets. Finally, the results show a U-shaped link between corporate social responsibility performance and return on assets. The ROA is likely to continue in the early implementation stage of corporate social responsibility practices. Still, the ROA improves when corporate social responsibility practices become more integrated. Next, Yang & Baasandorj (2017) analyze the relationship between corporate social responsibility and the financial performance of full-service and low-cost airlines. Their dataset spans from 2006 to 2015 and includes 16 airlines from all regions around the world. Moreover, the financial performance is measured using ROA and Tobin's Q. On the one hand, ROA was significant for full-service airlines, which

demonstrate high engagement in corporate social responsibility activities, while it was not significant for low-cost carriers.

On the other hand, Tobin's Q was only significant for low-cost carriers regarding environmental activities rather than overall corporate social responsibility activities. At the same time, it was not significant for full-service airlines. In addition, Lee et al. (2013) analyzed the relationship between corporate social responsibility and firm performance of airlines while including oil prices to see how it moderates this relationship. For this purpose, they collected data from 17 US airlines from 1991 to 2009 and used Tobin's Q to measure firm performance. The results document that operational-related corporate social responsibility activities have a significant positive effect on firm performance.

Chen et al. (2022) examined whether the pandemic significantly negatively impacted the stock returns of all included airlines. Moreover, they underlined that higher ESG scores positively influenced stock returns during the COVID-19 pandemic, which indicates a defense mechanism that helped during the pandemic's shock. Lastly, Mintah and Gulko (2023) also examined the financial performance of airlines during the COVID-19 pandemic and documented a significant decline in ROA, which is the profitability measure in this study.

2.4. Hypothesis development

After discussing the previous literature about the performance of companies that have a strong emphasis on corporate social responsibility as well as ESG and additionally about the connection of their performance in times of the COVID-19 pandemic, it stood out that companies with a high ESG performance performed better than their counterparts. On the one hand, most papers on this topic mainly investigated stock performance while conducting event studies. On the other hand, a few papers focused their analysis on financial performance, indicating better performance for companies with higher ESG performance. However, their research did not primarily target airline companies. At the same time, some papers for airline companies analyzed the stock performance of high ESG airlines during COVID-19, with the same result as the other papers. But, the literature also found that there is no effect at all. However, most of the literature results indicate that high ESG companies performed better. Therefore, I investigated the following question for a specific industry: Did airline companies with a high ESG score perform better during the COVID-19 pandemic?

The resulting hypothesis is: There has been a significantly better financial performance for high ESG airline companies than for airline companies without high ESG performance during the COVID-19 pandemic.

3. Methodology

The methodology will be discussed in this section, and the data used for this research will be displayed and described. Furthermore, there is a detailed explanation of how to determine the difference-in-difference approach to investigate the research question and the hypothesis.

3.1. Data

To investigate the hypothesis, I examined the financial data of 81 airlines from every region of the world. Firstly, the airline companies' financial data was retrieved from *Refintiv Eikon*. The financial data included the balance sheet and the profit and loss statement from 2017 to 2022 of the 81 airline companies. Moreover, the balance sheet and the profit and loss statement were used to examine essential positions and ratios to build the dependent and independent variables. Secondly, I retrieved the ESG scores for each airline company from *Refintiv Eikon*. The ESG scores have different thresholds oriented to credit rating classes. They start with a D-, which signifies the worst rating a company can achieve, and an A+, the highest rating available. Moreover, each rating has threshold limits in both ways (up and down), which are classified by numbers. I also added the regions where the airline companies originated. Table 1 provides an overview of the airline companies included in this sample, which comprises both listed and non-listed companies. It highlights that Asia and North America are the most prominent regions within the sample.

Table 1: List of sampled airline companies

Airlines	Region	Airlines	Region
Aegean	Europe	Icelandair	Europe
Aeroflot	Europe	IndiGo	Asia
Air Asia (Capital A)	Asia	Japan Airlines	Asia
Air Astana	Asia	Jazeera Airways	Middle East
Air Canada	North America	Jejuair	Asia
Air China	Asia	Jet2	Europe
Air France KLM	Europe	Jet Airways	North America
Air New Zealand	Oceania	JetBlue	North America
Air Transport Services	North America	Jin Air	Asia
Alaska Air Group	North America	Kenya Airways	Africa
Allegiant	North America	KNAFAIM Holdings	Middle East
American Airlines	North America	Korean Air	Asia
ANA Holdings	Asia	LATAM Airlines	South America
Asia Aviation PCL	Asia	Lufthansa	Europe
Asiana	Asia	Nok Airlines	Asia
ASL Airlines	Europe	Norwegian	Europe
Azul	South America	PAL Holdings	Asia
Bangkok Airways	Asia	Pegasus	Europe
Cathay Pacific	Asia	PIA Holdings	Asia
Cebu Air	Asia	Qantas Airways	Oceania
China Airlines	Asia	Regional Express Airlines	Oceania
China Eastern Airlines	Asia	Royal Jordanian Airlines	Middle East
China Express Airlines	Asia	Ryanair	Europe
China Southern Airlines	Asia	Singapore Airlines	Asia
Chorus Aviation	North America	Skywest	North America
Copa	South America	Southwest	North America
Croatia Airlines	Europe	Spicejet	Asia
Danish Air Transport	Europe	Spirit	North America
Delta Air Lines	North America	Spring Airlines	Asia
Easyjet	Europe	Starflyer	Asia
El Al Israel	Middle East	Thai Airways	Asia
Enterair	Europe	Tigerair	Asia
EVA Airways Corp	Asia	Titan Airways	Europe
Exchange Income Corp	North America	TUI	Europe
FedEx	North America	Turkish Airlines	Europe
Finnair	Europe	T'Way	Asia
Garuda Indonesia	Asia	UTAir	Europe
Gol	South America	United Airlines	North America
Hainain Airlines	Asia	Vietjet	Asia
Hawaiian	North America	Volaris	South America
IAG	Europe	Wizzair	Europe

Note: Table 1 displays an overview of all the airline companies which were used in this analysis. Additionally, the regions of the airlines were listed. Moreover, the regions are the following: Africa, Asia, Europe, Middle East, North America, Oceania, and South America.

Table 2: Description of the dataset

Panel A: Descriptive statistics

	ESG Score	Size	Leverage	Net Income	Cash Holdings	Tangibility
N	292	492	492	492	492	492
Mean	53,909	8,336	6,810	-48,306	0,155	0,566
St. Dev.	19,143	1,660	86,967	1.960,530	0,119	0,191
Min.	11,020	3,863	-206,059	-12.385,000	0,001	0,023
Median	56,780	8,351	1,369	6,755	0,130	0,602
Max.	86,700	11,362	1.836,826	13.277,270	0,711	0,904

Panel B: Pearson correlation matrix

	ESG Score	Size	Leverage	Net Income	Cash Holdings	Tangibilty
ESG Score	1,000	0,587	0,026	0,098	-0,100	0,037
		(0,000)	(0,666)	(0,098)	(0,100)	(0,530)
Size		1,000	0,052	-0,026	-0,160	0,350
			(0,249)	(0,555)	(0,004)	(0,000)
Leverage			1,000	-0,082	0,060	-0,038
				(0,071)	(0,192)	(0,410)
Net Income				1,000	-0,019	0,031
					(0,671)	(0,502)
Cash Holdings					1,000	-0,452
						(0,000)
Tangibility						1,000

Note: Panel A showcases the summary statistics of the dependent variables used to build the difference-in-difference regression. For a comprehensive overview, Panel A includes the number of observations, the mean, standard deviation, minimum, median, and maximum. Moreover, Panel A was constructed based on the paper of Bae et al. (2021).
Panel B displays the Pearson correlation matrix. It's constructed in the same way as in the paper of Yahya (2023). Furthermore, it highlights the linear relationships between the different variables. The values span between -1 and 1, which show the direction and strength of the correlation. A positive value indicates a positive correlation, while a negative value suggests a negative correlation. In contrast, a value close to zero displays a weak or absent linear connection between the variables (Duarte et al. 2019). Beneath each correlation value are the p-values in parentheses, which underline the statistical significance of the correlation between these variables.

Panel A of Table 2 shows the descriptive statistics for the airline companies' ESG scores and the control variables that were used for the difference-in-difference regression. The number of observations varies when comparing the variable ESG Score with other variables because the full sample also includes companies that have no ESG score. However, the panel displays an average ESG score of 53,909 and a median of 56,780**,** while the minimum ESG score is 11,020 and the maximum is 86,700. Moreover, the most extensive standard deviation in the data is the net income of the chosen airline companies. To compare the variable values among airline companies in the treated and control groups, refer to Table A.1.

Panel B underlines the correlations between the different variables used in this thesis. Notably, the variable ESG score has a significant positive correlation with the variable Size as it is significant at the 1% level. Moreover, the variable ESG Score significantly correlates with Net Income and Cash Holdings at the 10% significance level. The Pearson correlation matrix also demonstrates a significant negative correlation between Size and Cash Holdings and a positive significant correlation with Tangibility at the 1% significance level. However, Leverage just significantly correlates with Net Income at the 10% significance level. Lastly, Cash Holdings showcases a significant negative correlation with tangibility at the 1% significance level.

3.2. Empirical design

This research uses a difference-in-difference analysis to assess how a high ESG score affects an airline's profitability during the COVID-19 pandemic. In addition, the difference-in-difference method examines a treated effect for companies with a specific treatment, such as a high ESG score. It emphasizes the distinctions between the treatment and control groups. It depends on the parallel trend assumption, indicating that, without treatment, both groups would have displayed a similar trajectory in the outcome variable across time. In this research, the dependent variable is the profitability of airline firms, and the difference-in-difference regression can be illustrated here by the subsequent regression equation (Eq. 1):

$$Profitability_i = \alpha + \beta_1\, High\, ESG_{Treated_i} + \beta_2\, Corona_{After_t} + \beta_3\, High\, ESG_{Treated_i} \times Corona_{After_t} + \beta_4\, Controls_i + \gamma_i + \delta_t + \varepsilon_{it} \quad \text{(Eq. 1)}$$

First, profitability is measured by return on assets, which has been widely used in previous literature. I'm also using this ratio as a dependent variable to sustain a comprehensive comparison with the existing literature. Moreover, this ratio is structured as follows: Net Income over Total Assets times 100.

Second is the treated variable, which, in this case, is named High ESG. Every airline with an ESG score above 55% is classified as a treated company in this sample. It equals one when the ESG score of an airline is 55% or higher and zero when it's below the 55% limit.[1] The treated variable is considered as a dummy variable, as it measures the difference between treated companies and the control group. The next regression component is the after-variable, namely "Corona", which is again a dummy variable. Moreover, this variable allows us to distinguish the difference between the pre and post-treatment periods. Therefore, the after-variable equals one for 2020, 2021, and 2022, respectively, zero for the years before 2020. Additionally, there is an interaction term of treated and after, referred to as High ESG x Corona. It equals one if the ESG Score is equal to or above the cutoff limit and the year corresponds to the years 2020 to 2022. Furthermore, the interaction term captures the significant treatment effect, where airline companies with a high ESG score are treated as the exposed group. Next to that, the other regression components are the control variables, firm and time-fixed effects, and the error term. The control variables in this regression are the following: Size[2], Leverage[3], Net Income, Cash Holdings[4], and Tangibility[5]. Those control variables can also be found in previous studies addressing similar topics, such as the papers of Albuquerque et al. (2020), Inamdar (2024), Lee et al. (2013), and Yahya (2023).

Moreover, the study was conducted in two stages to ensure clarity and robustness. Firstly, the regression (Eq. 1) was performed on the full sample. The full sample includes airline companies with high ESG scores, low ESG scores, and no ESG scores. Furthermore, I assumed that including airline companies without ESG scores is important, as they present a lack of transparency regarding their ESG disclosures, which leads them to be less engaged with sustainability topics in their communication with their stakeholders.[6] For this reason, I classified airline companies without ESG scores as low ESG to avoid potential biases caused by their exclusion and to maximize the sample size. Secondly, a subsample was created to test the robustness of the results from the full sample and address potential concerns about the inclusion of airline companies without ESG scores. Therefore, the subsample excludes airline

[1] The 55% cutoff for the classification of a high ESG company was chosen because it is in the middle of the threshold B-, which is the first threshold that indicates a good grade in the scale of the ESG score from *Refintiv Eikon*. The threshold ranges from 50% to 58%, but I chose a value in the middle to avoid getting too close to each limit of the threshold. That ensures that companies near the edges of the threshold do not affect or distort the results.

[2] The variable size was constructed as follows: natural logarithm of total assets.

[3] The variable leverage was constructed with the debt-to-equity ratio.

[4] The variable cash holding was constructed as follows: cash and short-term investments over total assets.

[5] The variable tangibility was built as follows: PPE over total assets.

[6] Qin and Lee (2024) also suggest that higher transparency reduces asymmetries of information between companies and their stakeholders.

companies without ESG scores and allows a more direct comparison between companies with high ESG scores and low ESG scores.

The dataset obtains financial data for all airline companies from 2017 to 2022. After retrieving and organizing the data, I constructed a panel dataset with all financial ratios for each company and year. To answer the research question comprehensively, the regression (Eq. 1) has also been performed for the subsample. However, due to a lack of data within the subsample, the regression analyzed the treated effect only for the years 2018 to 2022.

Additionally, I used alternative thresholds to define the high ESG score variable and applied winsorizing techniques to address potential outliers. Moreover, I conducted parallel trend analyses to ensure the robustness of the regression findings. Lastly, the study was conducted using appropriate software, such as Stata and Excel. This provides a reliable platform for data preparation, regression analysis, and result validation.

4. Results

This chapter describes the results of the regression analyses. Moreover, it will delve into the results of the base scenarios and other scenarios. Additionally, it includes a discussion of the robustness of the findings following data winsorization. Additionally, the findings of the parallel trend analysis are presented.

4.1. Role of High ESG scores in airline performance during COVID-19 pandemic

Table 3 displays the coefficients of every variable from the difference-in-difference regression and provides an overview of how the variables intertwine with the profitability of airline companies within the observation period. The results of the base scenario for the full- and subsample indicate that airline companies who were treated had significantly better profitability during the COVID-19 pandemic, as High ESG x Corona presents a significant coefficient. Additionally, the p-value of the High ESG x Corona showcases a statistical significance at the 1% significance level. Therefore, the result allows us not to reject the hypothesis for this base scenario. On the one hand, the variable “High ESG” shows that companies with a high ESG score usually have a weak performance, as their coefficient is negative. Still, the base scenario didn’t find significant evidence.

On the other hand, the study found statistical significance in the after-variable “Corona.” This variable's negative coefficient means that profitability decreased significantly for all analyzed airline companies during the COVID-19 pandemic. Furthermore, the after-variable shows significance at all statistical significance levels.

Table 3: Results of the base scenario

Full Sample

Return on Assets		Coefficient	P-Value	Sig.
N	486			
High ESG		-4,01	(0,131)	
Corona		-7,47	(0,000)	***
High ESG x Corona		6,83	(0,000)	***
Size		-0,88	(0,614)	
Leverage		0,00	(0,940)	
Net Income		0,00	(0,000)	***
Cash Holdings		38,28	(0,000)	***
Tangibility		1,77	(0,789)	
R^2	0,28			
Firm FE	Yes			
Time FE	Yes			

Subsample

Return on Assets		Coefficient	P-Value	Sig.
N	230			
High ESG		-1,73	(0,477)	
Corona		-8,56	(0,000)	***
High ESG x Corona		5,50	(0,006)	***
Size		2,33	(0,456)	
Leverage		0,00	(0,979)	
Net Income		0,00	(0,000)	***
Cash Holdings		38,45	(0,006)	***
Tangibility		12,93	(0,225)	
R^2	0,39			
Firm FE	Yes			
Time FE	Yes			

Note: Table 3 shows the number of observations for each sample and the coefficients of each regression variable. Moreover, the table includes the P-value displayed in parentheses to show whether the coefficient is statistically significant. The significance level is presented in * for 10%, ** for 5%, and *** for 1%. Furthermore, the treated variable is displayed as High ESG, the after-variable as Corona, and the interaction term of treated and after as High ESG x Corona. The results aim to capture the effects of ESG performance, the COVID-19 pandemic, and financial characteristics such as size, leverage, net income, cash holdings, and tangibility on the firm performance of the analyzed airline companies. In addition, the table shows the R^2 and the fixed effects.

4.2. Different cutoff levels for the treated variable “High ESG”

This study chose different cutoff levels for the treated variable to further analyze how high ESG scores affected airline companies' performance during the COVID-19 pandemic. This procedure allows us to prove whether the statistically significant result for the difference-in-difference estimator from the base scenario still holds when the level of getting the treated status is shifted to the lowest limit of rating class B- from the *Refinitiv Eikon* ESG score rating and to the next highest rating class, B.

Table 4 summarizes the difference-in-difference regression results on the dependent variable profitability under different high ESG score cutoffs (50% and 60%) across the full and subsample. The difference-in-difference estimator (High ESG x Treated) presents a positive and statistically significant coefficient in both cutoff scenarios. The same as in the base scenario, the 50% and 60% cutoff in the full sample present significant difference-in-difference estimators for the significance levels 10%, 5%, and 1%. This supports the suggestion that airline companies with a high ESG score performed better during the COVID-19 pandemic than their counterparts.

Table 4: Results of different cutoff scenarios

Panel A:

50% Cutoff Scenario		*Full Sample*			*Subsample*		
Return on Assets		Coefficient	P-Value	Sig.	Coefficient	P-Value	Sig.
N	486			230			
High ESG		-4,09	(0,107)		-1,30	(0,588)	
Corona		-7,22	(0,000)	***	-8,07	(0,001)	***
High ESG x Corona		5,43	(0,004)	***	3,76	(0,088)	*
Size		-1,06	(0,548)		1,57	(0,620)	
Leverage		0,00	(0,999)		0,00	(0,914)	
Net Income		0,00	(0,000)	***	0,00	(0,000)	***
Cash Holdings		38,79	(0,000)	***	38,37	(0,007)	***
Tangibility		1,41	(0,832)		11,13	(0,307)	
R^2	0,26			0,38			
Firm FE	Yes			Yes			
Time FE	Yes			Yes			

Panel B:

60% Cutoff Scenario		*Full Sample*			*Subsample*		
Return on Assets		Coefficient	P-Value	Sig.	Coefficient	P-Value	Sig.
N	486			230			
High ESG		-4,48	(0,072)		-2,00	(0,424)	
Corona		-7,02	(0,000)	***	-7,52	(0,000)	***
High ESG x Corona		6,22	(0,002)	***	4,43	(0,028)	***
Size		-0,81	(0,645)		1,98	(0,531)	
Leverage		0,00	(0,987)		0,00	(0,959)	
Net Income		0,00	(0,000)	***	0,00	(0,000)	***
Cash Holdings		38,31	(0,000)	***	36,18	(0,010)	***
Tangibility		1,55	(0,814)		12,44	(0,247)	
R^2	0,28			0,40			
Firm FE	Yes			Yes			
Time FE	Yes			Yes			

Note: Table 4 presents the regression results between the independent variables and the Return on Assets across different sample compositions and ESG score cut-offs. The analysis is divided into a full sample and a subsample, which only includes firms with an ESG score. Furthermore, the threshold to receive the treated status was shifted to the ESG score of 50% and 60%. Table 4 includes the coefficients of the treated variable, after the variable, the difference-in-difference estimator, and control variables, along with their corresponding p-values and their significance level (*=10%, **=5%, and ***=1%). In addition, the table shows the R^2 and the fixed effects.

Next, in the full sample, the coefficient for the treated variable “High ESG” is negative across both cutoffs for high ESG. However, the variable is not significant except in the regression with a 60% cutoff level within the full sample, where the treated variable is significant for a 10% significance level. Moreover, the after variable “Corona”, representing the COVID-19 pandemic period, shows as same as in the base scenario: consistently negative and high significance for all significance levels. This indicates a strong association between the decline in profitability for airline companies and the COVID-19 pandemic.

However, the results of the difference-in-difference estimator changed in the subsample. In comparison to the results of the base scenario of the subsample, the interaction term “High ESG x Corona” is only significant for the 10% significance level in the 50% cutoff scenario. In contrast, the 60% cutoff scenario displays significance for the significance levels 10%, 5%, and 1%. This shows a decrease in significance in the 50% cutoff scenario. However, it remains significant and still supports the suggestion that airline companies with a high ESG score performed better during the COVID-19 pandemic. Moreover, the treated variable “High ESG” remains negative but statistically insignificant as well, which is consistent with the results of the base scenario and with the different cutoffs for the full sample. The after variable “Corona” continues to show negative and, at the same time, significant coefficients.

Table 5: Results with winsorized data (1%)

Full Sample - Base Scenario

Return on Assets		Coefficient	P-Value	Sig.
N	486			
High ESG		-4,42	(0,090)	*
Corona		-7,47	(0,000)	***
High ESG x Corona		7,16	(0,000)	***
Size		-0,62	(0,717)	
Leverage		0,00	(0,995)	
Net Income		0,00	(0,000)	***
Cash Holdings		38,16	(0,000)	***
Tangibility		1,24	(0,846)	
R^2	0,35			
Firm FE	Yes			
Time FE	Yes			

Subsample - Base Scenario

Return on Assets		Coefficient	P-Value	Sig.
N	230			
High ESG		-1,84	(0,452)	
Corona		-8,87	(0,000)	***
High ESG x Corona		5,46	(0,006)	***
Size		3,80	(0,242)	
Leverage		0,00	(0,855)	
Net Income		0,00	(0,000)	***
Cash Holdings		42,64	(0,002)	***
Tangibility		15,55	(0,147)	
R^2	0,49			
Firm FE	Yes			
Time FE	Yes			

Note: Table 5 displays the regression results after applying the winsorization technique for 1%. The table is divided into two sections: one for the analysis of the full sample and one for the subsample analysis. Moreover, it still includes the regression variables and their corresponding p-values in parentheses to show whether statistical significance exists. The different significance levels are displayed as *=10%, **=5%, and ***=1%. In addition, the table shows the R^2 and the fixed effects.

4.3. Results of base scenario after winzorizing the data

The winzorizing of the data limits the extreme values in the data set and allows the reduction of the effect of outliers, which could affect the results (Sullivan et al. 2021). Therefore, the data were winsorized to check if the results of the previously discussed analysis were still held after the data were manipulated. Therefore, the data were winsorized on two different levels, first to 99% 1% percentile and second to 97,5% 2,5% percentile.

For the full sample, even with the winsorized data, it can be shown that the coefficient of the difference-in-difference estimator "High ESG x Corona" is consistent with the base scenario and the various cutoff scenarios and demonstrates positive significance for all levels. Furthermore, the coefficient for the variable "High ESG" remains negative in Table 5, but compared to the previous analysis of the base scenario, it is significant at the 10% significance level. Moreover, the coefficient for the variable "Corona" remains significantly negative as during the previous analysis. Compared to the results of the subsample after winsorizing, Table 5 presents that the result regarding statistical significance for the interaction term is the same as those for the full sample and coherent with the previous results.

The results for the full sample in the base scenario, after winsorizing the data for 2,5%, follow the same trend as the previous analysis results in this study. Regarding the coefficient of the interaction term, Table 6 displays once again positive and significant for the 10%, 5%, and 1% levels. Furthermore, for the treated variable high ESG, Table 6 presents a significance coefficient at a 10% and 5% significance level. Moreover, the variable for the post-treatment period, namely Corona, remains with a negative coefficient with a high significance. Additionally, the results of the subsample in the baseline scenario in Table 6 confirm that they didn't change much and are in line with previous results. Therefore, the difference-in-difference estimator in Table 6 again shows a positive and highly significant coefficient, which is consistent with previous results. The treated variable High ESG is still negative but not significant, whereas Corona remains its negative, highly significant coefficient.

Table 6: Results with winsorized data (2,5%)

Full Sample - Base Scenario

Return on Assets		Coefficient	P-Value	Sig.
N	486			
High ESG		-5,40	(0,031)	**
Corona		-7,27	(0,000)	***
High ESG x Corona		8,64	(0,000)	***
Size		-0,42	(0,801)	
Leverage		0,00	(0,941)	
Net Income		0,00	(0,000)	***
Cash Holdings		39,09	(0,000)	***
Tangibility		0,62	(0,919)	
R^2	0,36			
Firm FE	Yes			
Time FE	Yes			

Subsample - Base Scenario

Return on Assets		Coefficient	P-Value	Sig.
N	230			
High ESG		-2,16	(0,366)	
Corona		-8,78	(0,000)	***
High ESG x Corona		5,98	(0,002)	***
Size		3,40	(0,289)	
Leverage		0,00	(0,948)	
Net Income		0,00	(0,000)	***
Cash Holdings		43,14	(0,002)	***
Tangibility		16,24	(0,126)	
R^2	0,46			
Firm FE	Yes			
Time FE	Yes			

Note: Table 6 presents the findings of the difference-in-difference regression with Return on Assets, as a measure of the profitability of airline companies, as the dependent variable. In this regression, the data were winsorized on 97,5% as the upper limit and on 2,5% as the lower limit. The different significance levels are displayed as *=10%, **=5%, and ***=1%). In addition, the table shows the R^2, the fixed effects, and the corresponding P-Values.

4.4. Results of the cutoff scenarios after winsorizing the data

Table 7 describes the results of both cutoff scenarios with the winsorized data of 1%. For the winsorized full sample with the 50% cutoff, the interaction term “High ESG x Corona” stays significant for all levels in the analysis. Moreover, the treated variable “High ESG” remains negative, but this time, this analysis does find statistical significance. Corona, which captures the effects of the pandemic period, is still significant and is in line with previous examination of the study. Furthermore, the subsample with the 50% cutoff displays a significant interaction term High ESG x Corona on a 10% significance level. Furthermore, there is still no statistical significance for the treated variable “High ESG” and the after-variable “Corona” remains significant, which is coherent with the previous analysis for the 50% cutoff.

Additionally, Table 7 presents also the results for the 60% cutoff with the winsorized data. Here, the full sample results are mostly consistent with the 50% cutoff using winsorized data and with those results from the examination of the 60% cutoff with the original data. This means the interaction term of the treated and after variable remains positively significant for all three significance levels. However, the coefficient for High ESG is statistically significant here at the 10% and 5% levels. The variable Corona remains negative and highly significant. Furthermore, in the subsample with a 60% ESG score cutoff, the coefficient of the interaction term is significant at the 10% and 5% levels. Moreover, High ESG remains negative and insignificant, while Corona still shows negative significance at the 10%, 5%, and 1% levels.

Table 7: Results of different cutoff scenarios with winsorized data (1%)

Panel A:

50% Cutoff Scenario		*Full Sample*			*Subsample*		
Return on Assets		Coefficient	P-Value	Sig.	Coefficient	P-Value	Sig.
N	486			230			
High ESG		-4,51	(0,071)	*	-1,67	(0,492)	
Corona		-7,25	(0,000)	***	-8,61	(0,000)	***
High ESG x Corona		5,88	(0,001)	***	4,04	(0,066)	*
Size		-0,80	(0,646)		3,26	(0,321)	
Leverage		0,00	(0,943)		0,00	(0,796)	
Net Income		0,00	(0,000)	***	0,00	(0,000)	***
Cash Holdings		38,58	(0,000)	***	42,62	(0,002)	***
Tangibility		0,80	(0,902)		14,44	(0,187)	
R^2	0,32			0,50			
Firm FE	Yes			Yes			
Time FE	Yes			Yes			

Panel B: Results

60% Cutoff Scenario		*Full Sample*			*Subsample*		
Return on Assets		Coefficient	P-Value	Sig.	Coefficient	P-Value	Sig.
N	486			230			
High ESG		-4,78	(0,051)	**	-2,11	(0,402)	
Corona		-7,02	(0,000)	***	-7,77	(0,000)	***
High ESG x Corona		6,42	(0,001)	***	4,27	(0,035)	**
Size		-0,54	(0,756)		3,50	(0,286)	
Leverage		0,00	(0,927)		0,00	(0,835)	
Net Income		0,00	(0,000)	***	0,00	(0,000)	***
Cash Holdings		38,08	(0,000)	***	40,22	(0,004)	***
Tangibility		0,93	(0,886)		15,10	(0,162)	
R^2	0,34			0,51			
Firm FE	Yes			Yes			
Time FE	Yes			Yes			

Note: The coefficient of regression results summarized in Table 7 investigate profitability, with Return on Assets as the measure of profitability. For this analysis, the winsorized data was used to examine whether the significant results of the difference-in-difference estimator still hold for both cutoff levels (50% and 60%). Moreover, the corresponding p-values of the coefficients are displayed in parentheses, along with their significance level (* = 10%, ** = 5%, *** = 1%). In addition, the table shows the R^2 and the fixed effects.

After winsorizing the data for 2,5% in each way, up and down, and applying this in the methodology for the different cutoffs, Table 8 describes the results of this examination. Noticeable for the results of the full sample is that the treated variable "High ESG" got more significant with the winsorizing of 2,5% in comparison to the winsorizing of 1% and the results with the original data for the different cutoff scenarios. For the 50% cutoff, the variable High ESG is now significant for the 10% and 5% significance levels. The same holds for the coefficient of "High ESG x ESG" which is significant at the 10%, 5%, and 1% significance levels in the 50% and 60% cutoff scenarios. Moreover, Corona remains significant on the same levels.

For the subsample, the results were consistent with previous findings. It can be observed that the significance of the difference-in-difference estimator has increased after the data was winsorized at 2.5% compared to the results of winsorizing at 1% within the 50% cutoff scenario. Therefore, the coefficient interaction term "High ESG x Corona" is significant at the 10% and 5% significance levels. For the 60% cutoff level, there are no changes in the significance of the coefficient for the interaction term compared to previous results using the 60% cutoff level with 1% winsorized data.

Table 8: Results of different cutoff scenarios with winsorized data (2,5%)

Panel A:

50% Cutoff Scenario		*Full Sample*				*Subsample*	
Return on Assets	Coefficient	P-Value	Sig.	Coefficient	P-Value	Sig.	
N	486			230			
High ESG	-5,44	(0,024)	**	-2,06	(0,389)		
Corona	-7,11	(0,000)	***	-8,35	(0,000)	***	
High ESG x Corona	7,37	(0,000)	***	4,34	(0,044)	**	
Size	-0,68	(0,682)		2,93	(0,368)		
Leverage	0,00	(0,873)		0,00	(0,882)		
Net Income	0,00	(0,000)	***	0,00	(0,000)	***	
Cash Holdings	39,44	(0,000)	***	41,45	(0,004)	***	
Tangibility	0,14	(0,982)		13,90	(0,201)		
R^2	0,33			0,46			
Firm FE	Yes			Yes			
Time FE	Yes			Yes			

Panel B: Results

60% Cutoff Scenario		*Full Sample*				*Subsample*	
Return on Assets	Coefficient	P-Value	Sig.	Coefficient	P-Value	Sig.	
N	486			230			
High ESG	-5,70	(0,016)	**	-2,67	(0,276)		
Corona	-6,72	(0,000)	***	-7,63	(0,000)	***	
High ESG x Corona	7,84	(0,000)	***	4,90	(0,013)	**	
Size	-0,34	(0,838)		3,04	(0,348)		
Leverage	0,00	(0,852)		0,00	(0,932)		
Net Income	0,00	(0,000)	***	0,00	(0,000)	***	
Cash Holdings	38,86	(0,000)	***	39,79	(0,005)	***	
Tangibility	0,27	(0,964)		15,52	(0,148)		
R^2	0,35			0,48			
Firm FE	Yes			Yes			
Time FE	Yes			Yes			

Note: The analysis in Table 8 examines the profitability difference between airline companies with a high ESG score and those without one or with a low ESG score during the COVID-19 pandemic. Moreover, the data for this regression were winsorized in a magnitude of 2,5% each way. The results are divided into two sections. Panel A presents the results of the 50% cutoff level for the variables' coefficients for the full sample and subsample. Panel B describes the results of the coefficients for the 60% cutoff level. The different significance levels are displayed as *=10%, **=5%, and ***=1%). In addition, the table shows the R^2, the fixed effects, and the corresponding P-values.

4.5. Parallel trend analysis for profitability

Regarding the parallel trend of profitability in the base scenario with the full sample in use, Figure 1 presents a downward trend in profitability for the pre-treatment period (before the COVID-19 pandemic) for the treated, displayed as high ESG and control companies, presented as low ESG. However, in the year 2020, both groups experienced a sharp drop in profitability, but for low ESG airline companies, the drop in profitability was heavier. For the following years, 2021 and 2022, it can be stated that both groups showcase a recovery in profitability. Whereas it seems that high ESG airline companies recovered faster than their counterparts. Noticeably, the profitability of low ESG airline companies is slightly higher than that of high ESG airline companies in 2021. Possible reasons for this circumstance are the travel restrictions in different countries or the fact that it's affected by an outlier. Moreover, for the year 2022, we see again a steeper increase in profitability for high ESG airline companies. Summarising, it can be concluded that the parallel trend assumption doesn't hold perfectly, as the year 2021 breaks the parallel trend.

Figure 1: Parallel trend for the base scenario while using the full sample

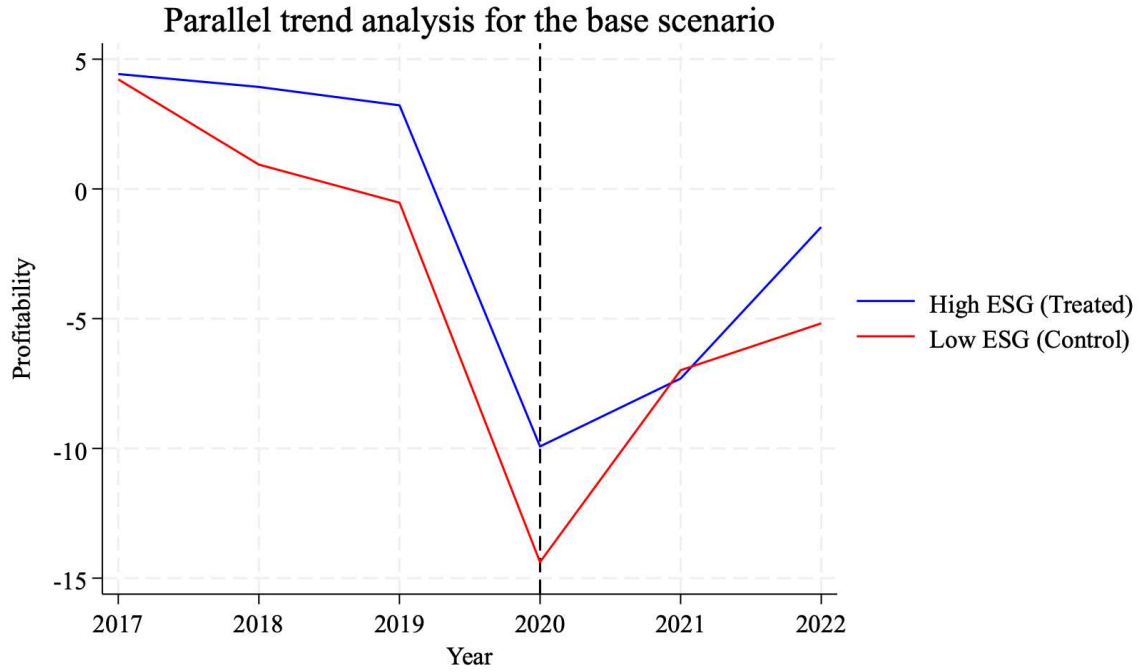

Figure 1 displays the average mean profitability for treated companies, classified as High ESG in this figure, and control companies, classified as Low ESG. The profitability is measured as Return on Assets. The graph covers the period from 2017 to 2022. Moreover, the full sample was utilized for this figure, which includes airline companies without ESG scores, which, as previously noted, are categorized as low ESG airline companies.

After winsorizing the data for the 1% and 99%, respectively, 2,5% and 97,5% percentiles, the parallel trend of both groups changed, as Figure A.1 shows. Here, the drop in profitability is not as heavy for high ESG airline companies as in Figure 1. Moreover, Figure A.1 no longer displays a higher profitability for the control group during the year 2021. This means the parallel trend assumption holds after the data was winsorized, indicating that the outliers could have affected the parallel trend in Figure 1.

Figure 2 presents the parallel trend while using the subsample, which excludes airline companies without ESG scores. Regarding the years before the COVID-19 pandemic, high ESG airline companies, as well as low ESG airline companies, demonstrate an almost parallel trend. Still, in comparison with Figure 1, their profitability trends are closer to each other. Moreover, the year 2021 presents higher profitability for the control group (low ESG airline companies) again. But this time, the difference to the treated airline companies is even higher than the full sample in Figure 1. Therefore, we cannot obtain a clear parallel trend for the subsample with the original data.

Figure 2: Parallel trend for the base scenario while using the subsample

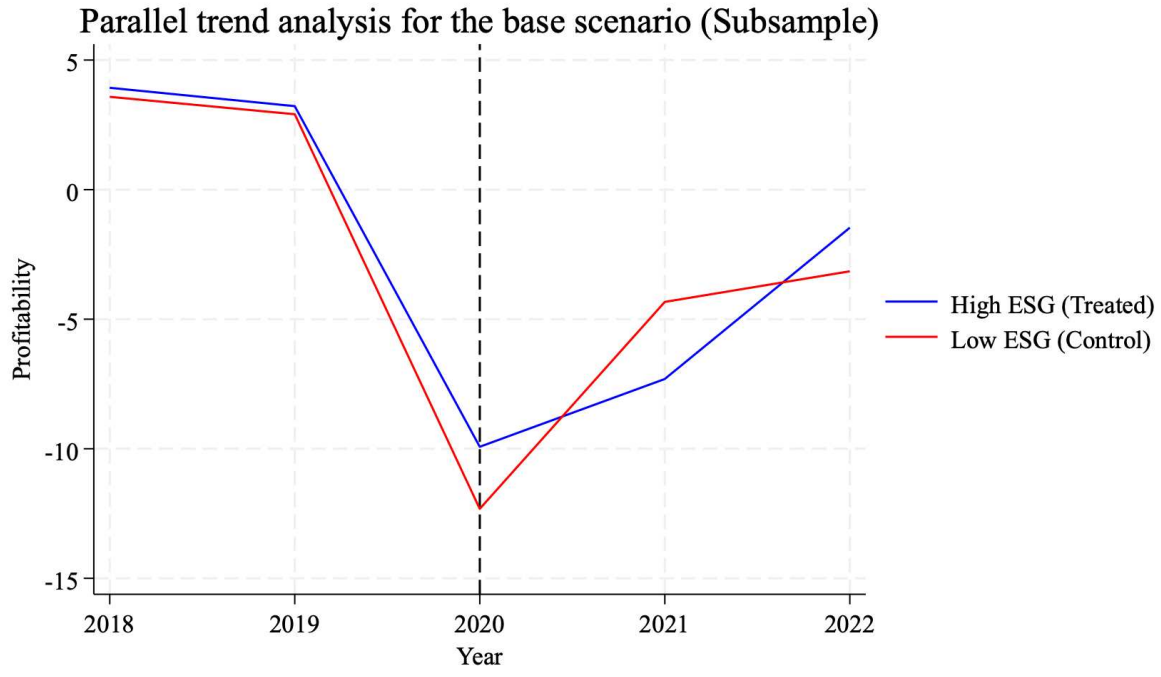

Figure 2 illustrates the average mean profitability for treated companies, classified as High ESG in this figure, and control companies, classified as Low ESG. The profitability is measured as Return on Assets. The graph spans the years from 2018 to 2022. Moreover, the subsample, which excludes airline companies without ESG scores, was used for this figure.

With the winsorized data in the subsample, the trends of high ESG airline companies and low ESG airline companies changed slightly, as shown in Figure A.2. The pre-treatment years now display a bigger difference in the average profitability of both groups. Furthermore, Figure A.2. presents again a slightly higher average profitability trend in 2021 for the control group (low ESG airline companies), whereas the difference in the average profitability between both groups isn't that huge, as shown in the year 2021 Figure 2. However, the parallel trend analysis with winsorized data in the subsample cannot obtain similar trends for the post-treatment period and is coherent with the findings of Figure 2.

5. Conclusion

This study examined the impact of high ESG performance, based on *Refintiv Eikons'* ESG score, on the financial performance of airline companies during the COVID-19 pandemic while running a difference-in-difference regression to obtain the effect. The study was completed while using different cutoff scenarios besides the base scenario and the winsorizing of the data. Moreover, I used a subsample and conducted a parallel trend analysis to establish a robustness test. Furthermore, in the literature, the sample size was smaller, whereas this study could include more airline companies in researching the effect of ESG performance on profitability during the COVID-19 pandemic.

5.1. Summary of the key findings

The results reveal several important patterns across the various analyses. As the empirical study is based on the difference-in-difference approach, the focus of the results lies on the treated variable, the post-treatment variable, and the interaction term of both, which is also considered the difference-in-difference estimator. Regarding the treated variable, which in this study is "High ESG," every company with an ESG score equal to or above 55% is considered a treated company; the results show in almost every scenario but without any significance. Moreover, the post-treatment variable "Corona" which presents the years of the COVID-19 pandemic, demonstrates a negative coefficient with a high significance for all levels throughout every analysis. Next, the results of the interaction term "High ESG x Corona" displayed a positive coefficient throughout every scenario. Regarding the significance of the interaction term, the findings of the study could demonstrate in almost every scenario a significance for 10%, 5%, and 1% significance level and that for both samples. Therefore, the hypothesis couldn't be rejected in almost every case.

Among the control variables, Cash Holdings was the only variable that consistently displayed a strong positive and significant coefficient for all profitability measures in every scenario. In contrast to the other financial characteristics that have been used as control variables, namely Size, Leverage, and Tangibility, they couldn't demonstrate significant coefficients. Furthermore, Net Income exhibited no variation in its coefficient, although it was consistently significant in every scenario. However, the parallel trend analysis does not show a clear parallel trend either for the full sample or for the subsample. However, with winsorized data, the full sample can demonstrate a clear parallel trend for the treated and control group. Lastly, the findings of the parallel trend analysis don't support the robustness of the statistically significant coefficients of the difference-in-difference estimator.

5.2. Interpretation of the key findings

The treated variable shows negative coefficients in the study's results and is either marginally significant or insignificant. Thus, it can be implied that companies with a high ESG score do not necessarily outperform their counterparts when measured by profitability. Moreover, the post-treatment variable "Corona," which represents the pandemic period, clearly shows the severe impact of the COVID-19 pandemic on airline profitability. The highly negative and significant coefficient of this variable suggests that the pandemic disrupted operations and financial performance across the industry, regardless of ESG performance or other firm-specific characteristics. However, this result is not surprising given the profound restrictions during this period for the airline industry, such as grounded flights, reduced demand, and heightened operational costs.

The results of the interaction term in this difference-in-difference regression were the main focus. Moreover, the main emphasis has been that the coefficient was positive throughout every scenario and almost significant for the 5% and 1% significance levels throughout the various analyses. Therefore, the main takeaway of these results is that the null hypothesis cannot be rejected, which implies that airline companies with a high ESG score indeed performed better regarding their profitability during the COVID-19 pandemic than their counterparts. From an economic perspective, the result of the coefficient of the interaction term suggests that high ESG firms may benefit from better reputations and enhanced operational risk management. During a crisis like the COVID-19 pandemic, these attributes may lead to better access to capital, customer loyalty, and operational flexibility, which can mitigate the negative economic impacts. Noticeably, the findings of the difference-in-difference estimator don't imply airline that high ESG airline companies were unaffected by the COVID-19 pandemic. Rather, it

highlights their relative resilience compared to their counterparts, as the coefficient of the treated variable is almost always negative. Moreover, the consistent results throughout the entire thesis suggest that airline companies with a high ESG score have a protective buffer.
Furthermore, the positive coefficient confirms that these companies performed better under the treatment conditions during the COVID-19 pandemic, which is equal to the post-treatment period, compared to their counterparts. Therefore, the findings of this study can be very interesting for investors, as ESG performance is linked to the profitability of firms, which indicates that a high ESG performance is also linked with the stability of a firm. Additionally, the findings of the study imply that airline companies without an ESG score don't distinguish themselves from those with a low ESG score. The results of this thesis confirm this assumption, as they don't show a significant difference between the full sample and the subsample.
Regarding the control variables, the study shows that the size of the airline companies is not significant across the various analyses. This indicates that firm size does not strongly influence company profitability in this analysis and that other factors played a more critical role in determining the profitability of these companies during the COVID-19 pandemic. The findings of the control variable leverage are somewhat unexpected, as leverage is often a substantial factor in the financial performance of companies, especially during difficult economic periods. Therefore, one possible explanation for this is that the airline industry is highly capital-intensive and operates with a relatively high level of debt under normal circumstances, which leads to less impactful variation in leverage during crises like the pandemic. However, it could also demonstrate the effectiveness of government support programs during this period, which could have mitigated the effects of leverage on profitability.
Furthermore, the consistently strong positive and statistically significant control variable Cash Holdings underlines the importance of liquidity during the COVID-19 pandemic. Companies with higher cash reserves were likely better equipped, for example, to manage operational disruptions or to meet their financial obligations. In addition, the results of the coefficient for the control variable Net Income limit their interpretive values, as there is a lack of variation throughout this study. Lastly, Tangibility shows insignificant results throughout this study. This implies that the asset structure of companies does not have an important impact on the profitability of the observed airline companies. Therefore, even though fixed assets are crucial for airline companies, their role in determining profitability is not as relevant as other factors that have been discussed previously.
The parallel trend analysis for the full and subsample shows that the average profitability for both groups in the years before the COVID-19 pandemic followed a similar trend. However, in

both samples, the year 2021 showcases a changing pattern regarding the average profitability trend of those two groups. Hereby, the low ESG airline companies demonstrate higher average profitability than the treated companies with a high ESG score. Reasons for this can be versatile. On the one hand, geographical differences could have led to this changing pattern. Many low ESG airline companies are from regions with far less severe travel restrictions than in Europe or North America in 2021.

Furthermore, government support could have been uneven, and some governments provided more substantial support than others, increasing the profitability of those companies. However, one or more outliers could also have affected these findings. In the full sample with winsorized data, the parallel trend analysis demonstrates a clear parallel trend between high ESG airline companies and low ESG airline companies.

5.3. Limitations and further research

This study provides a valuable overview of the relationship between airline companies' ESG performances and their profitability during the COVID-19 pandemic. Still, there must be acknowledged limitations that occurred in the context of this study.

First, the study focuses on the airline industry specifically. While the analysis provides meaningful findings regarding ESG performance and profitability for this sector, these results may not be generalizable to other industries. For instance, industries with lower capital intensity or different operational structures may exhibit different dynamics. Therefore, future research could explore if this relationship holds for other industries in the same way as for the airline industry. Furthermore, the ESG score from *Refinitiv Eikon*, which measures ESG performance in this study, may not fully capture the complexity of companies' ESG initiatives, as these initiatives are widely used and standardized. Factors such as qualitative sustainability efforts or stakeholder engagement may not be reflected in this score. Future research could explore this topic further by considering alternative ESG scores from other databanks, such as *MSCI*. Moreover, the return on assets was selected as the main measurement for companies' profitability due to its widespread use in the literature. However, returns on assets may not capture all dimensions of firm performance. Therefore, this study includes analysis with two further profitability measures, but besides them, there are also existing additional measures to capture the profitability. Expanding the analysis to include additional measures, such as Tobin's Q or EBITDA margin, would enhance the comprehensiveness of the results. Next, the winsorization at 1% and 2,5% of the data mitigates the influence of huge outliers on both upper and lower borders and ensures the robustness of the findings.

Further research on this topic could be conducted with different forms of robustness tests to revise the findings of this study. In addition, the choice of the cutoff levels to determine companies as high ESG companies could also be changed in future research to explore how the difference-in-difference estimator behaves in other cutoff scenarios to get even more insights. Besides that, despite the inclusion of several control variables, the difference-in-difference regression may have omitted factors that could influence airline companies' profitability. For example, regional government support programs, differences in restrictions for airline companies, or variations in customer demands during the pandemic. When these additional factors may be incorporated into future research, it can provide an even more comprehensive understanding of the facts of the case.

Lastly, data availability is an important point in this study. The airline industry includes fewer companies than others and fewer publicly traded companies, so data availability is limited. This led to a smaller sample size in general. Additionally, many airline companies don't publish their ESG disclosure, which makes the sample size even smaller. For future research, it is crucial to obtain more relevant data from airline companies to expand the sample size, which yield different findings or further strengthen the results of this study.

Appendix

Table A.1.: Descriptive Statistics of treated and control group

Treated	ESG Score	Size	Leverage	Net Income	Cash Holdings	Tangibilty
N	151	151	151	151	151	151
Mean	69,30	9,87	13,26	221,87	0,14	0,61
St. Dev.	7,70	0,92	152,03	3.211,66	0,08	0,13
Min.	55,08	7,05	-206,06	-12.385,00	0,01	0,19
Median	69,23	10,03	1,37	239,56	0,13	0,62
Max.	86,70	11,36	1.836,83	13.277,27	0,43	0,89

Control	ESG Score	Size	Leverage	Net Income	Cash Holdings	Tangibilty
N	341	341	341	341	341	341
Mean	37,43	7,66	3,95	-167,94	0,16	0,55
St. Dev.	13,00	1,45	26,42	976,38	0,13	0,21
Min.	11,02	3,86	-54,64	-9.970,42	0,00	0,02
Median	39,82	7,72	1,37	1,74	0,13	0,60
Max.	54,96	11,13	293,83	3.736,67	0,71	0,90

Note: Table A.1. showcases the descriptive statistics of the variables used to build the difference-in-difference regression. In addition to Table 2 Panel A, which presents the summary statistics of the variables of all airline companies, Table A.1. displays it for the treated airline companies and the control group. The structure of the panel is following Bae et al. (2021).

Figure A.1.: Parallel trend for the base scenario while using winsorized data for the full sample

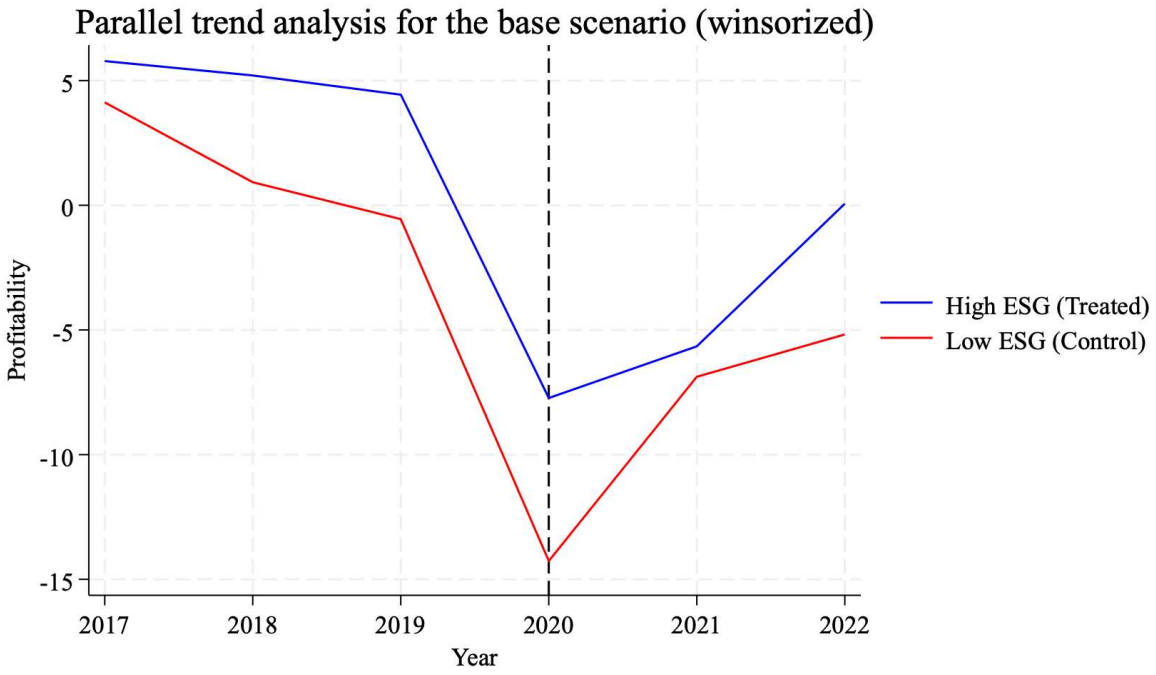

Figure A.1. displays the average mean profitability for treated companies, classified as High ESG in this figure, and control companies, classified as Low ESG. The profitability is measured as Return on Assets. Here, I used winsorized data to address potential outliers. The figure covers the period from 2017 to 2022. Moreover, the full sample was used for this figure, which includes airline companies without ESG scores, which, as mentioned earlier, are classified as low ESG airline companies.

Figure A.2.: Parallel trend for the base scenario while using winsorized data for the subsample

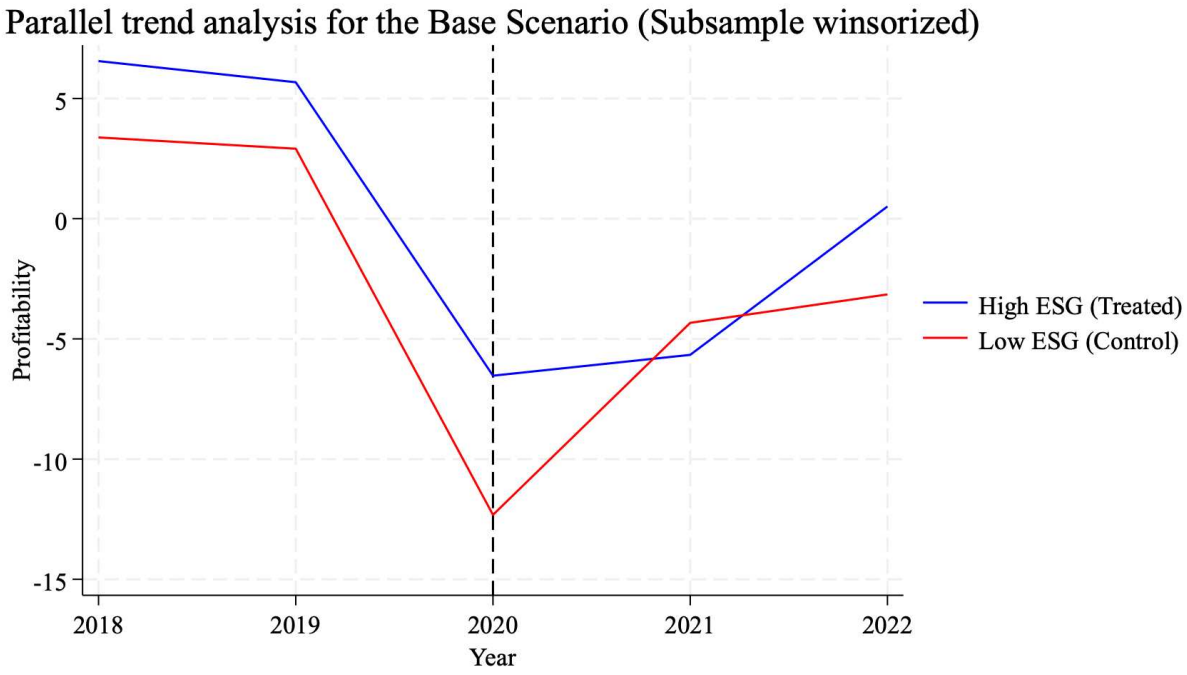

Figure A.2. displays the average mean profitability for treated companies, classified as High ESG in this figure, and control companies, classified as Low ESG. The profitability is measured as Return on Assets. The figure covers the period from 2018 to 2022. Moreover, this figure was based on the subsample, which excludes airline companies without ESG scores and includes winsorized data.

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