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Short Selling and Market Reactions to Penalties for Financial Violations

By GERGELY KUTI (S1081857)

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Program: Master's Program in Economics
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Supervisor: Imtiaz Sifat

Radboud Universiteit

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Abstract

This thesis examines, how market reactions around penalties for financial violations in the United States. It does so, by mainly focusing on the level of short interest around the penalty dates, which is then followed by observing the trading patterns of company insiders around the event. To carry out the study, the thesis looks at penalties between 2018 to 2024, where the enforcing agency was the Securities and Exchange Commission. The thesis finds no significant buildup of short interest around a 20-month period before and after the event but finds a significant relationship between the relative size of the penalty and short interest in the month prior to the event. The paper also shows that while short sellers do not react to the event by building up their positions before, insiders do, by demonstrating increased level of selling activity right around the penalty announcement dates.

1. Introduction

Short selling is an important aspect of modern financial markets. At times, it can make up 12% of the total volume of NYSE (Boehmer et al., 2008), or even higher with up to 24% in the case of NYSE or 31% for the Nasdaq, depending on the period observed (Diether et al., 2009).
Short sellers play an important role in financial markets, but there is a constant discussion whether their role is beneficial or not, and should short selling be restricted or should these restrictions be removed. The common understanding is that short sellers increase market efficiency, help the price discovery process by keeping the prices in line with the fundamental values (Boehmer et al., 2008; Boehmer & Wu, 2013; Dechow et al., 2001; Saffi & Sigurdsson, 2011). One of the ways short sellers contribute to keeping prices in line is through monitoring firms which can even lead to the discovery discover (or the very least speed up the time to discovery) of financial violations (Dyck et al., 2010; Fang et al., 2016; Karpoff & Lou, 2010). Financial violations can range from insider trading, tax and investor violations to accounting fraud, but in the literature, it most commonly refers to financial misrepresentation or financial reporting fraud which resulted in enforcement action by the SEC. (Amiram et al., 2018; Karpoff, Lee, et al., 2008; Karpoff, 2021; Karpoff & Lou, 2010). A more general definition of misrepresentation is "communicating honestly reported data in a deceptive manner" (Resnik, 2001, p. 10791). Previous studies on the topic of financial violations found that they result in negative consequences for firms, responsible individuals, and society. (Amiram et al., 2018; Giannetti & Wang, 2016; Karpoff, Lee, et al., 2008; Karpoff, Scott Lee, et al., 2008). While violations are expected to decline in the future due to technological improvements, increasing societal wealth and reduced information costs (Karpoff, 2021), they are a very relevant aspect to study within the field of financial economics.

It is unclear however, whether short sellers can anticipate certain news events, such as the public reveal of any form of financial violation, or they do not have such predicting powers or inside information and rather react to new information better by being more skilled than the average market participant (Daske et al., 2005; Engelberg et al., 2012).

While previous studies such as the paper of Karpoff & Lou (2010) investigated short sellers' ability to anticipate the initial public reveal of misconduct, this study focuses on penalty announcements. These announcements mark the conclusion of the regulatory process and are a formal confirmation of wrongdoing. By examining short interest around these announcements, this thesis contributes to our understanding of how efficiently markets, and short sellers specifically, process regulatory signals. It shifts the emphasis from detecting hidden misconduct to analysing whether sophisticated traders anticipate or react to formalized, more pronounced bad news, penalties that are both financially and reputationally costly. These studies also had a timeframe that seems far from today, as data from the period of the late 1980s to early 2000s was used which may not capture how changes in short selling activity, regulation, and market structure have influenced these dynamics in recent years. By analysing penalty announcements rather than initial misconduct revelations, this research can provide a more precise understanding of how informed traders react to financial misconduct and its regulatory consequences. Therefore, to address this gap in the literature, this research aims to answer the following research questions:

1.) *Do short sellers react to penalties for financial misconduct?*
2.) *Does the severity of the penalty affect short selling?*

The objective of this proposed study is to find answers to the above proposed research questions. To do so, the research uses US short interest data and a dataset on corporate violations sanctioned by the SEC, which contain a wide source of violations, including the dates and sizes of penalties 'awarded' for committing them.

Finding answers to these questions can lead to relevant insights in multiple aspects. It can provide additional information on whether short sellers anticipate certain important events, or whether they just react faster or better to new information than others in the market. It adds to academic literature on short selling, all the while combining it with financial violations. As the number of previous studies connecting the two areas is limited, new findings can add valuable information, by confirming or contradicting existing results. Findings of this study can also contribute new and valuable knowledge on the efficiency of financial markets around the penalty announcement dates.

Apart from its potential academic relevance results can yield new and useful knowledge in other areas, such as to general market participants, and policymakers by further highlighting the role short sellers play in modern financial markets.

The rest of the paper is structured in the following way: Section 2 gives an overview of the relevant literature to the topic and the research problem of the paper, Section 3 elaborates on the data and methodological approach used to carry out the analysis, and Section 4 showcases the results along with their discussion and interpretation. Section 5 is the conclusion to the study. Section 6 contains a bibliography for all the references used in the completion of the thesis. Lastly Section 7 contains the appendix, with additional tables that were left out of the main text, as well as a statement about the use of generative artificial intelligence regarding its use to help with the completion of certain parts of the paper.

2. Literature overview

Short selling

2.1.1 Short selling and returns

One of the common topics in the existing literature about short selling is about the connection of short selling activity and returns. Previous findings generally agree that stocks that face higher short interest perform worse compared to those with lighter short interest. (Boehmer et al., 2008; Christophe et al., 2004; Desai et al., 2002; Diether et al., 2009). The reason behind this is that short sellers are considered to be sophisticated investors, who can identify overvalued stocks (Boehmer et al., 2010). This predictive power of increased short selling has been proven to forecast negative future returns before earnings announcement news (Christophe et al., 2004), as well as before analyst downgrades (Christophe et al., 2010). The paper of Rapach et al., (2016) reinforces this finding about returns on an aggregate level, claiming that short interest is the best predictor of stock returns on an aggregate returns, showing that an increased level of short intertest predicts lower returns in the future.

2.1.2 short selling and information

A potential explanation on why short sellers can predict returns better, could be that short sellers are previously informed (meaning they possess some insider information they received before the public), or they simply process information better or more efficiently than other market participants.

Engelberg et al. (2012) claims that short sellers are highly skilled information processors, finding the negative relation between short selling and negative returns stronger on days with negative news. However, it fails to find evidence that short sellers anticipate bad news, rather that it only increases after the news are public. The paper of Daske et al. (2005) also reinforces this claim, looking at daily short data and finding no evidence that short sales precede bad news, but short selling increases around news events regardless of the nature of the news. On the other hand the paper of Blau et al. (2015) finds that short sellers even possess the skills to interpret the tone of earnings calls, and then use it to predict negative future returns. Furthermore, short sellers can also influence the tone of disclosures by management, as short selling pressure can reduce overly optimistic tones (Jain, 2023). While other research points to the conclusion that among other informed traders short sellers can predict earnings surprises of firms with more connected directors, indicating the leakage of information to them before it becomes public (Akbas et al., 2016).

2.1.3 Short selling and market efficiency

Another frequent and relevant debate within the topic of short selling, is whether short sellers improve market efficiency or should it be restricted. In general, findings across papers agree that short selling enhances market efficiency by improving price discovery and aligning prices with fundamentals (Boehmer et al., 2008; Dechow et al., 2001). However, the mechanisms behind this efficiency remain debated. Some studies suggest that short sellers gain an informational edge through accelerating the trading of insiders thus indirectly improving market efficiency (Massa et al., 2015), while other ones emphasize their role in uncovering fraud (Fang et al., 2016; Karpoff & Lou, 2010). Moreover, these findings further indicate that enforcing short sale constraints would decrease market efficiency and allow stocks to become overpriced, whether that's on a global level (Saffi & Sigurdsson, 2011), or on firm level anti-shorting measures (Lamont, 2012). However, not all findings point in the same direction. According to Brunnermeier & Oehmke (2014) short sellers can destabilize financial institutions during times of distress, particularly if short positions are disclosed. Or in some cases of seasoned equity offerings, short selling before the issue happened can be a sign of manipulative trading, which in this situation reduces market efficiency (Henry & Koski, 2010).

Misconduct

2.2.1 Reasons and consequences

The reasons to engage in financial misconduct vary in every case. It can be driven by potential financial gains, to keep up a certain reputation, or because of certain managerial decisions resulting from overconfidence or other personality traits (Amiram et al., 2018). Similarly, the paper of Dechow et al. (1996) finds that firms might manipulate their earnings to secure external financing at a lower costs. The occurrence of financial misconduct also varies within regions and cities, but it can be generally related to certain areas that showcase certain other types of misconducts such as political corruption and unethical medical practices (Parsons et al., 2018). Similarly to the reasons behind, the consequences after can vary for both the firms and the personnel involved as well. On the firm level consequences of revealed misconduct can mean losing on average 9% of their stock price (Dechow et al., 1996). This negative market reaction can even be as high as up to a third of the firm's market value, while also facing severe legal costs, and higher audit fees (Lee & Rezaee, 2022), but by far the highest of them all is the reputational costs (Karpoff, Lee, et al., 2008). The paper of Amiram et al. (2018) also confirms this finding, similarly finding that these consequences range from negative market reactions to a loss in revenue and by far the most severe is the lost reputation and trust.

And on the managerial level these consequences can be considered equally severe. Almost everyone deemed responsible loses their job (mostly by the means of being fired) and more than a quarter face criminal penalties which can even include jail sentences (Karpoff, Scott Lee, et al., 2008).

Financial misconduct can have serious negative results, not only for the firms or managers responsible for committing them, but for the whole of financial markets, market participants, or society at large. According to Cole et al. (2021) fraud or misconduct can be considered as a form of corporate failure, with it having severe negative effects for all stakeholders.

Financial fraud undermines trust in financial markets, one consequence of this is reduced participation. The paper of Giannetti & Wang (2016) finds that when financial misconduct is revealed it reduces household stock market participation. The lack of trust in markets and its negative consequences have been known and researched in the economic literature for a while, with one of the most notable example being the market for lemons by Akerlof (1970).

2.2.2 Who discovers it

When financial misconduct comes to light the responsible parties for uncovering it vary more than at first it could have been expected. As most would expect that in most cases the authorities responsible for overseeing financial markets such as the SEC uncover it. According to the paper of Dyck et al. (2010) the actual makeup of parties responsible for uncovering it is much more diverse. From investigative journalists to whistleblowing employees, equity holders and of course the SEC. The paper claims that it is through their shared efforts that financial fraud comes to light. Short sellers are also part of said group behind uncovering fraud, as they "have the strongest incentive to see fraud come to light" (Dyck et al., 2010, p. 2226), with the strong incentive being financial gains. However, according to their findings, short sellers are only mainly responsible for the discovery of fraud in about 3.5-14.5% of the time. The paper of (Karpoff & Lou, 2010) investigates whether short sellers can detect financial misrepresentation before it comes to light. Using a dataset that ranges from 1988 to 2005 and finds that short interest increases 19 months before the public reveal of the offense, and the size of the short interest is in line with the severity of the misconduct. Their findings imply that short sellers can identify misconduct and expect its revelation.

Research problem of the master's thesis

As showcased in the previous parts of this chapter, short sellers are sophisticated investors that can anticipate certain events and react more efficiently to news than the ordinary investors (Akbas et al., 2016; Boehmer et al., 2008; Dechow et al., 2001; Engelberg et al., 2012; Massa et al., 2015). They can also predict financial misconduct (Fang et al., 2016; Karpoff & Lou, 2010), even if they are only responsible for uncovering it to a certain degree (Dyck et al., 2010). Financial violations destroy firm value (both by generating legal costs, and decrease market value), and heavily damage reputation (Amiram et al., 2018; Karpoff, Lee, et al., 2008).Hence, it is expected that in the case of having information about violations before others, rational short sellers have high incentives to use it to generate profit.

Financial misconduct revelations are bad news for companies. Similarly, the penalties for violations can also be considered bad news, potentially resulting in long lasting damages in both severe fines and decreased reputation, which can have more severe negative effects on the firm's performance than a bad earnings announcement, or other negative news. Furthermore, penalties are more concrete as not only they remove any uncertainty regarding the potential reactions to the company's previous actions but also incorporate information about the severity of the misconduct in a quantifiable manner. Unlike allegations or investigations, penalties represent a *confirmed* judgment of wrongdoing by regulators and agencies involved (e.g., SEC). Therefore, it could be theorised that if short sellers gain prior knowledge about the outcome of regulatory investigations and the subsequent penalties, there would be an increase in the observed short interest before the penalties are publicly announced.

There are various ways for short sellers to foresee these penalties. To determine the possibility of a penalty being imposed, they might first monitor current regulatory investigations and historical enforcement patterns. Second, they might use other data sources, like court documents, whistleblower reports, or enforcement trends unique to a given industry, to forecast not just if a company will face penalties, but also how severe those penalties will be. Last but not least, pre-penalty indicators like management's legal disclosures, settlement talks, or heightened regulatory scrutiny in particular industries may cause short sellers to respond.

As not all financial misconduct carries severe penalties, this distinction is crucial. One would anticipate that short interest would rise at the first hint of misconduct (such as accusations or whistleblower reports) if short sellers only respond to bad news in general. However, it would indicate that short sellers are able to evaluate not only the existence of misconduct but also the regulatory response and its financial impact if short interest spikes precisely before penalty announcements.

However, as mentioned previously, not all previous studies agree that short selling precedes bad news, implying short sellers do not anticipate such events (Daske et al., 2005; Engelberg et al., 2012). To find an answer to these conflicting findings, the following hypothesis was developed:

H1: *Short interest increases around the time of financial misconduct penalty announcements.*

Even if this hypothesis expects short interest to increase, not all violations might result in the same expected increase. To account for this and to test whether short sellers can precisely estimate the severity of the violation, a second hypothesis was also created, which aims to confirm the relationship between the amount of short interest and the magnitude of the penalties.

H2: *The size of the short interest increase is larger for more severe penalties.*

To better be able to examine how market participants react to penalty announcements, apart from the short interest analysis, the trades of company insiders will also be analysed. Company insiders can also be viewed as sophisticated traders in financial markets, as they possess information not available to the public, or have access to information at a much sooner time than it is released to the public. Even further, according to literature the presence of short sellers can incentivise those with inside information to act on their knowledge faster, thus speeding up their trades (Massa et al., 2015). Therefore, to better capture trading activity, similar to short sellers, a possible method can be looking at the trades of company insiders in the period prior to the event and evaluate whether those with knowledge from the ‘inside’ demonstrate any irregular patterns when it comes to trading with their own company’s shares.

Finding an answer to these penalties could provide new knowledge on how well short sellers are informed, and whether they already know or can anticipate certain news before it becomes public while also allowing to see how well short sellers predicted the severity of these offenses. Answering these hypotheses therefore can add to the already vast sea of literature on the connection of short selling and market efficiency, information discovery all while combining it with research on financial violations and corporate misconduct.

3. Data and Methodology

Data:

Data for the financial violations comes from Good Jobs First's Violation Tracker dataset. This is an extensive US dataset that contains not only financial, but environmental, employment-, healthcare-related etc., offenses as well. Previous studies that also used data from GJF on various studies within the topic of corporate misconduct (Ghitti et al., 2024; Raghunandan, 2024). This study uses only violations classified in the dataset as 'financial offenses' where the enforcing agency was the SEC. These offenses include accounting fraud, investor protection violations, tax violations and toxic securities abuse. This somewhat differs from previous research as in those the violations in question were financial misrepresentation (Karpoff, Lee, et al., 2008; Karpoff, Scott Lee, et al., 2008; Karpoff & Lou, 2010). The dataset contains both private and public firms, for data availability purposes only public firms are chosen. This leads to 773 violations between the periods of 2000 and 2025. However, due to data availability of other variables (mainly short interest), a shorter, more recent timeframe of 2018 to 2024 was chosen. After filtering for firms for which short interest and other data is available this is further reduced to a total of 219 observations. The yearly distribution of violations can be seen in Table 1 below. This sample of violations contains some firms which appear multiple times, meaning repeat offenders. Out of the 219 observations there are 127 unique firms in the data. As mentioned previously the observations which are all recognized as "Financial offenses" are further partitioned based on their primary offense. In the dataset 'Investor protection violations' appear the most, namely 190 times out of 219. Followed by 'Accounting fraud or deficiencies' which appears 26 times. Lastly 'Anti-money-laundering deficiencies' which is the primary offense for 3 observations in the dataset.

As for the penalties received for committing these violations, the highest one was 500 million USD given to Wells Fargo in 2020, meanwhile, the lowest only 47 thousand USD. The average amount of the penalties in the dataset is 22.8 million USD.

Year	Number of Violations
2018	36
2019	31
2020	31
2021	12
2022	34
2023	28
2024	47
Total number of violations:	**219**
Number without repeat offenders	**127**

Table 1: Yearly distribution of cases

Short interest data is then gathered for the firms that committed violations. Source for this short interest data is LSEG/DataStream. In this case data is available bi-weekly, which differs from previous studies using short interest data, where in most cases, monthly short interest was used (Karpoff & Lou, 2010; Singer et al., 2022). Initially short interest data was planned to be downloaded from Finra. However, for the ease of matching it with other firm level data, it was downloaded from DataStream, as it is the same data with the difference that it in the latter, it is given in the thousands. Short interest as well as other controls were gathered for every firm on the NYSE and Nasdaq between 2017 and 2024. Short interest data was available for every second week, once at the middle of a month, and once at the end. As other variables were in monthly format, the short interest at the end of each month was taken to represent the short interest for a given month. To get raw short interest (SI) the number of shares shorted was divided by the number of shares outstanding for every firm each month. For further ease of interpretation, it was then converted into percentages.

Other firm level data that will be required to carry out this study were downloaded from LSEG Workspace using DataStream, as it is the richest source for general firm level data that is accessible. These other control variables include the Size of a firm measured by its market capitalization (in millions of USD) (later log transformed), the Book-to-market value of a firm, the Momentum, and the Turnover for a firm.

Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
penalty	7971	22807499	50021282	47000	1250000	18126170	500000000
Size	7944	82923	121367	179	7722	112894	1223192
LogSize	7944	10	1.8	5.2	9	12	14
BMV	7820	0.78	0.78	-0.98	0.34	0.97	10
Momentum	7597	0.1	0.35	-0.9	-0.11	0.27	2
Turnover	7944	0.26	1.4	0.00018	0.087	0.18	39
SI2	7971	2.4	3.8	0	0.77	2.6	56
ABSI1_1	7456	-1.6	3.9	-5.4	-3.5	-1.2	53
ABSI2_1	7456	-1.8	6	-169	-3.2	-1.2	50

Table 2: Summary statistics of variables

<u>Abnormal short interest:</u>

The study of Karpoff & Lou (2010) used 3 different measures for abnormal short interest, constructed by taking the raw short interest and subtract the expected short interest form it, which was constructed based on 3 different benchmarks.

To calculate the first abnormal short interest measure, the following control variables were used: firm size, book-to-market value and momentum. The second measure adds variables to measure share turnover and institutional ownership, and the third one adds total accruals and insider selling as well. As according to their paper, and other previous studies (Asquith et al., 2005; Dechow et al., 2001; Diether et al., 2009; Duarte et al., 2006) these can also influence the level of short interest. Similarly, the paper of Singer et al. (2022) also takes influence from the paper of Karpoff & Lou (2010) to construct their abnormal short interest measure based on the first two abnormal short interest measures.

Two measures of abnormal short interest were created based on the above mentioned methodology of Karpoff & Lou, (2010). The first measure ABSI1 uses the firm size, book-to-market value, and momentum, and the second measure (ABSI2) further adds to this Turnover. Compared to the previously mentioned measures, due to data availability the second abnormal short interest measure does not include Institutional ownership.

Abnormal short interest is received from subtracting expected short interest (E(SI)) from the raw short interest (SI). Expected short interest is calculated using a sample of all available firms on the NYSE and Nasdaq (except the firms that appear in the violation database). At the start of each month using a monthly cross-sectional regression based on Size, Book-to-market, Momentum, and then Turnover, the monthly expected short interest is determined. This slightly differs from the method used in similar previous research (Karpoff & Lou, 2010; Singer et al., 2022), not only by the final control variables used to determine expected short interest levels, but because in their paper, firms are sorted into terciles to form portfolios, whereas here instead of terciles, continuous values were used at the start of each month.

Methodology:

To answer hypothesis 1, an event study was conducted. The window around the event is 20 months both before and after. The event date (month 0) was the month in which the penalty was given for the violation, based on the dataset. According to previous findings (Karpoff & Lou, 2010), where a similar 40 month window around the reveal event was used, they found that short interest (both raw, and the constructed abnormal measures) increased 19 months before the public announcement of the violation. The paper of (Singer et al., 2022) confirms this, where they find an increase in short interest 18 months prior to the trigger date.

Taking the penalty dates as the main event to study, means that 1.) all wrongdoings in the dataset were severe enough to be result in at least financial penalties. (Whereas with public reveals of misconduct, the following investigation might still yet to come that would determine the severity of the alleged violation) And 2.) it allows to easily measure the severity of the violation committed. As it is expected the more serious a violation is considered to be, the larger the penalty given for committing it. The paper of (Karpoff & Lou, 2010) as mentioned before used public reveal dates in their study on short interest and financial misconduct, and in order to measure the severity of misconduct they used three different proxies to measure for severity. These were whether fraud charges were brought up, insider trading charges and total accruals as it was assumed that its size has a correlation with the magnitude of the misrepresentation. Compared to that, taking the monetary penalty to measure severity is a less time-consuming and perhaps even more accurate process, as severity of the violation has already been judged by the appropriate authorities.

Limitations of this approach:

Looking at the penalty dates to construct the event study can pose some limitations on the validity of the study, as by the time a wrongdoing is penalised, it has been already investigated meaning that the information has already reached the public, when it was originally uncovered.

According to the Theory of Efficient Markets, in the case of strong market efficiency prices would already completely reflect all publicly or even not publicly available information (Fama, 1970). Previous studies, most notably the paper of (Karpoff & Lou, 2010) used the dates when the misconduct was revealed to conduct their analysis. In the case of this study due to time limitations it was not possible to gather and match the dates at which the violations reached the public, therefore the dates on which the penalties were given were used. However, this method could also provide novel findings as to whether the penalties are predicted by short sellers.

To answer the second hypothesis, on whether the firms that face more severe fines see a higher short interest a regression will be used. Similarly to the paper of Karpoff & Lou (2010) the month previous to the event will be considered (-1) as if higher short interest predates penalties, it can be expected that the month closest before the event faces the highest short interest.

To conduct the complementary test of analysing the trades of company insiders around the penalty dates another dataset is used, which contained information about the trades of the insiders from the firms already included in the dataset used in the previous analysis. The dataset was provided from the supervisor of this thesis. In this dataset every firm is included only once, with their most ‘severe’ violation (because there are 127 unique firms in the original violation dataset, but ~220 observations due to firm appearing multiple separate times). Company insiders in this case include executives, board members, founders, and other high-level employees that are or were affiliated with the company.

However, determining the exact timeframe to observe cannot be easily done as every case of violation is different in its own way, with only limited information provided about the exact situation in the GJF dataset. Therefore, it was decided to focus on insider activity 60 months prior to 30 months after the incident. Looking at a timeframe this wide, can assist in observing patterns prior to the penalty date (thus having the chance of potentially capturing initial public reveal dates, even if it is not known that they would be in that period), as well as after the event.

4. Results

The following table and graph illustrate the changes in the level of both raw and abnormal short interest from 20 months before the event, and 20 months after. Month 0 is the month in which the event (the penalty for the violation) took place; *n* is the number of observations for each category of short interest for each month.

Months	SI			
	n	mean_SI	t_stat	p_value
-20	73	3,408	4,302	5,24E-05
-19	208	2,6359	7,9202	1,43E-13
-18	211	2,6363	8,2559	1,67E-14
-17	217	2,6599	7,9581	9,77E-14
-16	212	2,6718	7,8626	1,91E-13
-15	219	2,5403	7,7566	3,32E-13
-14	224	2,5723	7,5891	8,69E-13
-13	214	2,5579	8,6812	1,03E-15
-12	224	2,5133	9,1753	3,12E-17
-11	215	2,3711	8,9745	1,47E-16
-10	221	2,5876	8,9005	2,10E-16
-9	212	2,5917	9,072	8,33E-17
-8	219	2,3082	9,2815	1,73E-17
-7	223	2,5278	9,4548	4,81E-18
-6	210	2,7215	8,8375	4,07E-16
-5	223	2,6133	9,4547	4,82E-18
-4	220	2,5511	9,3975	7,69E-18
-3	222	2,586	10,1159	5,18E-20
-2	220	2,4166	10,2874	1,67E-20
-1	216	2,3352	10,4772	5,12E-21
0	219	2,4791	10,4338	6,20E-21
1	209	2,3232	10,4745	6,86E-21
2	208	2,2369	10,2333	3,75E-20
3	188	2,3104	9,6744	3,32E-18
4	179	2,3176	9,1047	1,75E-16

5	179	2,4118	9,405	2,62E-17
6	179	2,3736	9,1171	1,61E-16
7	175	2,3476	8,9512	5,19E-16
8	177	2,3331	9,2804	6,19E-17
9	177	2,4159	9,0519	2,60E-16
10	171	2,3504	8,5726	6,00E-15
11	170	2,3593	8,6427	4,04E-15
12	168	2,3687	9,1762	1,65E-16
13	167	2,3058	9,3454	6,02E-17
14	165	2,2074	9,8299	3,23E-18
15	157	2,2097	9,3645	8,16E-17
16	155	2,032	10,7158	2,28E-20
17	138	2,0955	10,3223	7,81E-19
18	149	2,1461	10,5768	8,00E-20
19	151	2,1459	10,4961	1,15E-19
20	42	2,3917	5,5937	1,63E-06

Table 3: Raw short interest around the event

Months	ABSI 1			
	n	**mean_ABSI1**	**t_stat**	**p_value**
-20	62	-0,5939	-0,6763	0,501383712
-19	170	-1,2234	-3,2197	0,001538709
-18	168	-1,251	-3,3772	0,000911098
-17	172	-1,2324	-3,1316	0,002045179
-16	178	-1,3674	-3,6421	0,000354947
-15	184	-1,5244	-4,1838	4,44E-05
-14	186	-1,5046	-4,0034	9,03E-05
-13	178	-1,5477	-5,1419	7,16E-07
-12	188	-1,6105	-5,8863	1,80E-08
-11	184	-1,7	-7,0175	4,25E-11
-10	197	-1,2856	-3,9155	0,000124484
-9	193	-1,3528	-4,2499	3,33E-05
-8	205	-1,6564	-6,1363	4,33E-09

-7	212	-1,4357	-5,0253	1,07E-06
-6	199	-1,2584	-3,8304	0,000171666
-5	213	-1,3901	-4,7222	4,24E-06
-4	214	-1,4925	-5,2457	3,75E-07
-3	217	-1,4531	-5,3903	1,84E-07
-2	215	-1,6131	-6,4627	6,84E-10
-1	211	-1,7061	-7,1866	1,14E-11
0	214	-1,6077	-6,3552	1,24E-09
1	204	-1,6973	-7,2234	1,00E-11
2	203	-1,8012	-7,7985	3,28E-13
3	185	-1,6792	-6,6719	2,87E-10
4	176	-1,681	-6,3418	1,87E-09
5	176	-1,5875	-5,9411	1,49E-08
6	176	-1,6015	-5,9525	1,41E-08
7	173	-1,6534	-6,1438	5,43E-09
8	175	-1,6911	-6,523	7,23E-10
9	175	-1,6019	-5,8079	2,94E-08
10	169	-1,6453	-5,8162	2,97E-08
11	168	-1,6997	-5,9866	1,27E-08
12	166	-1,6478	-6,1424	5,87E-09
13	165	-1,6974	-6,5787	6,08E-10
14	163	-1,8011	-7,6469	1,72E-12
15	155	-1,7732	-7,1687	2,96E-11
16	153	-1,9399	-9,7523	9,42E-18
17	136	-1,9239	-9,0802	1,17E-15
18	147	-1,8312	-8,7356	5,19E-15
19	149	-1,7673	-8,424	2,93E-14
20	41	-1,3906	-3,151	0,00307801

Table 4: Abnormal short interest 1 around the event.

Months	ABSI 2			
	n	mean_ABSI2	t_stat	p_value
-20	62	-0,5149	-0,6063	0,5465461
-19	170	-1,4157	-2,9777	0,0033313
-18	168	-1,1915	-3,2416	0,0014349
-17	172	-1,2591	-3,0632	0,0025448
-16	178	-1,3153	-3,7524	0,0002373
-15	184	-1,45	-4,1089	0,0000599
-14	186	-1,4122	-3,9105	0,0001292
-13	178	-1,4591	-4,9895	0,0000014
-12	188	-1,5888	-5,7592	0
-11	184	-1,9788	-5,0258	0,0000012
-10	197	-1,4436	-4,2636	0,0000312
-9	193	-1,3421	-4,4769	0,000013
-8	205	-1,843	-5,533	0,0000001
-7	212	-1,5798	-4,9532	0,0000015
-6	199	-1,477	-3,8007	0,000192
-5	213	-1,7763	-3,5336	0,0005031
-4	214	-1,3884	-5,2425	0,0000004
-3	217	-1,4848	-5,4454	0,0000001
-2	215	-1,5746	-6,2573	0
-1	211	-1,9959	-4,8171	0,0000028
0	214	-1,931	-4,8287	0,0000026
1	204	-1,9467	-5,2142	0,0000005
2	203	-1,9363	-6,4262	0
3	185	-1,591	-6,6676	0
4	176	-1,7264	-6,5619	0
5	176	-1,892	-4,9046	0,0000021
6	176	-1,5804	-6,2058	0
7	173	-1,8404	-6,2691	0

8	175	-1,7601	-7,4514	0
9	175	-1,7856	-5,7686	0
10	169	-2,0695	-4,4277	0,0000171
11	168	-1,8897	-5,7221	0
12	166	-2,078	-3,9487	0,0001162
13	165	-2,1923	-3,8168	0,0001913
14	163	-2,174	-4,8435	0,000003
15	155	-2,3696	-3,4573	0,0007055
16	153	-2,9311	-2,879	0,0045651
17	136	-3,1116	-2,4979	0,0136927
18	147	-2,8502	-2,7009	0,0077323
19	149	-2,3051	-3,6485	0,0003649
20	41	-1,3377	-3,0341	0,0042256

Table 5: Abnormal short interest 2 around the event

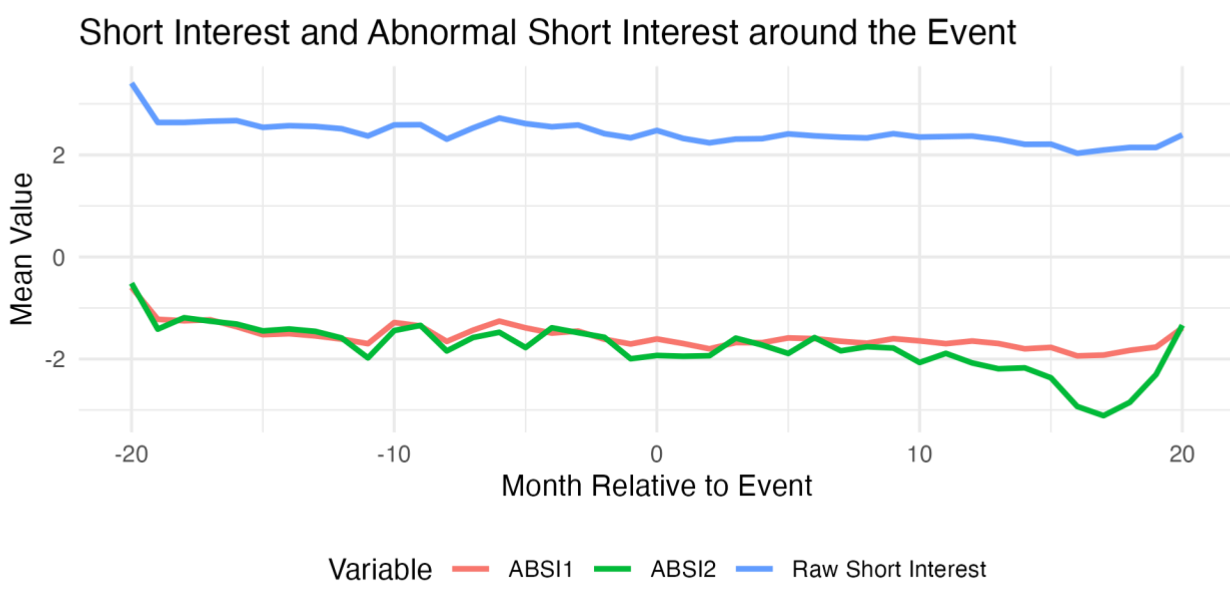

Figure 1: Short interest illustrated around the event

As it can be seen in both the table and the graph above, both raw short interest and the two constructed abnormal short interest measures stay relatively smooth in the 20-month period before and similarly after the event. In the visual representation on Graph 1 we can observe a fall in the first month, some small increases around 10 months prior to the event date, as well as a small and gradual decrease in all three short interest measures over the total observed period of 40 months. However, the expected rise and consequent fall of short interest around the event cannot be observed.

Table 4 shows more detailed information about the change in short interests around the event, by each month. The table shows the mean level of short interest for all three observed measures, as well as their t-statistics that shows if they differ from zero, and p-values, which provides information about the level of the results' significance.

In all three measures, we can observe a rather sharp drop in the level of short interest from month -20 to -19, which is then followed by a low amount of movement all the way up to the month of the event, month 0. In the case of raw short interest (SI) this is an average level of 3.4 at month -20, followed by 2.6 at month -19, and these values stay around ~2.5 all the way up to month 0. In the other cases, the levels of abnormal short interests are much lower, between 0 and -2 during the 40-month period. They start at -0.59 and -0.51 at month -20, followed by -1.2 and -1.4 at month -19, and their values stay around ~-1.5 and -1.6 all the way until the event. The abnormal measures being smaller than the raw short interest is in line with previous studies (Karpoff & Lou, 2010; Singer et al., 2022), with the raw short interest levels being around the same range, however opposed to those papers abnormal short interest values are much lower compared to those previous studies where abnormal short interest levels were above zero. T-statistics for all three measures are large in absolute value and rise from months -20 to 0, from a value of 4 to 10 in the case of raw short interest, and from -0.6 to ~-5 in the cases of abnormal short interest 1 and 2.

From the p-values from the t-tests in the table we can see that for all months the level of short interest is significant, with the exception of month -20 in the case of ABSI 1 and ABSI 2.

What differs in the results presented above from the previous study of Karpoff & Lou (2010) is that in their paper a gradual buildup and then decrease of short interest before and then after the event is found, which cannot be observed in the case of this study. To better show this buildup they also showcase the change of the average short interest by each month, where they find that in the 19 months prior to the event this change is positive in 15 months out the 19 observations, showing the buildup of short interest before the event. In the case of this study the change in the level of short interests for all three measures can be seen below in Table 5. We can observe that there is no buildup of short interest in our case, as out of the 20 months prior to the event, we find positive values in only 10 cases for raw short interest, and 7 and 8 for the two abnormal short interest measures.

Months	△SI	△ABSI1	△ABSI2
-20			
-19	-0,7721	-0,6295	-0,9009
-18	0,0004	-0,0276	0,2243
-17	0,0236	0,0186	-0,0676
-16	0,0119	-0,1349	-0,0562
-15	-0,1315	-0,1571	-0,1347
-14	0,0319	0,0198	0,0378
-13	-0,0144	-0,0431	-0,0469
-12	-0,0446	-0,0628	-0,1296
-11	-0,1422	-0,0895	-0,3901
-10	0,2165	0,4144	0,5353
-9	0,0041	-0,0672	0,1015
-8	-0,2835	-0,3036	-0,5010
-7	0,2196	0,2207	0,2632
-6	0,1937	0,1773	0,1027
-5	-0,1082	-0,1316	-0,2993
-4	-0,0622	-0,1024	0,3879
-3	0,0349	0,0394	-0,0964
-2	-0,1695	-0,1600	-0,0898
-1	-0,0814	-0,0929	-0,4213
0	0,1440	0,0984	0,0649

Table 6: Changes in short interest before the event

Apart from the tables above, a pooled regression was also used to measure the average growth of short interest before the violation with firm fixed effects. This method was also used in the previously cited paper of (Karpoff & Lou, 2010). The following regression equation was established:

$$ABSI\ 1 = \alpha + \beta * t + \varepsilon$$

Where β indicates the average rate by which short interest (in this case ABSI1) increases in the period before the violation (months -20 to -1).

The results are shown in Table 6, and as we can see, the result has a coefficient of -0.0137, with a t-statistic of -0.82 which is not significant, as the p-value is 0.41. The coefficient of -0.0137 means that the level of abnormal short interest in the timeframe before the event, decreases by on average 0.0137 percent every month. For the second abnormal short interest measure (ABSI2) the coefficient was -0.0099, indicating a decrease similar to ABSI1, but on a lower rate every month. Compared to the results of (Karpoff & Lou, 2010), where they got an estimate of 0.073, which was significant, this result shows the opposite and also not significant which means that when compared to their findings, this paper fails to find a significant or even positive buildup in the level of short interest prior to the public release of the penalty for the violations.

Model: **ABSI1**

term	estimate	std.error	statistic	p.value
Months	-0.013650	0.0165931	-0.822646	0.4116039

Table 7

As it can be seen in both the table and illustrated on the graph following it, short interest does not show movement around the penalty dates, as it was previously expected. Some small changes therefore have been made regarding the timeframe, the category of offenses used, and their severity. These minor changes allow for a more detailed investigation of the sample of violations used. The results from those observations are showcased next, and the tables with detailed information for each version can be found in the Appendix.

Due to the fact that on the chart and the table, there is a decrease of short interest in the earliest months (-20 and -19), another timeframe was created to see further back into the past, with the timeframe of 40 months before and 10 months after the event. This timeframe provides the opportunity to observe any possible movement that was before the initial -20-month mark. The reason behind it, apart from the previously mentioned decrease in short interest around month -20, was since there was no observable buildup of short interest around the event, it still could have started in an earlier period, as the information regarding the fact of the misconduct and the subsequent regulatory evaluation was likely already available to the public. Its results can be observed in the graph below, as well as the table in the Appendix. However, as can be seen below, short interest levels stay stable even when observing them over a longer period of time.

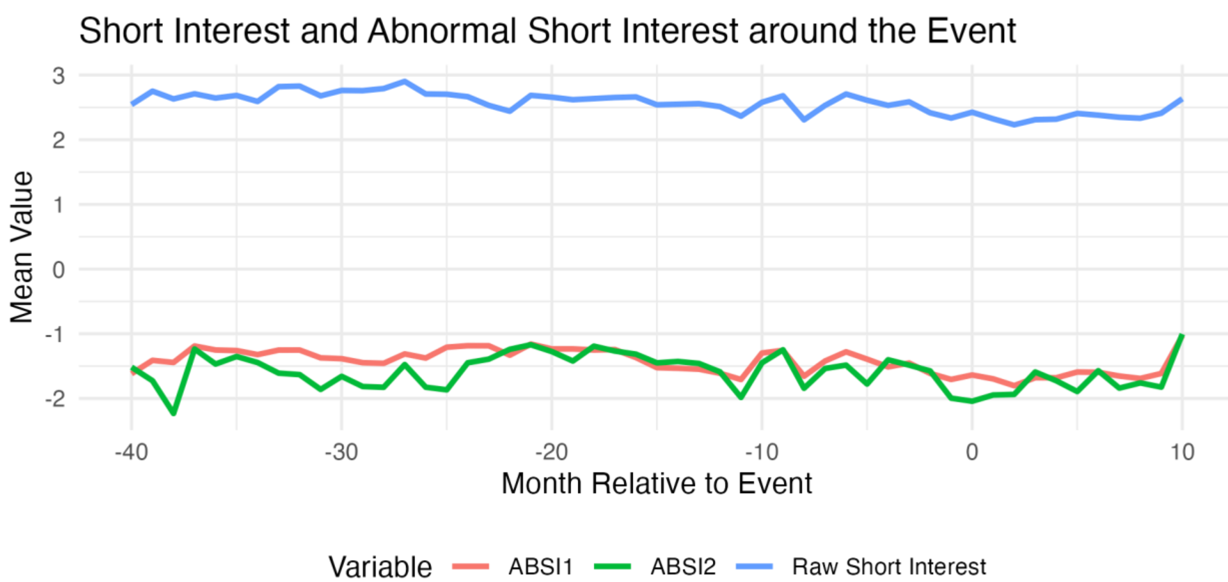

Figure 2: Short interest illustrated around the event, with longer timeframe

After finding barely to no movement or buildup in the level of short interest, it was also decided to further separate observations, based on the primary category of offense (within the broad financial offenses category). Below can be seen the short interest around the event for only violations with a primary offense of accounting fraud or deficiencies. Out of the 'Financial offenses' category 'accounting fraud or deficiencies' resembles the type of financial offenses (financial misrepresentation) used in previously mentioned papers (Karpoff, Lee, et al., 2008; Karpoff & Lou, 2010). As it can be seen, the levels of both raw and abnormal short interest are on average higher for this type of offense, but there still cannot be observed a rise around the event. There is however more movement, the increase around month -10 is somewhat larger than in the complete sample, and a continuous decline can be observed from around month -10/-9 all the way until the end of the timeframe, where short interests begin rising again.

In the case of this category of offenses, the decrease of short interest levels over the 40 months period observed can be seen even clearer, however still no buildup around the event is found, contrary to what was expected.

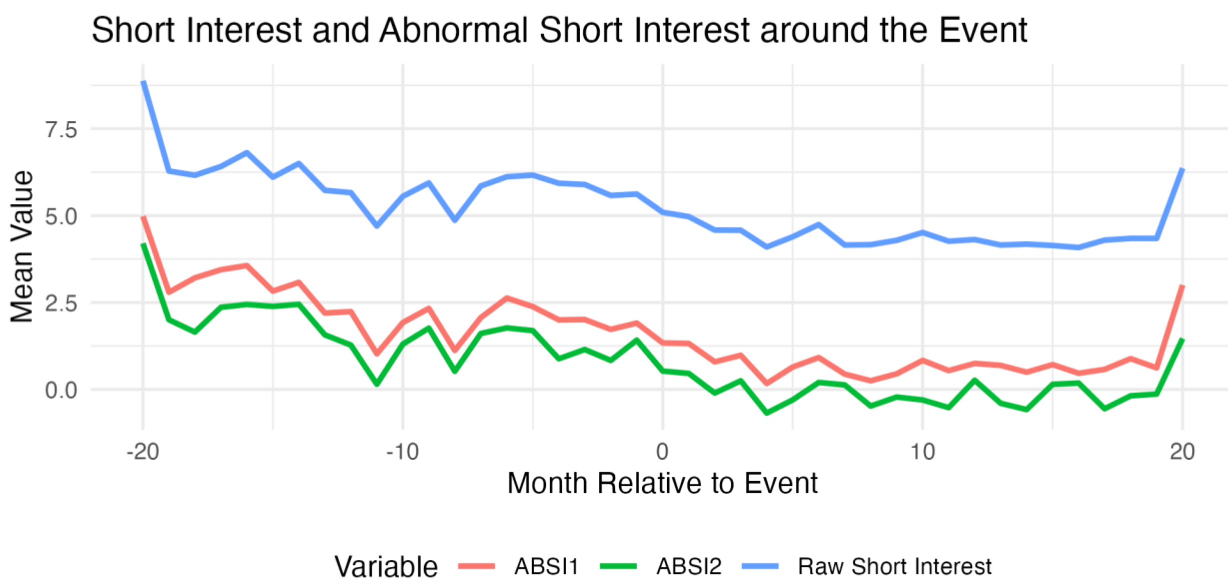

Figure 3: Short intertest for 'Accounting fraud or deficiencies' illustrated around the event

Another method that was tried was looking at the short interest for highest quarter of violations, based on their severity. In order to do this, violations were ranked on their severity, measured in the amount of penalty received for committing them. Below is the graph for the top 25% of the observations. This was done, to get a clearer picture of the 'worst' cases, and as it was previously mentioned when explaining the dataset, the penalties received vary intensely from around 50 thousand USD all the way to 500 million USD.

The level of short interest in this case also shows more movement than in the complete sample. This however could be because of the reduced number of observations, as with looking at only the quarter of the cases, the number of observations were reduced to 55 at most in the case of abnormal short interest 1.

ABSI 2 shows more movement in this case, compared to any other short interest measure in any other previous setting, starting from around month -10 until 10, followed by a sharp decline and an even faster recovery from months 10 to 20.

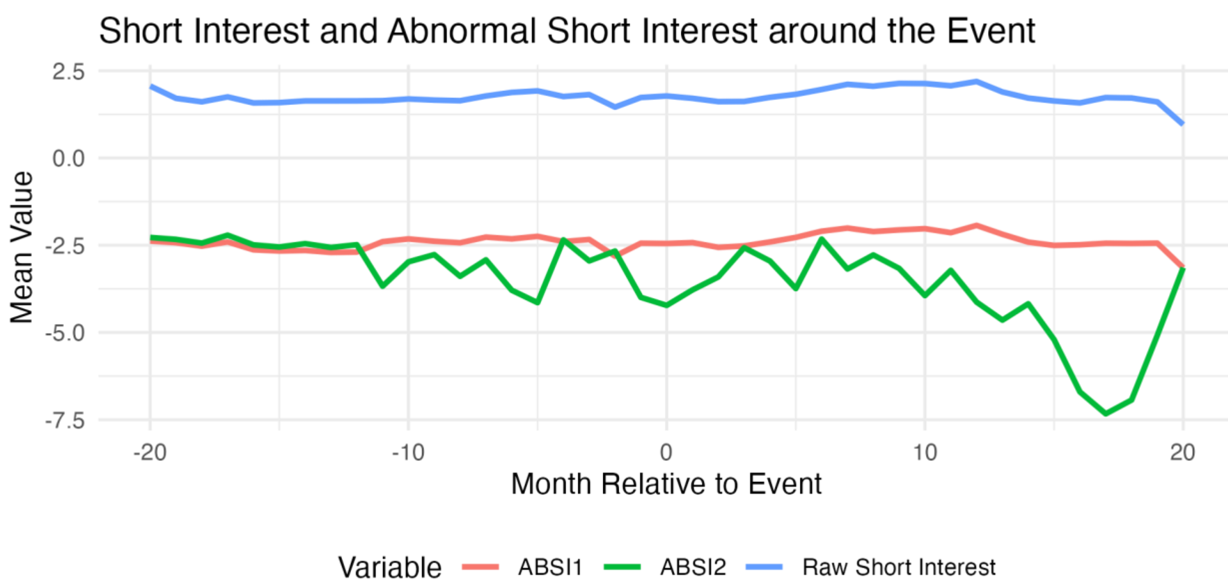

Figure 4: Short interest for the top 25% of penalties illustrated around the event

Similarly to the initial findings, where using the full available dataset with all observations and the original timeframe, in no other variation can we see a movement specifically around the penalty dates, as it was originally expected in Hypothesis 1. Rather, short interest levels are rather constant, with a slight decrease over the total 40-month period included in the analysis in some variations. Therefore, although short interest levels significantly differ from 0, Hypothesis 1 is rejected, as there is no observable increase in any variation of short interest (raw or abnormal) before the time leading up to the dates of the penalties.

To test Hypothesis 2 about the connection between the severity of the penalty and the short interest that pre-dates it, the following regression was constructed: The independent variable is the size of the penalty (originally in USD, log transformed to account for the large differences within their amounts). The control variables are Size (also log transformed), Book-to-market value and Momentum. The regression uses data from one month prior to the event, as according to our hypothesis, that month should see the highest increase in short interest for more severe penalties. This method of estimation and control variables used is based on the analysis of Karpoff & Lou (2010) The regression is conducted using both abnormal short interest and raw short interest, to account for any potential mistakes made in the process of creating abnormal short interest, as well as to increase robustness.

	Dependent variable:					
	SI	ABSI1	ABSI2	SI	ABSI1	ABSI2
	(1)	(2)	(3)	(4)	(5)	(6)
Penalty	-0.302***	-0.370***	-0.528**	-0.064	-0.062	-0.204
	(0.112)	(0.120)	(0.211)	(0.108)	(0.110)	(0.218)
Size				-0.858***	-1.010***	-1.056***
				(0.124)	(0.126)	(0.251)
BMV				-0.944***	-0.818***	-0.130
				(0.257)	(0.262)	(0.522)
Momentum				-0.918	-0.502	1.022
				(0.667)	(0.680)	(1.353)
Constant	7.003***	4.008**	6.163*	12.961***	10.337***	12.050***
	(1.745)	(1.872)	(3.291)	(1.716)	(1.751)	(3.482)
Observations	216	211	211	211	211	211
R^2	0.033	0.043	0.029	0.279	0.312	0.107
Adjusted R^2	0.028	0.039	0.024	0.265	0.299	0.090
Residual Std. Error	3.229 (df = 214)	3.381 (df = 209)	5.945 (df = 209)	2.830 (df = 206)	2.888 (df = 206)	5.743 (df = 206)
F Statistic	7.272*** (df = 1; 214)	9.469*** (df = 1; 209)	6.243** (df = 1; 209)	19.936*** (df = 4; 206)	23.371*** (df = 4; 206)	6.169*** (df = 4; 206)
Note:						*p**p***p<0.01

Table 8: Regression output for hypothesis 2

As it can be seen, no significant relationship can be found between the severity of the fine and the short interest before it. This finding is consistent for both for raw and abnormal short interest when the controls are added. In those cases, a non-significant negative relationship can be observed, which contradicts the previous initial assumption about the severity of the fine influencing the short interest before it is announced. It also opposes the findings of Karpoff & Lou (2010) where they found a significant positive relationship between the severity of the misconduct and the short interest level in the month before it became public knowledge. Some significance can be found with the short interest levels in Month -1 and the control variables: Size, and Book-to-market value (but in the latter only in the case of raw short interest and the first abnormal short interest measure). In all cases this relationship is negative, indicating that firms with higher market capitalisation have lower short interest, and similarly firms with high book-to-market value are shorted less.

For further robustness, another analysis was carried out as well. Since simply looking at the sizes of penalties can be misleading, as the amount of penalty given, can lead to vastly differing consequences among different firms. To better account for this effect, it was decided to also observe the effect of relative penalty on short interest. Relative penalty was received by dividing the penalty amount by the firm's market capitalisation (Size) to capture this effect. To account for outliers and large values, this variable was also log transformed before carrying out the regression. The control variable which accounted for the firm's market capitalisation (Size) was subsequently removed in order to reduce the possibility of multicollinearity, as it was used to calculate the relative penalty. The results of this regression can be viewed in Table 9 below.

	Dependent variable:		
	SI	ABSI1	ABSI2
	(1)	(2)	(3)
LogRelPen	0.299***	0.360***	0.292
	(0.104)	(0.110)	(0.200)
BMV	-1.004***	-0.887***	-0.211
	(0.285)	(0.299)	(0.548)
Momentum	-1.623**	-1.322*	0.059
	(0.731)	(0.767)	(1.404)
Constant	1.701***	-2.770***	-3.341***
	(0.647)	(0.679)	(1.242)
Observations	211	211	211
R^2	0.109	0.101	0.011
Adjusted R^2	0.096	0.088	-0.003
Residual Std. Error (df = 207)	3.139	3.294	6.028
F Statistic (df = 3; 207)	8.408***	7.714***	0.780
Note:			*p**p***p<0.01

Table 9: Regression for H2 using relative penalties

As it can be seen in Table 9, the results differ than that of Table 8. There are positive and significant relationships between short interest in the month prior, and the relative size of the penalties in the cases of raw short interest and the first abnormal short interest measure. 0.299 for raw short interest and 0.36 for ABSI1. These mean that a one unit increase in the log of relative penalty leads to a 0.29 and 0.36 percentage points increase in raw short interest and ABSI 1. In the case of ABSI 2, the coefficient matches the results of the other two short interest measures, but the relationship is not significant. Furthermore, significant and negative relationships can be observed between short interest and both book-to-market value and momentum for raw short interest and ABSI 1, indicating that the level of short interest prior the penalty dates is lower for firms with higher book-to-market values and for firms that experience higher momentum. This configuration therefore partly proves our second hypothesis about firms with higher penalties experience greater levels of short interest, - given that the penalty is measured relative to the firm's size. Hypothesis 2 of the paper is accepted, since as demonstrated above the level of short interest does increase in relationship to the severity of the penalty. This finding shows that relative penalties (when compared to the firm size) are able to predict short interest, suggesting that short sellers not only focus on whether there's negative information about a firm, but the information's specific effect on said firm.

However, as written above, the results for testing Hypothesis 1 were against the initial expectations, as short interest did not show an increase prior to the penalties. Compared to the findings of Karpoff & Lou (2010) where they found that short sellers can anticipate both the misconduct and its severity before it was publicly announced, those results could not be reproduced at the reveal dates for the penalties. Short interest levels, while different than zero, and show movement, it is not influenced by the event in the complete sample of observations, nor in any of the more specific sub-samples.

There could be several potential reasons behind the results of this study, and behind the reason that the first hypotheses were rejected. Most likely because of the penalty dates used in this study, rather than the initial public reveal dates for these violations. Markets reacted immediately when the information released and had already priced in the misconduct back when it first became public knowledge, therefore the reaction for the penalties were not as severe, as possibly months or even years prior. This is one of the biggest limitations of the paper, as the public reveal dates are not known in the dataset used and looking them up is not possible due to time constraints.

Secondly, the violations themselves, which included in the dataset and used to conduct the study. This paper uses a different set of data of financial violations (GJF dataset) compared to the previous papers, as mentioned before. Slightly different types of financial violations could have led to differing events being observed, thus the results. The paper of Karpoff & Lou (2010) looked at financial misconduct for which they used a previously collected database used in previous studies about financial misrepresentation (Karpoff, Lee, et al., 2008; Karpoff, Scott Lee, et al., 2008), the paper of Singer et al. (2022) studied internal control material weaknesses, whereas this paper looked at three main categories of financial violations, them being ‘Investor protection violations’, ‘Accounting fraud or deficiencies’ and ‘Anti-money-laundering deficiencies’. Moreover, there are other obvious differences such as the timeframe (1988-2005 compared to 2018-2024), however it is important to note about that is the number of violations, in both the dataset of Karpoff & Lou (2010) and in the dataset used in this paper, per year are roughly similar.

To test the assumption regarding the results, about markets already pricing in the violations prior to the announcement dates of penalties, a different approach is required. Looking at informed trading before the penalty dates is a possible option, but it is also a rather challenging one. Short sellers can be considered informed traders, however, as demonstrated above, short interests did not change prior to the event dates. Another category of informed trading is insiders. As mentioned in previous chapters 2 and 3, looking at the trading activity of insiders, can yield further knowledge on sophisticated trading around the penalty dates. Insider trading activity is gathered from 60 months prior to the event to 30 months after, and it is illustrated below at Figure 5. Figure 6 shows the exact same data, only with a more “zoomed-in” view of 12 months before and after the event.

Below we can see how the monthly average amounts of shares bought and sold by company insiders compare around the penalty. It does not show that markets previously priced in the misconduct, as the levels of buying and selling do not show any special movement or pattern in the 'further' past prior to the penalty. What is seen is that both selling and buying activity of insiders can vary widely in their amounts with selling being higher in quantity for every month observed. However, an important observation that can be seen, is the number of shares sold right around the event rises sharply, peaking at month + 1. Compared to this in the same period the buy side does not see such increase. This thus can be interpreted as a confirmation that there exists a form of market reaction to the penalties, but instead of rising levels of short selling, we can observe an increased level of company insiders selling their shares of the company right around their firms were penalised for committing financial violations. Apart from the monthly average amounts, the table also show the t-statistics from a t-test to see how the values differ from zero, as well as the p-values from the test, similarly as these numbers have been shown in table 3 for short selling.

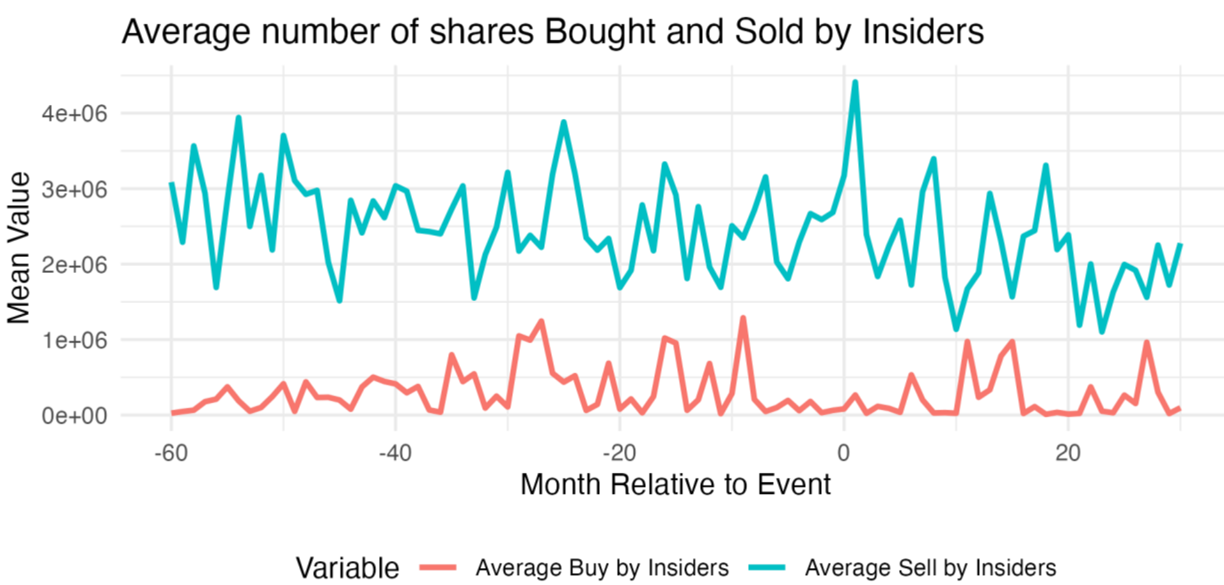

Figure 5: Average number of shares bought and sold by insiders, longer timeframe

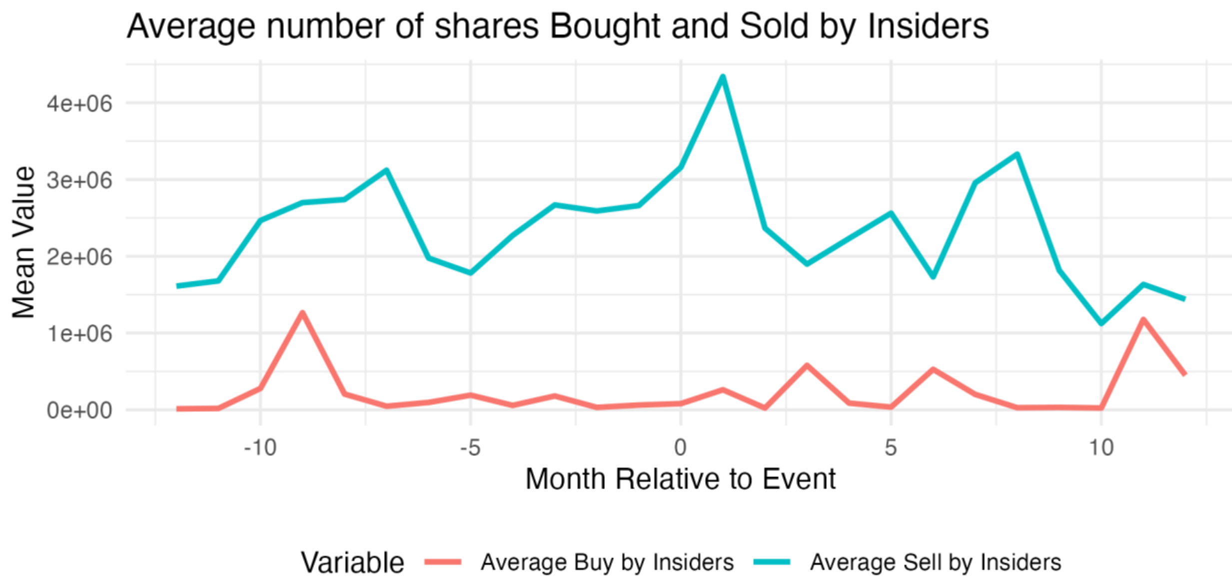

Figure 6: Average number of shares bought and sold by insiders, shorter timeframe

Months	mean_sell	t_stat_sell	p_value_sell	mean_buy	t_stat_buy	p_value_buy	sell_buy_ratio
-60	3086173,465	2,6573	0,01024439	25290,63897	1,1867	0,2404	122,0283
-59	2290586,34	6,1178	0,00000001	46898,69935	2,0048	0,0473	48,8411
-58	3565973,468	3,0834	0,00255789	65145,0833	2,1667	0,0323	54,7390
-57	2939075,005	3,2368	0,00155661	177487,2762	1,4931	0,1380	16,5594
-56	1691129,718	3,4935	0,00071439	211426,9324	1,7400	0,0850	7,9986
-55	2854243,205	2,6933	0,00814197	374318,451	1,4995	0,1365	7,6252
-54	3942170,29	3,8810	0,00017324	188952,1169	1,0838	0,2807	20,8633
-53	2500083,586	4,6776	0,00000817	50957,63846	2,3743	0,0193	49,0620
-52	3176203,07	3,1182	0,00233810	100164,6921	2,3439	0,0209	31,7098
-51	2188405,852	2,7375	0,00717535	244237,1835	1,3800	0,1703	8,9602
-50	3704153,563	3,2606	0,00149566	414739,3151	1,6383	0,1043	8,9313
-49	3107215,297	2,6607	0,00905894	49773,3575	2,2770	0,0249	62,4273
-48	2924971,234	3,6486	0,00041412	439786,1294	1,8344	0,0694	6,6509
-47	2976932,308	2,9706	0,00367007	233397,8364	2,0578	0,0420	12,7548
-46	2023367,631	3,2669	0,00140648	236062,7529	1,8974	0,0601	8,5713
-45	1514681,975	4,3706	0,00002636	199511,8919	1,6509	0,1014	7,5919
-44	2845336,706	4,3402	0,00003040	78471,57247	1,8600	0,0654	36,2595
-43	2414626,782	3,8678	0,00018982	373065,3045	1,5890	0,1150	6,4724
-42	2837039,621	4,1726	0,00005937	502471,5925	1,1359	0,2584	5,6462
-41	2616161,922	3,8867	0,00016829	445469,905	1,3818	0,1697	5,8728

-40	3037136,499	2,9823	0,00350513	413211,349	1,5752	0,1180	7,3501
-39	2965907,497	3,3494	0,00107774	295792,552	2,0725	0,0403	10,0270
-38	2448047,513	4,3103	0,00003457	379497,8102	2,0487	0,0428	6,4508
-37	2431092,099	2,6665	0,00884386	67723,61094	2,4908	0,0143	35,8973
-36	2401828,299	4,8030	0,00000456	38088,64093	2,0499	0,0426	63,0589
-35	2729509,14	3,3021	0,00127898	799264,5501	1,1652	0,2463	3,4150
-34	3036427,878	3,6198	0,00043424	443602,0436	2,3371	0,0211	6,8449
-33	1552095,035	3,3423	0,00110828	545799,9854	1,2716	0,2060	2,8437
-32	2126180,936	4,6185	0,00000959	93569,02408	1,6021	0,1117	22,7231
-31	2489648,396	3,2601	0,00145882	251107,5627	1,7056	0,0907	9,9147
-30	3215453,734	3,1717	0,00194768	108428,7979	1,9334	0,0557	29,6550
-29	2173064,348	3,5792	0,00052532	1049241,076	1,1031	0,2725	2,0711
-28	2381357,513	4,3359	0,00003441	993470,8272	2,3618	0,0201	2,3970
-27	2223086,155	3,2294	0,00165217	1245075,607	1,7807	0,0778	1,7855
-26	3191870,078	4,1819	0,00006297	554282,3554	1,2019	0,2323	5,7586
-25	3883332,9	2,8494	0,00537137	437269,1472	1,7807	0,0782	8,8809
-24	3198282,939	2,9512	0,00385578	521683,734	1,1012	0,2732	6,1307
-23	2350136,162	3,9507	0,00013367	62088,41093	2,8866	0,0046	37,8514
-22	2185091,689	3,4300	0,00083894	142193,7862	1,2537	0,2125	15,3670
-21	2339879,685	4,2124	0,00005161	687389,162	1,4926	0,1384	3,4040
-20	1688539,985	4,1184	0,00006946	79887,17132	1,7675	0,0796	21,1366
-19	1917281,5	4,1274	0,00006653	213324,6648	1,8126	0,0723	8,9876
-18	2784237,778	3,3125	0,00127254	30192,31337	2,1867	0,0310	92,2168
-17	2177744,576	3,9804	0,00012086	245563,5454	1,8386	0,0685	8,8684
-16	3325291,366	3,3798	0,00100456	1020833,134	1,7810	0,0777	3,2574
-15	2916736,842	2,6712	0,00877428	954348,2939	1,0551	0,2938	3,0563
-14	1809756,031	3,8272	0,00023753	63717,17793	1,8117	0,0733	28,4030
-13	2761372,503	2,5585	0,01220293	203532,2807	1,1149	0,2679	13,5672
-12	1962374,708	4,2637	0,00004320	683075,3696	1,0858	0,2800	2,8729
-11	1692883,031	3,4441	0,00080938	18528,03357	2,3127	0,0226	91,3687
-10	2507931,175	2,7935	0,00606316	285534,6757	1,6025	0,1117	8,7833
-9	2348812,421	3,5489	0,00057209	1288760,202	1,8938	0,0609	1,8225
-8	2715432,655	4,9019	0,00000282	208885,0836	1,6722	0,0969	12,9996
-7	3155683,078	3,1175	0,00230921	47873,40963	2,0212	0,0456	65,9172
-6	2027286,828	4,8019	0,00000482	99689,21596	1,6969	0,0925	20,3361
-5	1806919,368	4,2356	0,00004642	194252,1186	2,0675	0,0409	9,3019
-4	2292198,883	2,9918	0,00340604	58292,86793	1,8326	0,0695	39,3221
-3	2668949,913	3,0168	0,00321813	180385,1849	1,4124	0,1609	14,7958
-2	2590478,191	3,2358	0,00171649	31577,95031	2,1618	0,0334	82,0344
-1	2684550,218	4,0679	0,00008950	62753,93653	2,5872	0,0110	42,7790
0	3172618,213	3,2157	0,00170113	82069,22187	3,1068	0,0024	38,6578

1	4412982,328	3,3937	0,00094661	265877,7631	1,8652	0,0647	16,5978
2	2390273,929	3,5681	0,00051642	23761,69137	2,1960	0,0300	100,5936
3	1836569,306	4,8378	0,00000457	115543,0354	1,7587	0,0816	15,8951
4	2237527,734	3,1981	0,00179905	88962,80617	1,3053	0,1945	25,1513
5	2580880,761	3,8169	0,00022287	35946,41575	3,2128	0,0017	71,7980
6	1723867,156	3,7787	0,00026554	532850,4356	1,0863	0,2799	3,2352
7	2956491,43	2,5737	0,01151433	201267,7391	1,4903	0,1393	14,6893
8	3396254,112	3,4361	0,00093856	28135,32527	1,4199	0,1595	120,7114
9	1825947,518	3,8148	0,00024516	31990,60579	2,0747	0,0408	57,0776
10	1136523,858	5,8806	0,00000008	24134,09091	1,5251	0,1309	47,0921
11	1673173,97	2,8193	0,00608016	974988,6225	1,0480	0,2978	1,7161
12	1887247,052	2,5014	0,01408181	236207,3105	1,3397	0,1835	7,9898
13	2936546,095	2,4376	0,01673033	334754,5717	1,1292	0,2618	8,7722
14	2303565,744	3,2338	0,00169697	783265,3551	1,3075	0,1943	2,9410
15	1567106,173	3,2662	0,00156017	973733,1407	1,4934	0,1389	1,6094
16	2369946,501	3,1218	0,00234446	20998,60425	1,1700	0,2447	112,8621
17	2444605,118	2,4598	0,01579217	111905,1094	1,1427	0,2562	21,8453
18	3309024,554	2,8290	0,00596765	10031,11052	1,4579	0,1490	329,8762
19	2192957,826	2,7560	0,00719178	35822,43115	1,4751	0,1440	61,2174
20	2388793,923	2,0521	0,04343055	13238,65794	1,7080	0,0915	180,4408
21	1191387,964	5,1130	0,00000258	22247,87294	2,0643	0,0426	53,5506
22	2002101,611	2,8587	0,00554116	373585,7043	1,0160	0,3130	5,3591
23	1102170,238	4,0101	0,00014503	51860,49425	1,6814	0,0970	21,2526
24	1628220,738	3,5872	0,00058121	30615,85467	1,2174	0,2271	53,1823
25	1995459,034	4,3563	0,00003640	264152,4904	1,0566	0,2937	7,5542
26	1917772,537	4,0712	0,00010359	153928,9418	1,1660	0,2468	12,4588
27	1560674,86	3,5235	0,00071152	965065,2931	1,4081	0,1630	1,6172
28	2252321,418	3,5367	0,00063114	302417,7423	1,0549	0,2942	7,4477
29	1723237,583	3,1360	0,00247983	19992,47569	1,4234	0,1589	86,1943
30	2277063,481	1,5679	0,13000000	96684,90497	1,2070	0,2392	23,5514

Table 10: Selling and buying by insiders around the event

The values in Table 8 show the mean number of shares bought and sold by insiders, as well as the sell/buy ratio. To reduce the influence of large outliers, this sell/buy ratio was log-transformed. To test whether insider trading behavior changes around the event compared to more normal periods, several tests were conducted. As shown earlier, insider selling begins to rise around month −5 and remains elevated until about month +2. Therefore, this window (months −5 to +2) was compared to the rest of the sample. To test whether insider trading behavior changes around penalty announcements, three different statistical approaches were used. First, a Welch t-test was applied to compare the mean insider sell-buy ratio in the window around the event to the average ratio in the reference period, which is the rest of the months. This version of the t-test does not assume equal variances between groups, making it more suitable for data with potential differences in spread. Second, a Wilcoxon signed-rank test was used as a non-parametric alternative to evaluate whether there was a significant shift in the median ratio between the two periods. This test is less sensitive to outliers and does not rely on the assumption of normally distributed data. Finally, a regression using Newey-West standard errors was conducted, with a dummy variable for the penalty month included to account for potential changes in insider activity.

The results show a statistically significant increase in the sell/buy ratio during this period. Both the Newey-West regression and the Welch t-test indicate a difference of 0.826 in the log of the sell/buy ratio between the event window and the rest. This translates to insiders selling approximately $e^{0.826} \approx 2.3$ times more shares than they bought during that period. The difference is significant at the 1% level in the Newey-West test, and at the 5% level in the Welch t-test (p-value = 0.029). For further robustness check, the Wilcoxon test also showed significance at a p-value of 0.044. These results can be seen in Table 11 and 12 below.

Newey-West Regression on Insider Trading

	Dependent variable:
	Log(Sell/Buy Ratio)
Event Window Dummy (-5 to +2)	0.826***
	(0.251)
Constant	2.653***
	(0.158)
Observations	91
R^2	0.036
Adjusted R^2	0.025
Note:	*p<0.1; **p<0.05; ***p<0.01
	* p<0.1; ** p<0.05; *** p<0.01

Table 11

T-Test Result

Test	Statistic	p_value	Conf_Int_Lower	Conf_Int_Upper	Mean_Group1	Mean_Group2
t-test	-2.529931	0.02927827	-1.550403	-0.1013035	2.653478	3.479331

Wilcoxon Test Result

Test	Statistic	p_value
Wilcoxon test	188	0.04429978

Table 12: Welch t-test and Wilcoxon test

While short sellers in general (based on available short selling data) do not show significant reactions to penalties by increasing their short positions around the event in such ways that was showed by the previous research (Karpoff & Lou, 2010; Singer et al., 2022), insiders do demonstrate increased selling activity around the event (from 5 months prior to 2 months after) as well as lowered willingness to buy. This, however, does not necessarily confirm the reason for the lack of short interest buildup being that markets have already priced in the violation, resulting in no buildup for the penalty, as in that case it could have been expected that insiders would also demonstrate higher selling in previous periods. Insiders selling around the event indicates that the event was not necessarily anticipated by market participants, but the lack of interest by short sellers could mean that the events themselves do not carry that high significance or potential that would require higher attention by them.

5. Conclusions

This thesis set out to examine whether short sellers react to the announcement of penalties for financial violations, and whether these reactions depend on the severity of the penalties. While both short selling and financial misconduct have been widely studied in the academic literature, this paper aimed to build on previous research by shifting the focus from the initial public reveal of misconduct to the penalty announcements themselves. This change in focus allowed the study to explore how markets, and short sellers in particular, respond once the wrongdoing is confirmed and quantified by regulators. Using a dataset on U.S. financial violations from Good Jobs First, matched with monthly short interest data from LSEG Workspace (DataStream), the paper investigated 219 violations issued between 2018 and 2024 involving 127 unique publicly listed firms. To better understand short-selling behavior around these events, the analysis used both raw and abnormal short interest measures. The abnormal short interest was calculated to control for firm characteristics such as size, book-to-market value, momentum, and turnover.

The findings do not support the first hypothesis of the paper, that short interest increases before the announcement of penalties. Across all short interest measures, there was no clear buildup observed in the months leading up to the penalty date. While short interest levels were significantly different from zero throughout the period, they remained relatively stable around the event. This is in contrast to earlier studies (Karpoff & Lou, 2010; Singer et al., 2022),which found a rise in short interest ahead of the public reveal of misconduct. A possible reason for this difference is that in this study, the penalty announcements do not represent the first time the market learns about the wrongdoing therefore, much of the relevant information may already be priced in. However, one of the more important findings of this paper is that short interest before the penalty announcement is positively related to the relative size of the penalty, meaning the penalty amount scaled by the firm's market value. This suggests that short sellers may pay closer attention to the financial impact of penalties rather than just their existence. This result, which can be seen in Table 7, adds a new perspective by showing that traders react more when the penalty represents a more serious financial hit for the firm.

To gain further insight into how markets respond to penalties, the study also looked at insider trading activity. While in contrast to what was expected, short interest measures did not increase around penalties, insider selling showed a noticeable spike around the penalty dates. The ratio of shares sold to shares bought by company insiders rose significantly, peaking in the month after the penalty was announced. This finding suggests that penalties are still important market events, even if short sellers do not respond strongly, at least not at the announcement stage. Insiders, who are arguably among the best-informed market participants, appear to treat these penalties as bad news that are worth acting on.

<u>Limitations:</u>

The main limitation of this study is that it uses penalty announcement dates as the main event of interest, rather than the dates when the misconduct first became public. As previous studies have shown, markets react strongly to the initial reveal of bad news (Karpoff & Lou, 2010). Since those dates were not included in the dataset and collecting them manually was not possible due to time limitations, this study most likely has missed the point at which most of the market reaction happened. Future research that manages to collect and match those initial public reveal dates could provide deeper insights into how short sellers behave when news first breaks. Another limitation is related to the construction of abnormal short interest, which depends on the choice of control variables and sorting method. While this was handled carefully and followed approaches used in earlier studies (Karpoff & Lou, 2010), the results may still be sensitive to the specific control variables used, and alternative specifications might result in different estimates. This adds a layer of uncertainty compared to analyses based purely on raw, directly observed short interest.

<u>Future research:</u>

There are several directions future research could take. First, as mentioned above, studies that include both the public reveal date and the penalty announcement date could allow for a more complete understanding of how markets react across the entire enforcement timeline. Second, this paper focused only on financial violations, but the dataset from Good Jobs First also includes environmental, labour, and other types of violations. It would be interesting to test whether short sellers or insiders react differently to those types of misconduct. Moreover, future work could explore the interaction between insider trading and short selling more closely, for example, whether insider sales lead to more shorting by outside investors, or whether both groups tend to react to the same types of news. Lastly, because of the addition of the insiders trading analysis, which as mentioned was a later addition, future research can put a higher emphasis on it, and not only look at it together with short interes, but perhaps solely focus on studying the behaviour and trading patterns of insider around certain negative news events.

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7. Appendix

Months	SI				ABSI1				ABSI2			
	n	mean	t_stat	p_value	n	mean_val	t_stat	p_value	n	mean_val	t_stat	p_value
-40	111	2,54	6,81	5,47751E-10	89	-1,62	-3,97	0,000145	89	-1,52	-4,00	0,000130494
-39	147	2,75	8,02	3,10049E-13	117	-1,41	-3,83	0,000209	117	-1,73	-3,05	0,002802866
-38	153	2,63	8,14	1,31151E-13	125	-1,44	-4,26	3,97E-05	125	-2,23	-2,30	0,022971481
-37	147	2,71	8,03	2,8955E-13	121	-1,19	-3,02	0,003083	121	-1,24	-3,21	0,001682225
-36	156	2,64	8,12	1,32011E-13	130	-1,25	-3,42	0,000838	130	-1,47	-3,09	0,002453378
-35	159	2,68	8,02	2,17332E-13	137	-1,26	-3,60	0,000444	137	-1,35	-3,47	0,000688525
-34	162	2,59	7,76	8,66374E-13	140	-1,32	-3,81	0,000205	140	-1,45	-3,38	0,000940817
-33	165	2,82	7,66	1,4942E-12	141	-1,25	-3,59	0,000449	141	-1,61	-2,65	0,009097812
-32	168	2,83	8,02	1,76319E-13	141	-1,25	-3,72	0,000289	141	-1,63	-2,68	0,008345858
-31	172	2,68	8,21	4,65201E-14	144	-1,37	-4,31	2,99E-05	144	-1,86	-2,81	0,005622908
-30	172	2,76	8,27	3,5962E-14	148	-1,39	-4,51	1,29E-05	148	-1,66	-3,08	0,00243813
-29	173	2,76	8,36	2,03176E-14	150	-1,45	-4,89	2,52E-06	150	-1,82	-3,30	0,001194228
-28	173	2,79	8,36	2,04954E-14	149	-1,46	-4,90	2,48E-06	149	-1,83	-3,34	0,00105062
-27	178	2,90	8,27	2,96726E-14	153	-1,31	-4,06	7,87E-05	153	-1,48	-3,35	0,001027602
-26	184	2,71	8,18	4,69256E-14	150	-1,38	-4,27	3,51E-05	150	-1,83	-2,73	0,007156627
-25	187	2,70	7,97	1,47886E-13	155	-1,21	-3,12	0,002129	155	-1,87	-2,17	0,031816734
-24	183	2,67	8,06	9,8791E-14	151	-1,18	-3,05	0,002733	151	-1,45	-2,69	0,007888615
-23	192	2,53	8,14	4,95725E-14	163	-1,19	-3,23	0,001484	163	-1,39	-3,16	0,001913288
-22	189	2,44	8,04	8,64233E-14	166	-1,33	-3,87	0,000158	166	-1,24	-3,75	0,000241999
-21	186	2,69	7,45	3,47589E-12	160	-1,16	-2,93	0,003916	160	-1,17	-3,02	0,002920302
-20	204	2,66	7,89	1,80542E-13	171	-1,23	-3,29	0,001214	171	-1,28	-3,18	0,001725598
-19	208	2,62	8,02	7,29624E-14	170	-1,23	-3,32	0,001086	170	-1,42	-3,06	0,002566642
-18	211	2,64	8,26	1,66594E-14	168	-1,25	-3,38	0,000911	168	-1,19	-3,24	0,001434876
-17	217	2,65	7,97	8,71473E-14	172	-1,24	-3,18	0,001751	172	-1,27	-3,10	0,002257097
-16	212	2,66	7,87	1,81869E-13	178	-1,37	-3,64	0,000355	178	-1,32	-3,75	0,000237266
-15	219	2,54	7,76	3,31606E-13	184	-1,52	-4,18	4,44E-05	184	-1,45	-4,11	5,9916E-05
-14	224	2,55	7,58	8,93226E-13	186	-1,53	-4,12	5,77E-05	186	-1,43	-4,00	9,26794E-05
-13	214	2,56	8,68	1,02764E-15	178	-1,55	-5,14	7,16E-07	178	-1,46	-4,99	1,4391E-06
-12	224	2,51	9,18	3,12043E-17	188	-1,61	-5,89	1,80E-08	188	-1,59	-5,76	3,42007E-08
-11	215	2,36	8,99	1,30683E-16	184	-1,71	-7,08	2,89E-11	184	-1,98	-5,07	9,80363E-07
-10	221	2,58	8,91	1,94319E-16	197	-1,30	-3,97	0,000101	197	-1,45	-4,30	2,6853E-05
-9	212	2,68	9,00	1,28277E-16	193	-1,26	-3,80	0,000195	193	-1,25	-3,99	9,41234E-05
-8	219	2,31	9,28	1,72583E-17	205	-1,66	-6,14	4,33E-09	205	-1,84	-5,53	9,58995E-08
-7	223	2,53	9,91	1,37939E-19	212	-1,42	-5,23	3,85E-07	212	-1,54	-5,08	7,78364E-07

-6	210	2,71	8,91	2,33436E-16	199	-1,28	-3,95	0,000108	199	-1,48	-3,88	0,000142623
-5	223	2,61	9,49	3,77274E-18	213	-1,39	-4,75	3,69E-06	213	-1,78	-3,55	0,000471565
-4	220	2,53	9,39	7,46245E-18	214	-1,51	-5,36	2,16E-07	214	-1,40	-5,34	2,35038E-07
-3	222	2,59	10,12	5,17933E-20	217	-1,45	-5,39	1,84E-07	217	-1,48	-5,45	1,40006E-07
-2	220	2,42	10,29	1,67149E-20	215	-1,61	-6,46	6,84E-10	215	-1,57	-6,26	2,1056E-09
-1	216	2,34	10,48	5,12046E-21	211	-1,71	-7,19	1,14E-11	211	-2,00	-4,82	2,78672E-06
0	219	2,43	14,64	1,54673E-39	214	-1,64	-9,31	7,49E-19	214	-2,04	-6,11	2,3673E-09
1	209	2,32	10,47	6,85609E-21	204	-1,70	-7,22	1,00E-11	204	-1,95	-5,21	4,53299E-07
2	208	2,23	10,26	3,08276E-20	203	-1,80	-7,84	2,44E-13	203	-1,94	-6,46	7,54375E-10
3	188	2,31	9,67	3,32074E-18	185	-1,68	-6,67	2,87E-10	185	-1,59	-6,67	2,94052E-10
4	179	2,32	9,10	1,74572E-16	176	-1,68	-6,34	1,87E-09	176	-1,73	-6,56	5,79777E-10
5	179	2,41	9,44	2,08106E-17	176	-1,59	-5,99	1,16E-08	176	-1,89	-4,94	1,84275E-06
6	179	2,38	9,19	9,84646E-17	176	-1,60	-5,96	1,33E-08	176	-1,57	-6,20	3,8759E-09
7	175	2,35	8,95	5,19023E-16	173	-1,65	-6,14	5,43E-09	173	-1,84	-6,27	2,83386E-09
8	177	2,33	9,28	6,19139E-17	175	-1,69	-6,52	7,23E-10	175	-1,76	-7,45	4,14725E-12
9	177	2,41	9,08	2,09216E-16	175	-1,61	-5,88	2,04E-08	175	-1,83	-5,88	2,01384E-08
10	18	2,63	3,62	0,002093492	17	-1,03	-1,26	0,225403	17	-1,00	-1,26	0,226810975

Table for Figure 2

Months	**SI**				**ABSI1**				**ABSI2**			
	n	**mean_val**	**t_stat**	**p_value**	**n**	**mean_val**	**t_stat**	**p_value**	**n**	**mean_val**	**t_stat**	**p_value**
-20	11	8,88	2,22	0,050530236	10	4,98	1,21	0,255893402	10	4,20	1,11	0,29579977
-19	25	6,28	3,15	0,004378416	22	2,80	1,38	0,182789553	22	2,00	1,05	0,307861282
-18	25	6,16	3,26	0,003316412	21	3,21	1,64	0,117657014	21	1,65	0,87	0,394514645
-17	26	6,41	3,09	0,004835183	22	3,44	1,56	0,133591536	22	2,36	1,12	0,274081403
-16	24	6,81	3,05	0,005696124	20	3,56	1,48	0,154375256	20	2,44	1,07	0,295871244
-15	25	6,11	2,84	0,008966594	21	2,83	1,20	0,24270603	21	2,39	1,09	0,288880451
-14	26	6,50	2,95	0,006759581	22	3,08	1,30	0,209122371	22	2,45	1,10	0,28459589
-13	25	5,73	3,73	0,00104327	21	2,20	1,41	0,173963874	21	1,57	1,10	0,282494492
-12	26	5,66	4,36	0,000197495	22	2,24	1,64	0,116755778	22	1,28	1,05	0,304864981
-11	25	4,70	4,53	0,000137351	21	1,02	1,02	0,322189269	21	0,15	0,16	0,874710817
-10	25	5,56	4,13	0,000382435	22	1,92	1,30	0,207307778	22	1,30	0,93	0,360546081
-9	25	5,94	4,25	0,000263121	23	2,33	1,69	0,104557359	23	1,76	1,37	0,185369284
-8	25	4,87	4,28	0,000257734	24	1,12	1,03	0,315534326	24	0,52	0,46	0,651773414
-7	26	5,85	4,61	9,30464E-05	25	2,07	1,76	0,091139638	25	1,61	1,35	0,189239996
-6	25	6,12	3,93	0,000631767	24	2,63	1,70	0,102601179	24	1,77	1,19	0,247322964
-5	26	6,17	4,61	0,000101271	25	2,38	1,88	0,072764985	25	1,69	1,33	0,195693865
-4	26	5,93	4,55	0,000121045	25	2,00	1,60	0,123067039	25	0,88	0,76	0,456740252
-3	26	5,90	4,69	8,32634E-05	25	2,01	1,69	0,104875216	25	1,15	0,95	0,35397654

-2	26	5,58	4,68	8,5902E-05	25	1,73	1,54	0,137234768	25	0,83	0,74	0,465967862
-1	24	5,62	4,79	7,79961E-05	23	1,91	1,71	0,100939745	23	1,42	1,23	0,230468599
0	26	5,09	7,16	4,18364E-09	25	1,34	2,08	0,042789845	25	0,53	0,80	0,427493048
1	22	4,97	5,91	7,19113E-06	21	1,32	1,61	0,122292848	21	0,46	0,51	0,613280743
2	23	4,58	5,79	7,93712E-06	22	0,79	0,99	0,335157812	22	-0,11	-0,13	0,895594407
3	22	4,58	5,91	7,27495E-06	21	0,98	1,34	0,195704881	21	0,25	0,31	0,76020852
4	23	4,10	5,77	8,38353E-06	22	0,17	0,23	0,820680109	22	-0,68	-0,95	0,353960362
5	23	4,39	5,69	8,47547E-06	22	0,64	0,89	0,383432939	22	-0,30	-0,40	0,690680648
6	22	4,74	5,63	1,37841E-05	21	0,92	1,17	0,254154518	21	0,20	0,26	0,799444106
7	22	4,15	5,77	9,98649E-06	21	0,44	0,70	0,494296014	21	0,13	0,20	0,841888237
8	23	4,16	5,87	6,68198E-06	22	0,25	0,39	0,697312328	22	-0,48	-0,66	0,513401746
9	23	4,29	5,84	7,01059E-06	22	0,45	0,68	0,505950446	22	-0,22	-0,29	0,77648703
10	22	4,51	5,54	1,67785E-05	21	0,83	1,14	0,268035785	21	-0,30	-0,39	0,704297646
11	23	4,26	6,05	4,33037E-06	22	0,54	0,80	0,430006799	22	-0,53	-0,74	0,470394344
12	23	4,31	6,34	2,21832E-06	22	0,75	1,23	0,230843433	22	0,26	0,38	0,704643476
13	22	4,15	5,50	1,87862E-05	21	0,69	0,98	0,338349404	21	-0,40	-0,55	0,587053534
14	21	4,18	6,20	4,65905E-06	20	0,49	0,81	0,426027311	20	-0,58	-0,82	0,423974379
15	21	4,14	6,13	5,4551E-06	20	0,71	1,17	0,25503944	20	0,14	0,24	0,810114837
16	20	4,08	5,98	9,44911E-06	19	0,46	0,73	0,474475878	19	0,18	0,22	0,829526779
17	20	4,29	6,35	4,34157E-06	19	0,57	0,97	0,345674225	19	-0,56	-0,94	0,357390852
18	20	4,35	5,71	1,66766E-05	19	0,88	1,48	0,155904462	19	-0,19	-0,35	0,73167194
19	20	4,34	5,88	1,15734E-05	19	0,62	0,94	0,3577221	19	-0,14	-0,22	0,830501852
20	3	6,37	1,45	0,284305783	3	3,00	0,95	0,440718727	3	1,47	0,55	0,638878482

Table for Figure 3

Months	**SI**				**ABSI1**				**ABSI2**			
	n	**mean_val**	**t_stat**	**p_value**	**n**	**mean_val**	**t_stat**	**p_value**	**n**	**mean_val**	**t_stat**	**p_value**
-20	29	2,06	3,03	0,005275776	25	-2,38	-6,79	5,07327E-07	25	-2,28	-8,07	2,68838E-08
-19	53	1,71	4,51	3,57705E-05	46	-2,43	-11,63	2,66111E-15	46	-2,33	-13,86	4,93466E-18
-18	55	1,61	4,27	7,92241E-05	47	-2,53	-11,28	7,73145E-15	47	-2,44	-12,68	1,26385E-16
-17	57	1,75	4,40	4,85509E-05	48	-2,41	-7,82	4,14993E-10	48	-2,21	-8,16	1,26201E-10
-16	54	1,58	4,72	1,7644E-05	45	-2,63	-12,94	1,34353E-16	45	-2,49	-12,95	1,29102E-16
-15	57	1,59	4,87	9,38472E-06	48	-2,67	-13,32	1,41942E-17	48	-2,55	-13,13	2,44549E-17
-14	57	1,64	4,75	1,43092E-05	49	-2,65	-12,27	2,08954E-16	49	-2,45	-11,80	8,52245E-16
-13	53	1,64	4,76	1,56709E-05	46	-2,71	-12,59	2,41306E-16	46	-2,56	-12,46	3,44849E-16
-12	56	1,64	4,81	1,21864E-05	50	-2,70	-12,64	4,93018E-17	50	-2,49	-11,86	5,20408E-16

-11	57	1,64	4,62	2,28163E-05	53	-2,40	-6,40	4,42909E-08	53	-3,68	-3,23	0,002144481
-10	56	1,69	4,74	1,48853E-05	52	-2,32	-6,10	1,35782E-07	52	-2,98	-5,18	3,59899E-06
-9	46	1,66	4,21	0,000121475	42	-2,39	-5,60	1,60195E-06	42	-2,77	-10,72	1,81988E-13
-8	56	1,64	4,73	1,59175E-05	53	-2,43	-6,85	8,56705E-09	53	-3,39	-3,78	0,000406613
-7	56	1,78	5,16	2,40805E-06	54	-2,27	-6,60	9,24359E-09	54	-2,92	-4,58	2,1825E-05
-6	45	1,88	3,61	0,000785885	43	-2,32	-4,37	8,09321E-05	43	-3,79	-3,33	0,001842121
-5	57	1,92	4,27	7,54868E-05	55	-2,25	-4,92	8,37869E-06	55	-4,15	-2,54	0,014132983
-4	56	1,76	4,40	4,93058E-05	54	-2,40	-5,87	2,80246E-07	54	-2,35	-8,32	3,02106E-11
-3	56	1,82	4,54	3,08638E-05	54	-2,34	-5,67	5,94343E-07	54	-2,95	-6,44	3,64788E-08
-2	54	1,46	7,72	3,15368E-10	52	-2,81	-14,48	1,06883E-19	52	-2,67	-14,67	6,23314E-20
-1	57	1,73	4,89	8,84948E-06	55	-2,44	-6,71	1,22886E-08	55	-3,99	-2,98	0,004306178
0	55	1,78	6,83	5,54887E-10	53	-2,45	-9,03	1,04152E-14	53	-4,22	-3,68	0,000367153
1	52	1,71	5,07	5,6372E-06	50	-2,43	-6,98	7,2409E-09	50	-3,78	-3,09	0,003300871
2	52	1,61	5,07	5,34079E-06	50	-2,56	-7,68	5,21525E-10	50	-3,41	-4,09	0,000157563
3	48	1,62	4,69	2,35067E-05	46	-2,52	-7,05	8,63424E-09	46	-2,57	-11,14	1,5745E-14
4	43	1,74	4,29	0,000101518	41	-2,41	-5,73	1,12286E-06	41	-2,95	-6,97	2,03445E-08
5	42	1,82	3,87	0,000377071	40	-2,28	-4,63	3,76119E-05	40	-3,74	-3,01	0,004538572
6	42	1,96	3,56	0,000959462	40	-2,10	-3,70	0,000665049	40	-2,32	-7,86	1,44325E-09
7	43	2,11	3,50	0,00111468	42	-2,01	-3,27	0,0021651	42	-3,18	-4,12	0,000179518
8	43	2,06	3,61	0,000817731	42	-2,11	-3,68	0,000678692	42	-2,78	-7,36	5,1205E-09
9	43	2,14	3,83	0,000423278	42	-2,06	-3,70	0,000630055	42	-3,17	-4,00	0,000259319
10	43	2,13	3,80	0,000463177	42	-2,03	-3,68	0,000671788	42	-3,94	-2,49	0,017039816
11	42	2,07	3,91	0,000336024	41	-2,14	-3,94	0,000313894	41	-3,22	-3,70	0,000640339
12	40	2,19	4,25	0,000129129	39	-1,93	-3,69	0,000699094	39	-4,13	-2,07	0,045021425
13	40	1,89	4,19	0,00015642	39	-2,19	-4,78	2,65696E-05	39	-4,65	-2,11	0,04182579
14	41	1,72	4,33	9,71874E-05	40	-2,41	-6,34	1,76986E-07	40	-4,18	-2,63	0,012230704
15	39	1,63	4,43	7,73212E-05	38	-2,51	-7,02	2,68173E-08	38	-5,21	-1,99	0,053819943
16	38	1,58	5,15	8,78253E-06	37	-2,49	-8,30	7,0823E-10	37	-6,70	-1,63	0,11191733
17	36	1,73	4,87	2,40198E-05	35	-2,44	-6,99	4,61818E-08	35	-7,33	-1,54	0,133095705
18	36	1,72	5,30	6,53846E-06	35	-2,45	-7,49	1,08034E-08	35	-6,94	-1,60	0,119250675
19	36	1,61	5,40	4,7847E-06	35	-2,44	-8,38	8,65553E-10	35	-5,08	-2,00	0,05352084
20	3	0,96	15,53	0,004120449	3	-3,15	-14,17	0,004940172	3	-3,14	-12,52	0,006314699

Table for Figure 4

Appendix: Documentation of Generative AI Usage

I declare that Generative AI tools were used during the creation of this thesis. It was used to help with the code in R for the analysis part of the thesis. All outputs generated were critically evaluated and, where necessary, modified by me. **By submitting this thesis, I declare that I am fully responsible for the accuracy and completeness of its content.**

Tools used:
Only ChatGPT (GPT 4o) was used.

Scope of use

1. Coding and data analysis - AI was used to help speed up the process of the data analysis in R, by asking it to help solving issues when what I tried was not working properly. These instances where it was used, are listed below
    a. Help with merging and handling the data using R.
       This included help to properly merge datasets, change the format of the raw data to be able to work with it better.
    b. Help with extracting outputs of tests and regressions from R, such as Table 8, 9, 11, 12, to be able to better present it in text.
    c. Help with the creation of tables 3, 4, 5 and 10. It helped getting the monthly average values for short interest and insiders selling/buying.

Reflection:
As I use AI for many other tasks both in university (such as help to prepare for exams) and outside, the permission to use AI to assist with certain parts of the thesis came highly useful. The use of AI sped up the process of working in R, therefore saving me time that I could use on working on other parts of the thesis.