Green Lies and Market Cries?

A Diff-in-Diff Analysis

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Abstract

This paper explores the short-term impact of greenwashing accusations on S&P100 firms' stock prices. By manually collecting online news allegations of greenwashing and integrating them with Yahoo finance data, we estimate their causal effect on company stock prices over time using a staggered Difference-in-Differences approach. Contrary to our expectations, we find no statistically significant difference in stock prices after a scandal, suggesting that the market does not penalize the firms when they are accused. This study contributes to the existing literature by providing evidence of the short-term financial impacts of greenwashing scandals on American companies. It offers insights into the market's reaction to corporate environmental misconduct and the potential mechanisms driving it.

Keywords: Greenwashing, Stock Prices, Difference-in-Differences

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1 Introduction

Throughout the 21st century, firms increasingly consider the environment a critical business stakeholder.[1] Firms' accountability towards ensuring a sustainable future has become a focal point in the media.[2] Companies that fail to meet these standards and that conceal their shortcomings often face greenwashing accusations when discovered, with greenwashing being the practice of misleadingly portraying a company or product as being environmentally friendly.[3]

Greenwashing scandals have increasingly cast doubt on companies' considerations for the environment. These accusations highlight the growing concern among investors, consumers, and regulators about corporate environmental responsibility and transparency.[4] This study investigates the short-term impact of greenwashing accusations on the share prices of public firms listed on the S&P 100 from January 1st, 2019, to December 31st, 2023, to see how such accusations might deter investors from investing in these companies. Understanding whether these accusations can significantly impact a firm's share price is crucial, given investors' widespread access to online journals and news outlets and the need to enforce corporate responsibility.

Several theoretical frameworks underpin our study of greenwashing accusations and their impact on stock prices. Signaling theory explains how firms use greenwashing to signal environmental responsibility, highlighting the role of information asymmetry between companies and market agents. However, greenwashing represents misleading signals, which can significantly impact stock volatility as investors react to the perceived deception.[5] Stakeholder theory emphasizes the importance of maintaining trust with stakeholders. Firms accused of greenwashing risk losing credibility and confidence, leading to potential commercial and financial repercussions.[6] Legitimacy theory posits that companies use environmental disclosure to align their actions with social norms and values, thereby maintaining their legitimacy.[7] In the context of greenwashing, firms might use environmental disclosure as a legitimation strategy, aiming to appear environmentally responsible even if reality does not match their claims.

The paper is structured as follows: The data section will detail the sources, variables, and sample selection criteria used in the study. The descriptive analysis section will present our database and how we filtered it. The results section contains our methodological approach, findings, and interpretations. Finally, the conclusion will summarize the key elements of our paper, discussing their significant implications, and suggesting directions for future research.

[1] Schaltegger, S. (2019)
[2] Li, W. (2022)
[3] Oxford English Dictionary (2011)
[4] Deng, P. (2024)
[5] Seele, P. (2015)
[6] Torelli, R. (2019)
[7] Lee, M. (2023)

1.1 Literature Review

Despite extensive research on the long-term impacts of greenwashing, there is a gap in understanding its short-term effects on U.S.-listed firms. Previous research has explored the financial repercussions of greenwashing in other geographical markets but has not adequately addressed the immediate market reactions. This study aims to fill this gap, providing insights into how quickly and severely the market reacts to such news.

Our research, which is novel in its focus on the short-term financial impacts of greenwashing accusations on U.S.-listed firms, addresses the identified gaps. By employing a staggered difference-in-differences (DiD) approach we provide a unique methodological contribution to the field by implementing an econometric approach to a financial question. Our study will offer insights into the immediate financial consequences of greenwashing, focusing on the 3-week window post-accusation, enhancing our understanding of corporate environmental accountability and its market implications.

Mazzacurati et al. studied the influence of greenwashing controversies on firm value, focusing on the changes in stock return. They found that greenwashing controversies did not have a negative financial impact on large European firms in 2020 – 2021, suggesting that even if they might impact public perception, they do not significantly sway investors in the long term. The study uses a financial event study, calculating the cumulative abnormal return (CAR) in conjunction with the total number of controversies found in their chosen time frame.[8] Our study differs by observing a longer period and addressing the short-term impact of one single accusation.

Du's analysis of the Chinese market (2011 – 2012) revealed a significant negative impact of greenwashing on the CAR. This research underscores the negative market reactions to greenwashing highlighting the role that media plays in influencing market perceptions.[9] Its focus though is on a different geographical context and an earlier timeframe, highlighting the need for updated research on U.S.-listed firms.

Li et al. studied the effects of greenwashing on corporate financial performance (CPF) in Chinese firms (2013 - 2017), showing that the financial impact varies with the strictness of local environmental regulations and the type of media coverage. While their regression analysis provides valuable insights, it is limited by its focus on medium-term effects, leaving a gap in understanding short-term market reactions.[10]

The relationship between the media and investors remains complex, yet studies have highlighted the connection between investors incorporating journals into their investment decisions. Raza et al. contribute to the literature by focusing on daily news events' impact on the KSE-100 index, the index acting as a benchmark to compare prices on the Pakistan Stock Exchange, from 2012 – 2022. The study shows that global and political news substantially impacts the stock market. Investors respond promptly to negative news, which can result in hazardous stock exchange conditions. The research

[8] Mazzacurati et al. (2023)
[9] Du, X. (2015)
[10] Li et al.

emphasizes the impact of online journals and the role of news in shaping stock exchange conditions.[11]

Gulen and Hwang shed light on a similar phenomenon in a more recognized market. Using a sample of shares from the New York Stock Exchange (NYSE), National Association of Securities Dealers Automated Quotations (NASDAQ), and NYSE Amex Composite Index, they observe the short-term share price performance in response to firm-specific news. The analysis uses an event study around specific news topics, such as an acquisition announcement, to examine the market response to firm-specific news over a two-day window surrounding the new delivery date. The results show that positive news typically has higher abnormal returns on high-market return days than low-market return days. Conversely, negative news has fewer negative returns on high-market return days. Gulen and Hwang find that investor reactions to firm-specific news may lead to short-term price deviations.[12]

The findings of Raza et al. and Gulen and Hwang affirm the significant influence, both positive and negative, that news, as a form of media, can have on investor behavior. This observation is pertinent to our study, and we aim to explore whether similar effects can be observed in response to news about greenwashing.

2 Data

Governments and regulatory agencies worldwide, including the U.S.A Federal Trade Commission, are strengthening environmental regulations to address corporate misconduct and greenwashing.[13] Simultaneously, investors gradually prioritize sustainability and shift towards ESG investments.[14] This increasingly severe context amplifies the damage of being under scrutiny. It underscores the financial and reputational risks and highlights the importance of understanding the market's reaction. This is the purpose of our paper: to explore whether investors truly value a company's sustainability practices, and if a reported greenwashing accusation could impact their investment decision.

Our initial sample consists of S&P100 companies during our four-year time period, spanning from the 1st of January 2019 to the 31st of December 2023.[15] While analyzing our primary sample, we identified two extreme outliers in stock closing prices (see Appendix A). To ensure a more accurate analysis and diminish the sample bias, we excluded these outliers. Similarly, we ensured that missing data did not bias the sample and influence the integrity of the dataset, which led to the exclusion of another company from our sample. In the end, the dataset used in this study consists of a large sample of 121 companies with 48 being accused of greenwashing. Considering that we have daily data for each company over 4 years, the total number of observations amounts to 146'201.

Our independent variable is a binary variable: 1 for the accused, 0 otherwise. This allowed us to identify a control group and a treatment group corresponding to the non-accused and accused

[11] Raza et al. (2023)
[12] Gulen & Hwang. (2012)
[13] Federal Trade Commission. (2022)
[14] PricewaterhouseCoopers. (2022)
[15] S&P 100. S&P Dow Jones Indices

firms respectively. To identify this variable and record the date corresponding, we manually searched on Google using the following keywords: "greenwashing", "greenwashing scandal", and "greenwashing accusations", and selected the most relevant results. We primarily focused on high-ranking global newspapers such as the Financial Times, The Guardian, and Bloomberg, due to their global importance and credibility, which heightens their likelihood of impacting the share prices of our target companies.[16] Furthermore, we included sector-specific news outlets which are likely read by investors when they are looking to invest in a specific sector and require a more in-depth perspective.[17][18]

The dependent variable is defined as the logarithm of daily closing prices. We look at the closing price of a company because it can be seen as a good representation of investors' sentiment on a given day. Further, it is highly volatile, which allows it to capture the short-term effect. We opted for a semi-logarithmic model to capture the percentage variations, offering a more insightful perspective than examining the absolute closing values alone. Furthermore, it helps stabilize the variance, making it easier to observe underlying patterns and trends. This approach provides a deeper understanding of market dynamics and investor behavior.

We included control variables such as sector, trade volume, dividends, stock splits, and operating margin (%). We included these variables in our analysis to mitigate the effects of potential confounding factors, since these variables are all likely to influence the share price of a company, and not including them could lead to omitted variable bias. Each sector has its unique competitive landscape, and some sectors are more likely to greenwash than others (see Appendix B).[19]

Our financial data, including the information we have on the dependent variable and the control variables, was retrieved from Yahoo Finance. The use of this platform allowed us to comprehensively retrieve and analyze market trends, stock prices, and other relevant financial metrics.

3 Descriptive analysis

In the long term, the evolution of the close price for the treated and non-treated groups shows parallel trends asserting that there is no long-term effect of greenwashing accusation as supported by the existing literature.[20] As represented in Figure 1, even though the logarithm of the closing price is on average greater for the control group than for the accused companies, the two groups do have very similar variation and tend to have the same fluctuations.

[16] Forbes, Nasdaq.com, Thomson Reuters, Daily Mail UK, The Washington Post, BBC, NY Times, Yahoo Finance Medium, ABC News, The Baffler, and CNN.
[17] NRDC.org, Print Week, Light Reading, Carriermanagement.com, and Public Citizen.
[18] Miller & Shanthikumar (2010)
[19] Mazzacurati et al. (2023)
[20] Mazzacurati et al. (2023)

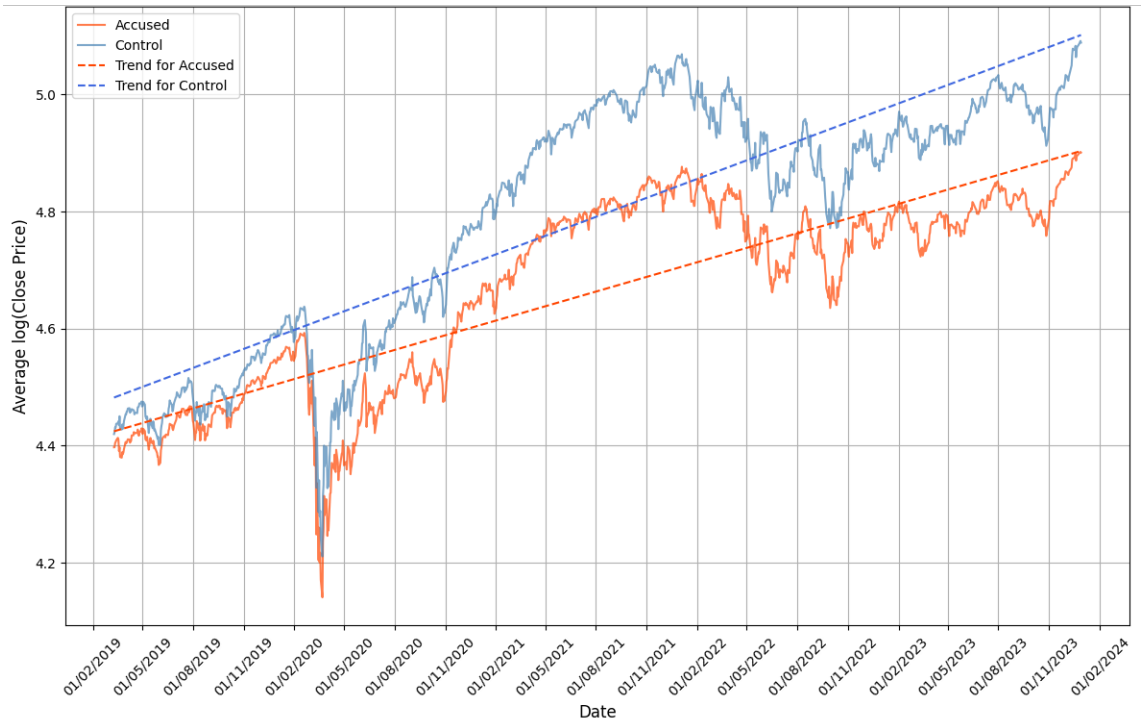

Figure 1: Average log (Close) Value for Companies in S&P 100

The maximum close price value is 908.26, the minimum is 3.36, and the mean is 160.17. To avoid biases coming from this important variance, we compared the distribution of close price for both treated and control group (see Appendix C). We ensured that the distributions were similar, indicating that any observed differences in stock prices can be attributed to the greenwashing accusations rather than pre-existing dissimilarities.

We analyzed the correlation between our interest variables in Appendix D. To prevent multicollinearity issues, we excluded the controls that were too highly correlated from our analysis. Maintaining a low level of multicollinearity enhances the robustness of the regression model.

Analyzing the distribution of the greenwashing accusations over time, we remarked that the number of accusations increases each year. Figure 2 demonstrates how the presence of greenwashing accusations has increased noticeably in the most recent period. This highlights the need to control for year-fixed effects in the analysis to account for temporal trends in accusations.

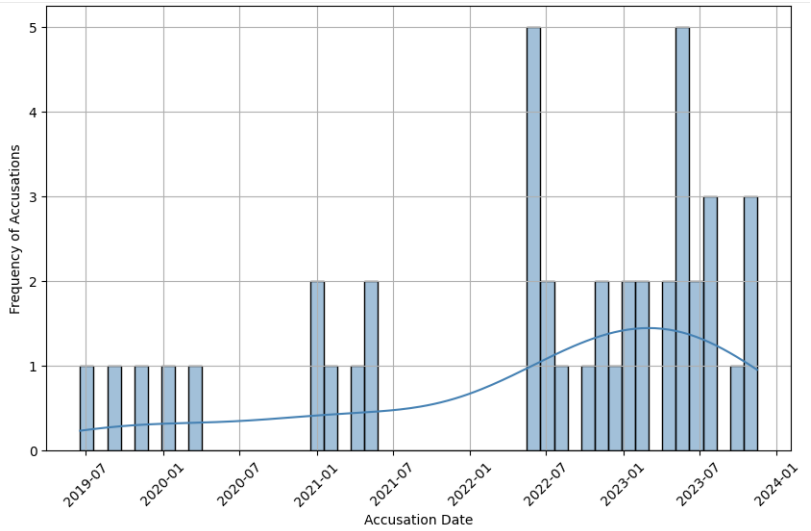

Figure 2: Distribution of Accusation Dates Over Time

Furthermore, we performed a Chi-squared test to confirm that the distribution of controversies over a year is uniform, as represented in Table 1 below. This ensures that there is no seasonality in accusation distribution.

Statistic	Value
Chi-Squared Statistic	343.435
P-value	0.774

Table 1: Chi-Squared Test

We observed a clear weekly cyclicality in stock prices that we handle in our model. Regarding the cyclicality in volatility due to varying market conditions, we consider it low because our analyzed period includes both bear and bull markets equally. We assume that these conditions affect both the treated and control groups, similarly, thereby not significantly biasing our results.[21]

4 Results

4.1 Empirical strategy

We estimated our model using the Staggered difference-in-difference method. In contrast to a regular DiD, this approach allows asynchronous treatment times. DiD models are valuable in controlling for unobservable confounding variables, thus reducing heterogeneity. They do so by comparing outcomes before and after the accusation between treated and control groups. As Angrist and Pischke emphasize,

[21] Hsu, J., & Li, F. (2010)

this quasi-experimental design provides a straightforward framework for causal inference. We use the two-way fixed effects (TWFE) estimator to identify the average treatment effect on the treated (ATT). This controls for unobserved heterogeneity in both time and entity dimensions. Our regression model presented in equation (1) includes the coefficient of the interaction term and short-term impact, and time and unit fixed effects.[22][23]

$$\ln(\text{Close}_{it}) = \alpha_i + \lambda_t + \delta^{DD}(\text{Accusation}_i \times \text{Post}_{it}) + \sum_{k=-30}^{30} \delta_k^{ST} D_k + \gamma X_{it} + \varepsilon_{it} \tag{1}$$

$\ln(\text{Close}_{it})$ = logarithm of the stock value of i at time t

δ^{DD} = coefficient capturing the average treatment effect on treated

$\text{Accusation}_i \times \text{Post}_{it}$ = interaction term: a treated company after it is treated

δ_k^{ST} = coefficient capturing the treatment effect on treated for event window

X_{it} = vector of control variables

See Appendix E for the remaining regression variables.

4.1.1 Fundamental hypothesis

This model relies on three fundamental hypotheses. At the core of the DiD model is the presence of parallel trends. We tested this hypothesis by comparing the never- and not-yet-treated groups in 2019.[24] Table 2 shows that the difference in slopes between the treated and control groups is not statistically significant at the 0.01 threshold. Appendix F visually represents the validation of the parallel trends' hypothesis.

Hypothesis	T-Statistic	P-Value
Equality of Slopes Between Pre-Treated and Control Groups	-2.6835	0.0079

Table 2: Statistical Test for Equality of Slopes

The second assumption is the absence of anticipation, meaning units do not change behavior before the treatment. Anticipation of treatment can bias the treatment effect estimation. Finally, a homogeneous treatment effect is essential, meaning the impact of greenwashing is uniform across treated units.[25]

[22] Angrist, J. D., & Pischke, J. S. (2008)
[23] Abadie et al (2010)
[24] Wooldridge, J. M. (2001)
[25] Wooldridge, J. M. (2001)

4.2 Results

We report the effect of accusations on log(price) with three progressively complex models in Table 3. We began our analysis by estimating a DiD model with time and entity-fixed effects. Since we rely on panel data, standard errors are clustered by companies to ensure accuracy and robustness, accounting for the correlation of error terms within units over time. Then, we reduce omitted variable bias by adding control variables. Given the periodicity we observed in our dataset, we finally extended the model with years, months, and days of the week fixed effects, which helps control for time-specific unobserved heterogeneity such as market trends, thereby isolating the treatment effect more effectively and enhancing the robustness and reliability of our analysis.

Table 3: Staggered Difference-in-Difference results

	(1) FE	(2) FE and Controls	(3) Extended Model
Constant	4.404***	4.435***	4.448***
	(0.0281)	(0.0288)	(0.0372)
Accusation*Post	0.0100	-0.0013	-0.0013
	(0.0680)	(0.0612)	(0.0612)
Day of accusation	0.0065	0.0111	0.0111
	(0.0415)	(0.0372)	(0.0372)
1 day post	0.0160	0.0177	0.0177
	(0.0408)	(0.0385)	(0.0385)
14 days post	-0.001	0.0062	0.0062
	(0.0402)	(0.0396)	(0.0396)
28 days post	0.0134	0.0065	0.0065
	(0.0409)	(0.0402)	(0.0402)
Volume		-2.6e-09***	-2.6e-09***
		(5.2e-10)	(5.2e-10)
Dividends		0.0115***	0.0115***
		(0.0039)	(0.0039)
Stock Split		0.0150	0.0150
		(0.0108)	(0.0108)
Year Fixed Effects:	NO	NO	YES
Month Fixed Effects:	NO	NO	YES
Observations	146201	146201	146201

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.025$, *** $p < 0.01$

As represented in Table 3, the results reveal that accusations do not have a statistically significant effect on the close price at any time horizon. In the more precise models, the coefficient of the interaction term is negative, aligning more closely with our initial expectations. It indicates a decrease of 0.00132% in the stock price for accused companies, a financially negligible change. The coefficients for the post-accusation periods (0, 1, 14, and 28 days) are generally insignificant, suggesting that immediate and short-term market reactions to greenwashing accusations are not statistically significant. The constant term is significant at the 1% level in all three models, with values of 4.404, 4.435, and 4.448. This suggests a robust baseline log close price across the models. The base log closing price increases further when adding yearly variations and their significance suggests that external factors related to specific years, such as macroeconomic phenomena, have an impact on stock prices. Significant effects are also found for the Volume and Dividend control variables, indicating that these two factors impact a company's share price. Overall, the inclusion of control variables and fixed effects enhances the robustness of the analysis.

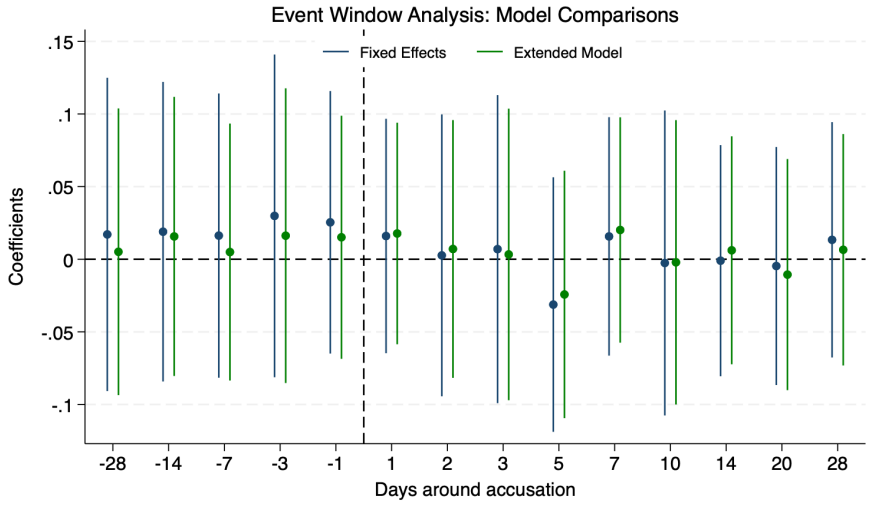

Figure 3: Event Window Analysis: Model Comparison

Graphically, we represent the event window around the date of accusation to better understand the dynamic absorption of news (see Figure 3). On the one side, we see that none of the days before are statistically significant, validating the no anticipation hypothesis. On the other hand, we observe the same lack of significance refuting our initial hypothesis.

4.3 Interpretation

Several reasons participate to explain why greenwashing claims do not affect S&P 100 stock prices. Notably, they are *too big to fail*. For us, the size and resilience of a blue-chip S&P 100 company plays a defining role in our results. S&P 100 companies are too large to be seriously impacted by one or a few cases of greenwashing that would affect their stock prices. This occurs because institutional investors

engage in long-term investments and are thus unlikely to react to short-term events or allegations with no long-term trend.[26]

It could be that investors do not regard greenwashing claims highly. This indifference on the part of the investors may suggest that the general investor base does not prioritize environmental responsibility enough to alter investment decisions or initiate boycotts against the accused firms.

Alternatively, the accusations could lack the legal weight to sway investors' valuations of firms. Greenwashing typically centers on subjective appraisals, and until it carries tangible legal repercussions or proof, investors may disregard such accusations as illegitimate. This perception lowers the likelihood of such accusations impacting stock prices.[27][28]

Furthermore, the reason that greenwashing accusations do not affect closing prices may be the existence of an efficient market hypothesis. In a highly efficient market, potential arbitrage arising from these accusations will be corrected within intra-day trading, and it will not substantially affect closing prices. Finally, since we use a TWFE model, we assumed that the treatment effects are homogeneous across all companies and periods. Using Mazzacurati et al., which shows no long-term impact on similar companies, we confirmed our assumption of homogeneous treatment effects.[29] This implies that the first accusation does not affect the impact of subsequent accusations, establishing that the overall effect on financial performance is not significant.[30]

5 Conclusion

In summary, our results support the literature by adding that there are no statistically significant short-term declines in the close price of examined firms following greenwashing scandals. This suggests the immediate market response is muted, despite the accusation potentially harming a firm's reputation. This is different from corporate misconduct, which has a clear impact on the company, pointing to the fact that investors may not penalize environmental scandals due to the lack of interest or complexity of valuing their impact.[31]

Our results have potentially dire policy consequences implying that current regulations are not strict enough to force companies to behave responsibly toward sustainability. If this is the case, policymakers need to consider more stringent regulations that incentivize investors to penalize guilty companies.

Some limitations were identified in the current study. The manual data collection process introduced a bias toward recent incidents, due to search engines prioritizing recent news. Larger events, such as COVID-19 or the Russian-Ukrainian conflict, happening could have overshadowed reporting of greenwashing, monopolizing investors' attention. Market efficiency in correcting after a shock due

[26] Mazzacurati et al. (2023)
[27] Flammer, C. (2011)
[28] Ehlers T. et al. (2023)
[29] Mazzacurati et al. (2023)
[30] Callaway, B., & Sant'Anna, P. H. C. (2020)
[31] Ichev, R. (2023)

to arbitrage opportunities intraday might explain the lack of effect observed despite a momentaneous impact, indicating divestment by investors. These limitations point to the need for future research to rely on better data collection and measurement tools, like automated web scraping to reduce these biases and guarantee validity.

Studying the difference in reactions of green investors relative to conventional investors can provide insight into the market's environmental accountability. Future work should compare legal environmental cases and greenwashing scandals' impact to determine the share of investors with environmental concerns from the ones adjusting their valuation due to the risk increasing for the firm.[32]

The efficient market hypothesis suggests that any potential effects of greenwashing accusations are corrected within intraday trading for large, liquid markets. Future studies should focus on smaller, less liquid markets where arbitrage opportunities might not be seized as fast. By analyzing those markets, we can assess if the effect of greenwashing is noticeable when market efficiency is low, showing how market liquidity influences the speed and extent of price adjustments. Other metrics like intraday return predictability measure and the variance ratio measure could be used to isolate this effect.[33]

Regarding methodology, executing a robustness check with the Callaway and Sant'Anna estimator would confirm the homogeneous treatment hypothesis. Examining whether previous accusations have any cumulative or spillover effects on future ones would further strengthen the findings and reduce concerns about treatment heterogeneity.[34]

These extensions offer insights into the mechanics behind the market's reaction to greenwashing and provide a comprehensive view of the factors that may influence investor decisions and stock price dynamics. By deepening our understanding of these dynamics, we lead the way to fostering greater accountability in corporate sustainability practices, ensuring that companies not only commit to environmental responsibility in principle but also demonstrate it in practice.

[32]Barnea et al. (2003)
[33]Chen, J et al. (2023)
[34]Callaway, B., & Sant'Anna, P. H. (2021)

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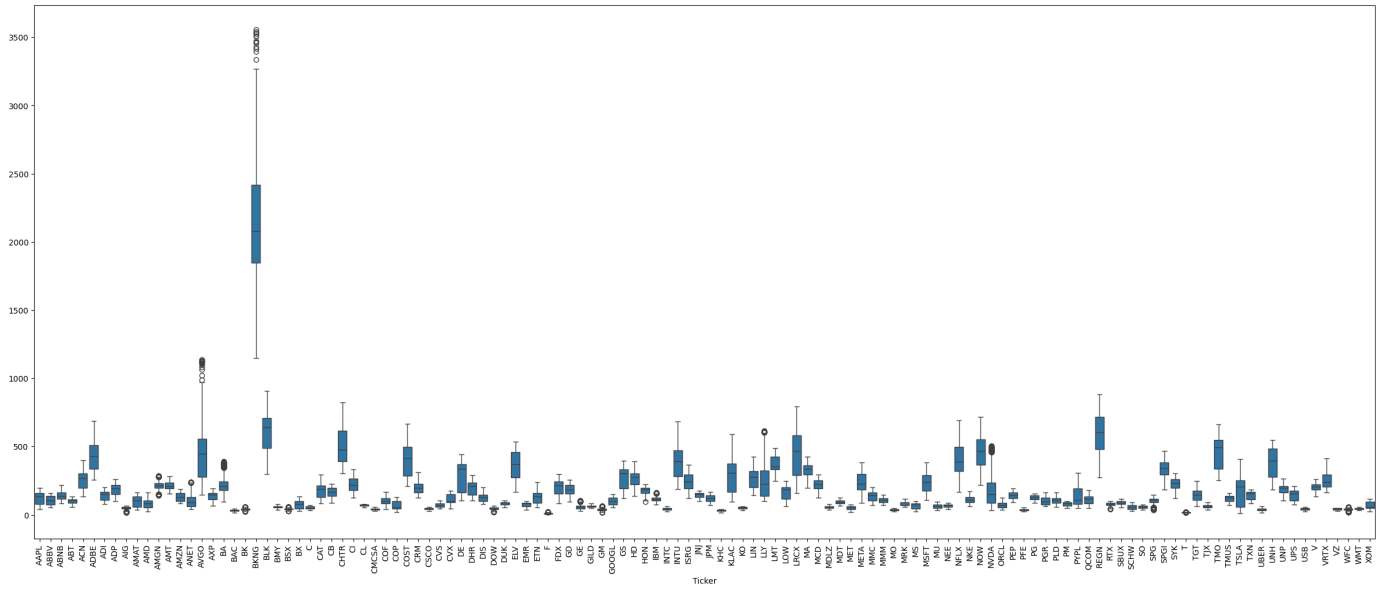
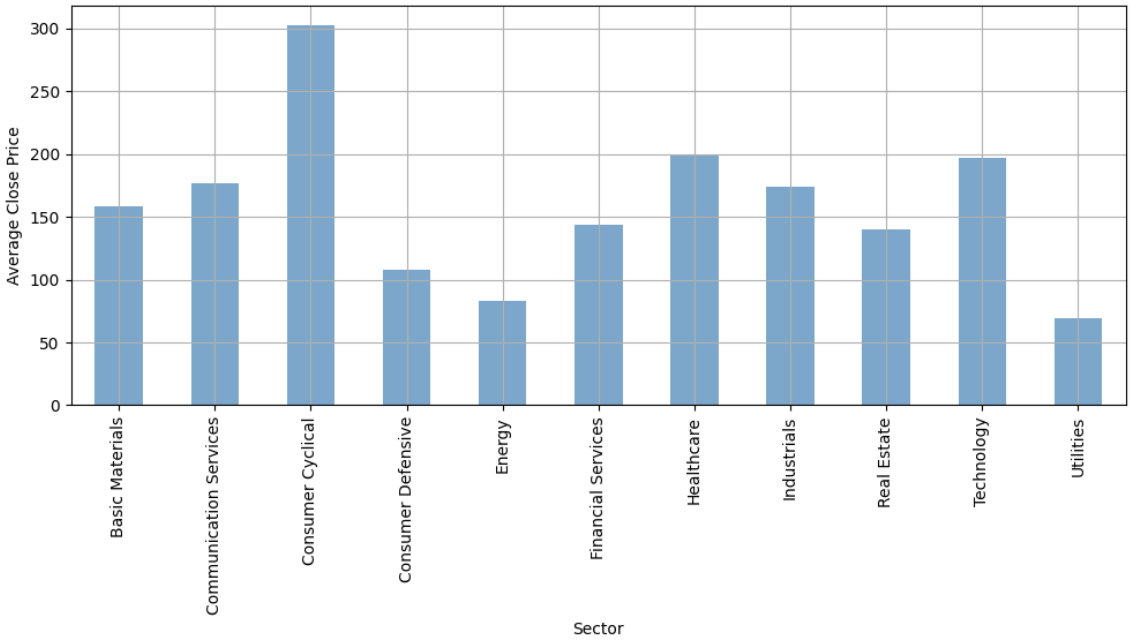
Appendices

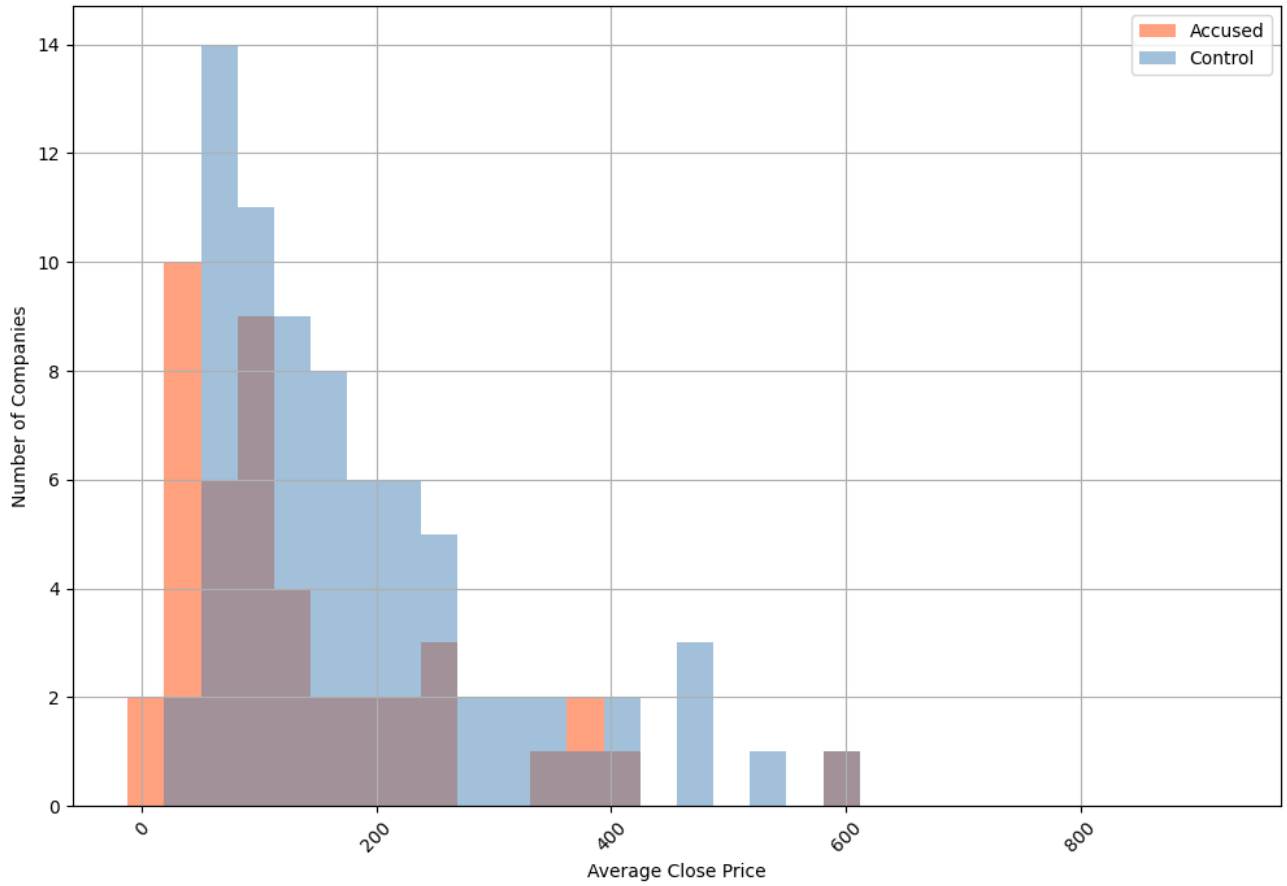
A Outliers in the initial database



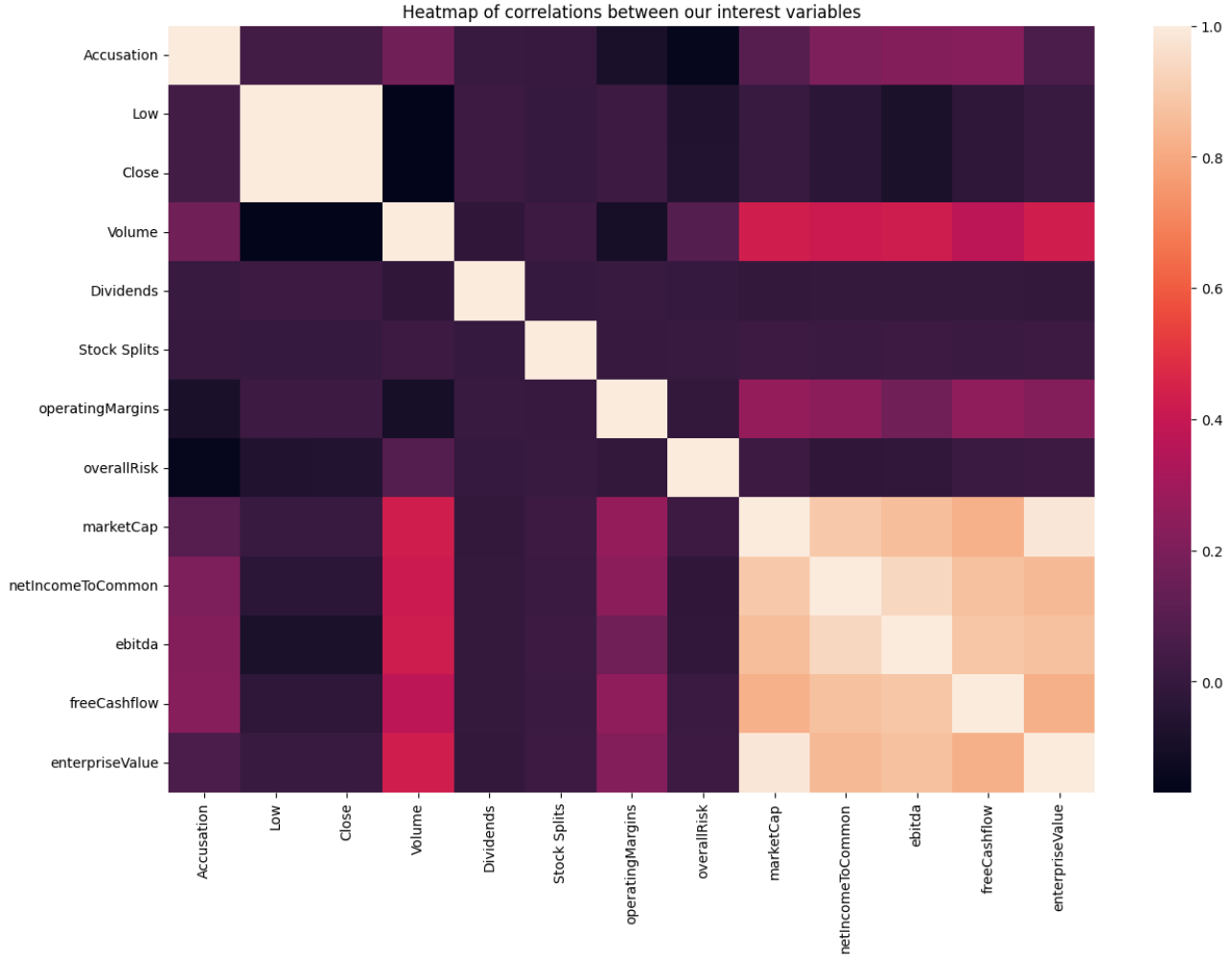
B Histogram of Sector close prices



C Histogram representing the distribution of the closing price for the two groups



D Correlation matrix between our variables of interest



E Regression Variables

$\ln(\text{Close}_{it})$ = logarithm of the stock value of i at time t

α_i = company fixed effects

λ_t = time fixed effects

δ^{DD} = coefficient capturing the average treatment effect on treated

$\text{Accusation}_i \times \text{Post}_{it}$ = interaction term: a treated company after it is treated

δ_k^{st} = coefficient capturing the short-term treatment effect on treated for different days

D_k = vector of dummies variables indicating the event window

γ = coefficients associated with each control variable

X_{it} = vector of control variables

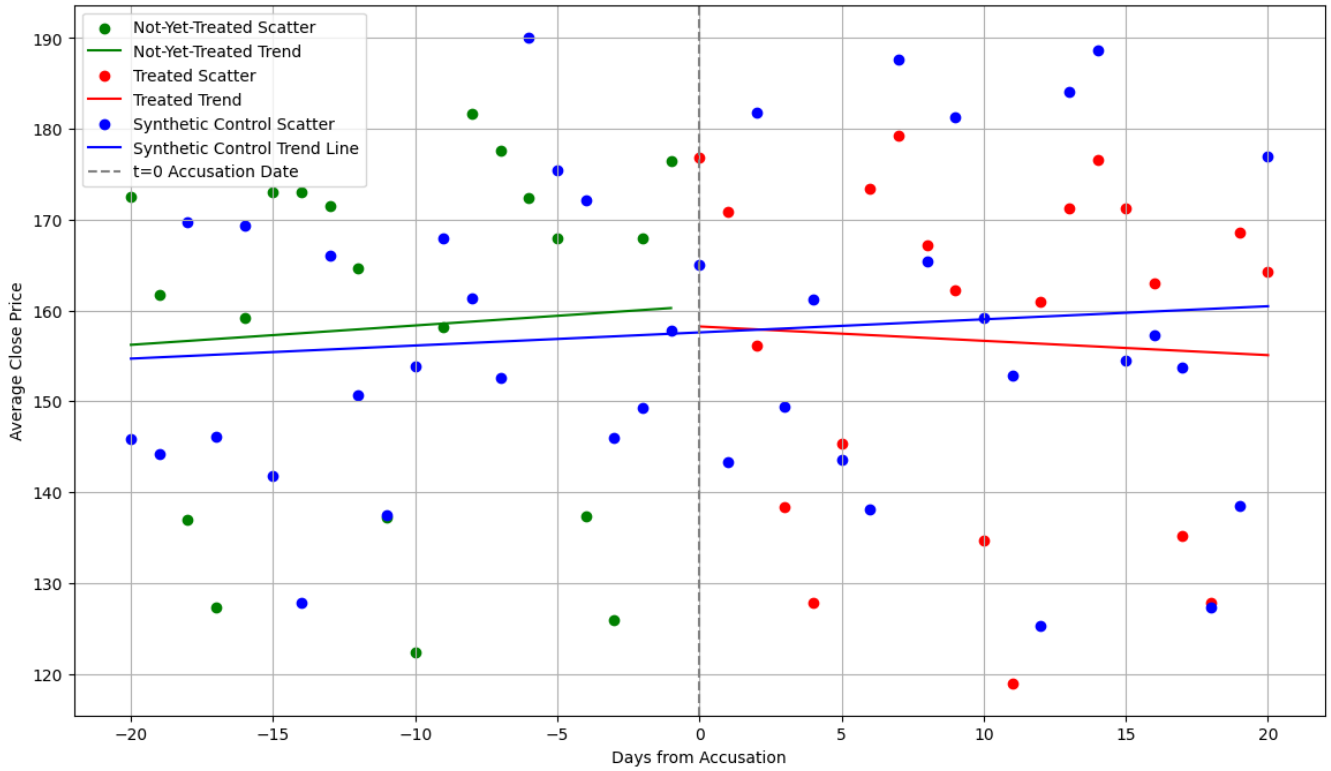
ε_{it} = error term

i = 1,2,...,N (Companies)

t = 1,2,...,N (Time periods)

k = [-30, -29, ..., 29, 30] (Days from the accusation)

F Parallel trends hypothesis



G Complete Table of Results

Table 4: Complete Staggered Difference-in-Difference results

	(1) FE	(2) FE and Controls	(3) Extended Model
Constant	4.404***	4.435***	4.448***
	(0.0281)	(0.0288)	(0.0372)
Accusation*Post	0.0100	-0.00132	-0.00132
	(0.0680)	(0.0612)	(0.0612)
1 day post	0.0160	0.0177	0.0177
	(0.0408)	(0.0385)	(0.0385)
7 days post	0.0157	0.0201	0.0201
	(0.0415)	(0.0392)	(0.0392)
14 days post	-0.001	0.0062	0.0062
	(0.0402)	(0.0396)	(0.0396)
Volume		-2.63e-09***	-2.63e-09***
		(5.19e-10)	(5.19e-10)
Dividends		0.0115***	0.0115***
		(0.00395)	(0.00395)
Stock Split		0.0150	0.0150
		(0.0108)	(0.0108)
Tuesday			-0.00144
			(0.00325)
Wednesday			0.00163
			(0.00342)
Thursday			0.00293
			(0.00306)
Friday			0.00378
			(0.00298)

Continued on next page

Table 4 – continued from previous page

	(1) FE	(2) FE and Controls	(3) Extended Model
Month Fixed Effects:	NO	NO	YES
Year Fixed Effects:	NO	NO	YES
Time Fixed Effects:	YES	YES	YES
Unit Fixed Effects:	YES	YES	YES
Observations	146201	146201	146201

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.025$, *** $p < 0.01$

H GitHub link

https://github.com/Staiana/Greenwashing_Project_Group_6/tree/main