Post-environmental incident drift and institutional trades: who benefits from environmental shocks?

George Aragon, Jiaguo (George) Wang, Yaqiong Yao, Adina Yelekenova*

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Abstract: This paper examines the impact of environmental incidents on stock returns and institutional investors' trading patterns around environmental incidents, focusing on the strategic behavior of hedge funds. We show significant negative drift in stock returns following environmental incidents that persists over one quarter. We find significant selling pressure from banks, pension funds, and insurance companies, particularly in high ESG risk stocks. In contrast, hedge funds often purchase these stocks, capitalizing on temporary price depressions caused by divestment from environmentally conscious investors. Our analysis reveals that non-PRI hedge funds generate positive returns from this strategy, whereas PRI signatories do not exhibit similar trading behavior. This study enhances understanding of ESG incidents' market impacts and highlights the divergent strategies of institutional investors, with hedge funds playing a pivotal role in providing liquidity and exploiting opportunities arising from climate-related risks.

* George Aragon is with Finance Department, W.P. Carey School of Business, Arizona State University, Tempe, AZ, george.aragon@asu.edu. Jiaguo (George) Wang is with Department of Accounting and Finance, Lancaster University Management School, Lancaster, LA1 4YX, UK, george.wang@lancaster.ac.uk. Yaqiong Yao is with Department of Accounting and Finance, Lancaster University Management School, Lancaster, LA1 4YX, UK, chelsea.yao@lancaster.ac.uk. Adina Yelekenova is with Department of Banking and Finance, Monash Business School, Melbourne, adina.yelekenova@monash.edu. We thank the comments from Vikas Agarwal, Tao Shu, Pedro Matos, Qifei Zhu, Frank Weikai Li, Philipp Krueger, Zacharias Sautner, Olga Kolokolova, Ingmar Nolte.

1. Introduction

With climate change posing a significant threat to humanity, all institutional investors are under the increasing pressure from the public to take actions to alleviate the impacts of climate change by changing their investment strategies to incorporate climate concerns. The shift in ESG preferences of investors has led to the higher green tilt in the portfolios of large institutional investors achieved mainly through divestment from brown firms (Pastor, Stambaugh, and Taylo, 2023; Atta-Darkua, Glossner, Krueger, and Matos, 2023), exits after environmental and social incidents (Gantchev, Giannetti, and Li, 2022), and analyst downgrades following ESG incidents (Derrien, Krueger, Landier, and Yao, 2023). However, it is still unclear how different institutional investors react to ESG incidents. With the growing awareness of ESG ratings disagreement, environmental incidents provide a more clear signal to investors and a point-in-time shock to firms environmental performance. Therefore, in this paper we examine trading patterns of different types of institutional investors around environmental incidents, and who stands to benefit from them

Environmental incidents may have significant negative impact on stock returns. Previous studies show that stocks, that experienced ESG incidents experience abnormal negative returns in the two day window around environmental incident date and in the same month (Groen-Xu and Zeume, 2021; Gantchev, Giannetti, and Li, 2022a). We analyze stock returns, following environmental incidents on a longer horizon and find significant negative drift in stock returns that persists up to one quarter. Negative impact on returns is more pronounced among stocks that have low ESG risk profile. We posit two hypothesis that can explain prolonged negative reaction to environmental incidents. First, stocks that experienced environmental incidents may suffer from selling pressure imposed by the environmentally conscious investors. If socially responsible investments start selling incident stock in large amount, the impact can be equal to fire-selling of Coval and Stafford (2007), which can manifest in negative stock returns. Second hypothesis is underreaction, where investors may underreact to the negative implications incidents might have on firm fundamentals, resulting in long-term negative future returns.

We study institutional investors trading around environmental incidents to test whether there is significant fire selling pressure from institutions and if so, who stands to benefit from it. We start by examining the aggregate trading for each type of institutional investor. We find

that banks, pensions funds, and insurance companies exhibit significant selling in incident stocks. However, selling pressure is concentrated in stocks with high ESG risk profiles, which can explain significant negative returns. When considering low ESG risk firms, we do not find selling by these institutions, on the other hand, they tend to buy low ESG risk firms despite incidents. This is consistent with finding of Huynh and Xia (2023) that stocks with strong environmental profiles experience lower selling pressure when disaster strikes. On the buying side, we find that hedge funds and mutual funds engage in buying stocks following the incidents. Several studies have explored mutual funds trading in incident stocks and find that only non-committed ESG mutual funds sell stocks (Lowry, Wang, and Wei, 2023) and mutual funds with high concentration of incident stocks in their portfolios (Beschwitz, Filali-Adib, and Schmidt, 2023). However, there is a gap in the literature on the hedge funds trading in incident stocks, therefore, we next explore hedge funds trading around environmental incidents and whether they benefit from it.

Hedge funds face lower pressure to abide by Environmental, Social, and Governance (ESG) standards in their investment strategies. Several media outlets report that hedge funds see an opportunity when other institutional investors divest from fossil fuel companies and end up on the buying side.[1] According to Hedge Fund Research, hedge fund industry collectively managed US$4.01 trillion by the end of 2021. Therefore, in our efforts to combat climate change, hedge funds may be a key player to allocate capital in the financial market and should be involved in green efforts to achieve the goal collectively.

Hedge funds are well known for their profit driven nature, that is rooted in their fee structure (Agarwal, Daniel, and Naik, 2009; Aragon and Nanda, 2012; Lan, Wang, and Yang, 2013). To maximize their profits, hedge funds are motivated to generate alpha and implement strategic trading to achieve the target.[2] Previous studies show that hedge funds strategically trade in stocks sold by distressed institutional investor (Chen, Hanson, Hong, and Stein, 2008; Aragon, Martin, and Shi, 2019; Agarwal, Aragon, Nanda, and Wei, 2022). In the current market, where institutional investors face a significant pressure to allocate capital to greener firms, hedge funds may see an opportunity arising from the divestment of environmentally conscious

[1] See "Hedge funds cash in as green investors dump energy stocks", *Financial Times*, October 7, 2021.
[2] Previous studies show that hedge fund managers possess superior skill, where hedge funds performance is persistent and cannot be explained by luck (Kosowski, Naik, and Teo, 2007; Aragon and Martin, 2012; Agarwal, Jiang, Tang, and Yang, 2013; Cao, Goldie, Liang, and Petrasek, 2016; Jiao, Massa, and Jang, 2016; Chen, Cliff, and Zhao, 2017). Hedge funds strategically traded during technology bubble by investing in technology stocks and reducing their positions before the bubble burst (Brunnermeier and Nagel, 2004).

investors and trade on the other side to lock-in profits. When environmental incident strikes, we found that several institutional investors, including banks, divest from incident stocks. At the same time we found a negative drift in stock returns following incidents. These, in turn, may motivate hedge funds to profit from temporary downward price pressure and purchase incident stocks.

On the other hand, hedge funds may choose to divest from firms that experienced environmental incidents. This can be due to one of the following. First, environmental incidents may cause investors to revise their projections regarding a company's future cash flows, thereby influencing the firm's fundamental value (Pastor, Stambaugh, and Taylor, 2021; Pedersen, Fitzgibbons, and Pomorski, 2021; Ardia, Bluteau, Boudt, and Inghelbrecht, 2023). In this case, hedge funds may want to divest from such firms. Second, hedge funds may face significant pressure from their investors to implement socially responsible investment strategies and divest from brown stocks. Large proportion of hedge fund investors are endowment funds, who in turn face pressure from their stakeholders to adopt responsible investment policies (Aragon, Jiang, Joenvaara, Tiu, 2023). Third, hedge funds may be motivated to attract flows from responsible investors. Previous research shows that hedge fund investors tend to chase past fund performance, despite past performance not reflecting future fund returns (Agarwal, Daniel, and Naik, 2004; Baquero and Verbeek, 2022), which may motivate some hedge funds to misreport their returns (Agarwal, Daniel, and Naik, 2011). However, socially responsible investors are willing to forgo financial performance for their social preference (Riedl and Smeets, 2017), and research shows that mutual funds with highest sustainability ratings attract higher flows (Hartzmark and Sussman, 2019). This may motivate hedge funds to invest in greener portfolios to attract socially responsible investors. One way for investment managers to signal their orientation towards sustainable investing is to endorse the United Nations Principles for Responsible Investment (PRI). Liang, Sun, and Teo (2022) show that hedge funds managed by PRI signatories attract higher flows and collect larger fees. Therefore, hedge funds may reduce their exposure to incident firms to attract socially responsible investors, implying even higher selling pressure imposed on such stocks.

We uncover several new findings in our paper. First, we examine trading patterns of hedge funds in stocks with environmental incidents. To do so, we use fund-security level hedge fund trades and regress it on the environmental incidents. We find a strong positive relation between individual hedge fund trades and environmental incidents. The relation holds only for

the sample of NonPRI signatory hedge funds, while hedge funds managed by PRI signatories do not engage in trading of stocks with environmental incidents. However, there is a heterogeneity in stocks that experience environmental incidents. We show that stocks with low ESG risk profile experience lower selling from other institutional investors and more significant negative drift in returns. Therefore, we expect hedge funds to avoid buying stocks with low ESG risk profile. We find that indeed hedge funds exhibit lower trading in stocks with low ESG risk profile after environmental incidents.

Hedge funds may serve as liquidity providers to other institutional investors who are divesting from incident stocks. At the same time, hedge funds may profit from buying incident stocks sold by other institutional investors. To find whether hedge funds trade on the other side of institutional investors, we examine the relation between hedge fund trades and stocks with environmental incidents sold by different types of institutional investors. Our results suggest that hedge funds buy incident stocks from banks, pension funds, insurance companies, and endowment funds. Interestingly, PRI hedge funds also trade on the other side of some institutional investors. Results align with the idea that committed ESG funds do not shun away from firms after they experienced incidents, but instead provide liquidity to selling investors (Lowry, Wang, Wei, 2023). However, some PRI hedge funds may not necessarily align with ESG principles (Liang, Sun, and Teo, 2022), and hence buy incident stocks. Overall we find that hedge funds tend to buy incident stocks sold by other institutional investors.

Next, we explore the profitability of the hedge funds trading strategy around environmental incidents. We conduct fund level analysis and test whether hedge funds that buy stocks following environmental incidents generate significant returns. We use hedge funds long-equity portfolio returns and show that NonPRI hedge funds that buy incident stocks generate significant positive returns over the next quarter. We fail to find similar results for PRI signatories, which is consistent with findings by Liang, Sun, and Teo (2022) that PRI signatory hedge funds with low ESG portfolio exposure underperform. Overall, our study shows that hedge funds are smart investors and exploit opportunities when trading brown stocks, which reflects in their performance.

Finally, we examine strategic trading by hedge funds in incident stocks by exploring short interest and option positions. If hedge funds want to capitalize on the price movement of incident stocks following environmental incidents, but do not hold long positions in the stock, they could do so by acquiring a short position. We find that short interest increases in the month

preceding environmental incidents and remain high during the incident month, with subsequent reversal. Results suggest that short sellers are able to anticipate negative news and trade in advance. We also examine directional and non-directional option holdings of hedge funds in incident stocks. According to our results, hedge funds tend to hold straddle positions in stocks with environmental incidents. We do not find significant holdings of directional option positions in incident stocks. Unlike other events, such as earnings announcements and corporate news, there is uncertainty in market reaction to environmental incidents due to the diverse investor preferences. Therefore, we suggest that hedge funds' use of straddle positions allows them to profit from stock price volatility following the incident regardless of the price direction. Overall we show that hedge funds may try to benefit from the impact environmental incidents may have on stock market in derivatives market and through short selling.

Our study contributes to three main strands of literature. First, we contribute to the literature that studies ESG incidents and their impact on the market. Several studies use natural disasters and ESG incidents to examine investors reaction to unexpected climate events and find that such events prompt selling by responsible investors and have impact on stock returns (Huynh and Xia, 2023; Huynh, Li, and Xia, 2024; Gantchev, Giannetti, and Li, 2022a). Studies find that firms with past ESG incidents are more likely to experience incidents in the future, have lower profitability (Glossner, 2021), and experience significant analyst downgrades on both short and long-term horizons (Derrien, Krueger, Landier, and Yao, 2023). We contribute to this literature by examining the trading pattern of different institutional investors around environmental incident to partially explain the continuous negative return drift after the incident. We show the implications of negative impact on stock returns and find that hedge funds may profit from such price movements.

Second, we contribute to the growing body of research on the institutional investors preferences and trading patterns towards ESG. Pastor, Stambaugh, and Taylor (2023) find that on average institutional investors' portfolios have a green tilt, which can mainly be attributed to large institutions, while Starks, Venkat, and Zhu (2023) find that ESG-oriented institutional investors tend to have longer investment horizons. Studies also show that institutions reduce exposure to carbon intensive firms (Bolton and Kacperczyk, 2021; Choi, Gao, and Jiang, 2020). Atta-Darkua, Glossner, Krueger, and Matos (2023) show that climate-conscious investors mainly use portfolio re-weighting to green their portfolios, and find no evidence of engagement. Such divestment strategy by socially responsible investors has lower efficiency in improving

firm's environmental policies and has limited effects on stock prices (Broccardo, Hart, and Zingales, 2022; Berk and van Binsbergen, 2021). We are among the first studies to provide an in-depth examination of hedge fund behavior towards climate change and their trading in response to environmental incidents and their trading patterns around such events.

Third, we contribute to the large body of research on strategic trading by hedge funds. Previous research shows that hedge funds strategically trade around events such as technological bubble both in equity and derivatives market (Brunnermeier and Nagel, 2004; Aragon and Martin, 2012), trade in anticipation of fire-sales from distressed fund managers (Brunnermeier and Pedersen, 2005; Chen, Hanson, Hong, and Stein, 2008; Aragon, Martin, and Shi, 2019; Agarwal, Aragon, Nanda, and Wei, 2022), and in anticipation of predictable flow-induced mutual fund trade (Shive and Yun, 2013; Jiao, Massa, and Zhang, 2016). We contribute to this literature by examining how hedge funds react to climate change risks and whether it affects their trading behavior. We show that hedge funds, as profit driven investors, exploit opportunities arising from selling pressure imposed by environmentally conscious investors on brown stocks by purchasing them. At the same time, hedge funds recognize the detrimental effect climate risks may have on firms' future cash flows, and avoid investing in stocks, where such risks may materialize.

2. Data and sample

In this section, we outline the three main datasets used in the paper: carbon environmental incidents data, and hedge funds holdings data, and hedge funds options data.

2.1 Environmental incidents

We obtain data on environmental incidents from RepRisk. RepRisk compiles information on daily updates of negative news counts. The data spans from 2007. RepRisk daily screens over 100,000 media and third-party sources in 23 languages. The incidents are classified into 28 ESG issues, including pollution poor employment conditions, discrimination, child labor, supply chain problems, etc., that are further divided into more specific thematic 73 topic tags. The classification is performed using proprietary methodology based on AI and human analysis. Risk incidents are evaluated based on three parameters: severity, reach, and novelty. Severity of an incident reflects the extent of its impact, the consequences, and whether the incident is a result of systematic issue or was caused by an accident, negligence, or intent. Incidents can be classified as high, medium, or low severity. The reach of the information source the incident was covered in, where limited reach sources include local media or governmental bodies, and

small NGO; medium reach sources are most national and regional media, international NGOs, and national and international governmental bodies; and high reach sources are global media outlets such as New York Times, etc. RepRisk also provides an indicator of whether an incident is related to environmental, social, or governance issues. In our study, we focus on environmental incidents only and cover the whole sample of such incidents. We include results using high reach environmental incidents only in the Internet Appendix.

RepRisk also provide the RepRisk Rating (RRR), which is a letter rating from AAA to D, that reflects the risk exposure of a company benchmarked against the peer group and sector of a company. Companies with RRR of AAA have the lowest ESG risk exposure, and companies with RRR of D have the highest ESG risk exposure. We use companies' RRR to separate between companies with low and high ESG risk profile to examine their impact on hedge funds decision making when trading stocks with environmental incidents.

2.2 Hedge fund holdings

We obtain HF quarter-end holdings from the Thomson Reuters 13F equity portfolio holdings database. To identify hedge funds in the 13F institutional database, we extract the list of HF firms by following methodology of Agarwal, Fos, and Jiang (2013), where they manually identify an institution as HF if it satisfies the following criteria: 1) it matches the name of a fund from the Union Hedge Fund Database,[3] 2) it is one of the top HFs listed by industry publications, 3) on the firm's website description, HF management is listed as the main business area, 4) it is listed as a HF firm in Factiva, and 5) if the filer name in 13F is one of the leading personnel in a HF.[4] As a result, we obtain the final sample of 1,854 unique HF firms from 13F filing institutions.

2.3 Hedge fund options

Most standard commercial databases, like Thomson Reuters, do not provide information on complete 13f positions and only include stock holdings. To obtain option holdings data from 13f, we use Whale Wisdom database that offers a complete set of reported 13F positions, including stock, option, and other types of securities. We extract 13f position of hedge funds using the sample of hedge funds obtained in the previous section and cross-reference names. We follow Aragon, Martin, and Shi (2019) and use the original 13F filings by excluding amendments. We filter observations using the "mv_multiplier" to retain only those with market

[3] Agarwal, Fos, and Jiang (2013) compile the Union Hedge Fund Database that merges four commercial databases: Eureka, Hedge Fund Research, Morningstar, and Lipper TASS.
[4] Agarwal, Jiang, Tang, and Yang (2013); Agarwal, Ruenzi, and Weigert (2017)

values reported in thousands. To ensure data accuracy, we validate reported values by calculating market values using price data from CRSP. Observations with disparities between 13F filing values and our calculated values are removed. We focus solely on positions classified as either equity or equity options.

3. Post-environmental incident drift

With the rising investor awareness on climate change and a global push to action, environmental performance of the company is becoming an important signal to investors. We zoom into the environmental incidents as a point-in-time shock to the environmental performance of the firms. Using environmental incidents helps us avoid the existing disagreement in the ESG ratings documented in the literature and provides a clear signal about the firms' fundamentals and compliance with environmental standards.[5] Previous research uses RepRisk ESG incidents as a salient shock to firms' ESG profiles and shows that stocks that experienced an ESG incident have lower abnormal returns, with stronger effect for high severity events (Groen-Xu and Zeume, 2021). Such firms have more incidents in the future, have lower profitability (Glossner, 2021), and experience downgrades by analysts at both short and long term horizons (Derrien, Krueger, Landier, and Yao, 2023). We contribute to this literature by studying the long-term impact of environmental incidents on stock returns across different ESG risk firms.

3.1 The impact of environmental incidents on the stock market

In this section we examine the impact of environmental incidents on stock returns. We posit two main hypotheses. First, we hypothesize that environmental incidents may impose selling pressure from investors who care about firms' ESG characteristics, similar to fire-selling of Coval and Stafford (2007). According to fire sales hypothesis, environmental incidents may trigger forced selling by institutional investors, which may results in significant price drops during selling period, followed by a period of positive returns due to the buying force of liquidity providers, such as hedge funds.[6] Alternative hypothesis is investors underreaction (Jiang and Zhu, 2017; Ben-Rephael, Da, and Israelsen, 2017). If investors do not consider ESG factors as important, it may lead to underreaction to the negative implications

[5] Avramov, Cheng, Lioui, and Tarelli (2022); Berg, Fabisik, and Sautner (2021); Berg, Koelbel, Pavlova, and Rigobon (2022); Gibson, Krueger, and Schmidt (2021); Serafeim and Yoon (2023).
[6] Huynh and Xia (2023) show that investors overreact to climate risk exposure of firms, causing bond and stock prices to drop when disaster strikes, resulting in higher future returns. Ardia, Bluteau, Boudt, and Inghelbrecht (2023), using news about climate change, find that on days with high climate change concerns, brown firms' prices decrease and associated with an increase in their discount rate.

incidents might have on firm fundamentals, resulting in long-term negative drift in future returns. The two scenarios are not necessarily mutually exclusive, as underreaction may only partially explain the impact on stock returns for specific types of stocks.

To test the hypotheses, we examine the relation between environmental incidents and stock returns by running the following pooled OLS regression:

$$RET_{i,t+1} = a_0 + b_1 E\_incident_{i,t} + b_2 Controls_{i,t} + e_t \quad (1)$$

where dependent variable $RET_{i,t+1}$ is the returns of stock *i* in month *t* + 1. $E\_incident_{i,t}$ is a dummy variable equal to 1 if stock *i* experienced an environmental incident in month *t*, and 0 otherwise. Controls are measured as of the prior month *t* and include previous one- and eleven-month returns, log of market capitalization, book-to-market ratio, volatility, ROE, investments, sales growth, and EPS growth. We also include year/month fixed effects and cluster standard errors at the firm and year levels. Additionally, we estimate the regression using contemporaneous returns, and returns in the next two months as dependent variables.

Results are presented in Panel A of Table 1. In Column (1) the dependent variable is returns in contemporaneous month *t*. The relation between environmental incident dummy and returns is negative and statistically significant, with an estimated coefficient of -0.521 and a *t*-statistics of -2.19. In Column (2) the dependent variable is future returns in month *t* + 1. The relation between stock returns and environmental incidents remains negative and becomes more significant, with an estimated coefficient of -0.514 and a *t*-statistics of -2.83. We further estimate regression for returns in month *t* +2 and *t* + 3 and find that returns fail to fully reverse, despite coefficient becoming less significant.

[Insert Table 1 here]

The negative relation between stock returns and incidents is consistent with results found in Groen-Xu and Zeume (2021), where they find negative relation between contemporaneous stock returns and incident dummy. These results indicate that stocks experience a significant negative drift following environmental incidents. Similar to Post-earnings announcement drift anomaly, stock prices do not experience an instantaneous adjustment after an environmental incident, but rather drift down for up to three months following an incident, which is contrary to the efficient market hypothesis (Fama, 1970). In unreported results we confirm that without controlling for different firm characteristics as in the regression, stocks with environmental

incidents have significantly negative returns, CAPM and DGTW adjusted alphas in the first quarter following the incidents. Such post-incident drift presents an opportunity for investors to potentially profit from the downward returns trend.

One possible explanation for the extended negative price drift following environmental incidents is investor underreaction. If investors have limited attention to the environmental performance of firms, prices may fail to adjust fully immediately after the incident, resulting in a prolonged negative drift. Pedersen, Fitzgibbons, and Pomorski (2021) show in their theoretical model that in an economy with a substantial number of investors who do not incorporate ESG information into their investment decisions, ESG stocks may have higher expected future returns. In the case of environmental incidents, where investors fail to see the impact of ESG on a firm's future profits and fundamentals, this can manifest in negative future returns. Derrien, Krueger, Landier, and Yao (2023) show that ESG incidents result in analysts forecasts downgrades on both short term and long term horizons. Alternatively, in the presence of ESG-conscious investors, underreaction may occur if an incident comes as a surprise. This can happen with low ESG risk stocks, where the occurrence of an incident is unexpected and rare. We study the returns of different ESG risk profile stocks in the next section.

3.2 The difference in post-environmental incident drift in low and high ESG risk stocks

In previous section we establish the negative relation between environmental incidents and future stock returns, with negative drift continuing throughout the next quarter. At first, these results may appear to be inconsistent with the selling pressure hypothesis. If investors care about firm’s environmental characteristics, we expect them to divest from such stocks imposing temporary downward selling pressure on stock prices, followed by subsequent reversal. However, we fail to see immediate price reversal following the incidents. Huynh and Xia (2023) find that stocks with high environmental scores are less likely to experience selling pressure. This could be either due to investors underreaction or incentives of fund managers to engage with such firms rather than shun away from them (Lowry, Wang, and Wei, 2023; Beschwitz, Filali Adib, and Schmidt, 2023). Therefore, we posit that underreaction to environmental incidents is most likely to happen for stocks with low ESG risk profile, while stocks with high ESG risk may be subject to selling pressure.

We use RepRisk Rating (RRR) to identify risk level of stocks. RRR is a letter rating that evaluates company's risk exposure relative to its peer group, sector, and country affiliations.[7] We identify stocks as low ESG risk stocks if they have a RRR of A and higher, and high ESG risk stocks if they have RRR of BBB and lower. To empirically test we repeat baseline regression, but this time we include an interaction with ESG risk dummy. The new regression looks as follows:

$$RET_{i,t+1} = a_0 + b_1 E\_incident_{i,t} \times Low\_ESG\_risk_{i,t} + b_2 E\_incident_{i,t} + \\ + b_3 Low\_ESG\_risk_{i,t} + b_4 Controls_{i,t} + e_{i,t} \quad (2)$$

where *Low_ESG_risk* is a dummy variable equal to 1 if RRR of stock *i* in month *t* is A or above, and 0 otherwise. The main coefficient of interest is b_1. We expect the relation between future returns and interaction variable to be negative, signifying the negative impact incidents have on future firm value (Derrien, Krueger, Landier, and Yao, 2023; Glossner, 2021).

Panel B of Table 1 presents the results. In Column (1) the dependent variable is contemporaneous stock returns. The relation between stock returns and incidents is negative for both low ESG risk stocks and the rest of the sample. However, there is a striking difference when we run regression on future stock returns. In Column (2), the dependent variable is next month stock returns, and the estimated coefficient on the interaction variable is -0.488 with a *t*-statistics of -2.23. The relation remains negative and statistically significant in month $t + 2$, with an estimated coefficient of -0.692 and a *t*-statistics of -2.15 in Column (3). After controlling for low ESG risk dummy, the coefficient on environmental incident dummy reverts and becomes positive in two month period. In Panel C we repeat regression for high ESG risk stocks, where we use high ESG risk dummy if the RRR of a stock is BBB or below. We find significant reversal in stock returns in month $t + 1$, with the estimated coefficient of 0.414 and a *t*-statistics of 1.75. Returns become more significant in month $t + 2$ with an estimated coefficient of 0.552.

Results indicate that environmental incidents have different impact on stock returns conditional on the level of ESG risk exposure. Firms with low ESG risk exposure that experience an incident are initially overpriced, which results in the negative future stock returns that persist due to investors underreaction and failure to respond to the long-term impact incidents have on firm value. For high ESG risk stocks, incidents have a different impact on

[7] Beschwitz, Adib, and Schmidt (2023) use RRR to identify mutual funds trading in high and low ESG risk stocks.

stock returns where stocks experience negative returns in the contemporaneous month, followed by a reversal. These results may be due to the selling pressure imposed on high ESG risk stocks by environmentally conscious investors.

Overall, our findings reveal a significant negative drift of stock prices after environmental incidents that persists over the following quarter. The drift may be caused by the initial underreaction of investors to the information, especially in the low ESG stocks, where incidents are an unexpected event.

4. Institutional trading around environmental incidents

In this section we examine how institutional investors trade on the environmental incidents. Several studies use natural disasters and ESG incidents to examine investors reaction to unexpected climate events and find that such events prompt selling by responsible investors and have impact on stock returns. Huynh, Li, and Xia (2024) show that fund managers exposed to air pollution underweight stocks of firms with high carbon emissions, where such stocks subsequently outperform. Gantchev, Giannetti, and Li (2022) find that environmentally conscious investors reduce exposure to stocks with high environmental and social risks, while there is no significant selling from other investors. We aim to identify the sellers and buyers of the stocks with environmental incidents.

4.1 Aggregate institutional trading in stocks with environmental incidents

If institutional investors care about environmental characteristics of the companies, then we expect a significant selling by institutions following environmental incidents. According to our first hypothesis, if stocks are sold by substantial amount of environmentally conscious investors, they should experience downward price pressure immediately after the incident. This, in turn, may create trading opportunities for investors that do not incorporate ESG metrics into their investment decisions. Hedge funds are well known for their profit-driven nature, and therefore, may try to profit from the downward price pressure imposed by selling investors.

To examine trading around environmental incidents for different types of institutional investors, we extract institutional holdings from Thomson Reuters (TR) 13F database. Using TR institution type and Brian Bushee classification[8], we identify the following eight categories: 1) banks - type 1 institutions by the TR classification; 2) insurance companies - type 2

[8] Brian Bushee classification obtained from the website: https://accounting-faculty.wharton.upenn.edu/bushee/

institutions by the TR classification; 3) mutual fund management companies - type 3 institutions by the TR classification; 4) independent investment advisors - type 4 institutions by the TR classification; 5) pension funds – Brian Bushee classification identified from type 5 institutions by the TR classification; 6) university and foundation endowments - Brian Bushee classification identified from type 5 institutions by the TR classification; and (7) hedge funds – manually identified as described in section 3.2.2. For each institution type we calculate the aggregate trade for each stock i in quarter q as the quarterly difference in shares held, divided by the shares outstanding at the end of quarter q. We include not only the change in existing positions, but also initiating buys and terminating sales to account for all the trading.

We hypothesize that hedge funds do not adhere to ESG selection criteria in their investment decisions. However, there are some hedge funds that signal their commitment to responsible investments to investors by becoming a United Nations Principles for Responsible Investment (PRI) signatory. PRI signatories must endorse six fundamental principles of responsible investments.[9] Pastor, Stambaugh, Taylor (2023) show that PRI signatories tilt their portfolios toward green stocks. At the same time, Liang, Sun, and Teo (2022) find that hedge funds managed by PRI signatories underperform despite attracting significant flows and collecting larger fees. Therefore, it is important to differentiate between hedge funds managed by PRI signatories, we call them PRI hedge funds, and non-PRI hedge funds. To do so, we obtain a list of PRI signatories from the PRI website that contains signatory name, signature date, headquarter, and category (investment manager, asset owner, or service provider). We manually match the names of PRI signatories with hedge fund management company names and headquarter countries. We identify 100 PRI hedge fund companies in our sample. We then separately calculate aggregate trade for PRI and non-PRI hedge funds.

To empirically test how different institutions trade on environmental incidents, we run the following regression for each type of institution:

$$Buy\_dummy_{i,q}(Sell\_dummy_{i,q}) = a_0 + b_1 E\_incident_{i,q} + b_2 Controls_{i,q} + e_{i,q} \quad (3)$$

where *Buy_dummy (Sell_dummy)* is a dummy variable equal to one if aggregate institutional

[9] The six principles are: (I) to incorporate ESG issues into investment analysis and decision-making processes; (II) to be active owners and incorporate ESG issues into ownership policies and practices; (III) to see appropriate disclosure on ESG issues by the entities in which they invest; (IV) to promote acceptance and implementation of the Principles within the investment industry; (V) to work together to enhance effectiveness in implementing the Principles; (VI) to report their activities and progress towards implementing the Principles.

trade of stock *i* in quarter *q* is greater than (less than) zero, and zero otherwise. Control variables are measured as of the prior quarter *q* - 1 and include stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. We include time fixed effect and cluster standard errors at the firm and quarter level.

Table 2 presents the results. In Panel A the dependent variable is buy dummy, and in Panel B the dependent variable is sell dummy. Columns (1) and (2) present results for subsample of PRI and non-PRI signatory hedge funds. Strikingly, PRI and non-PRI hedge funds have opposite results, where PRI hedge funds have significant negative coefficient on environmental incident dummy, indicating that such hedge funds significantly reduce buying in stocks that experienced environmental incident. In the meantime, non-PRI hedge funds engage in buying incident stocks with an estimated coefficient on incident dummy of 0.023. Results confirm our hypothesis that PRI signatory hedge funds avoid stocks with heightened environmental risks, while other hedge funds do not see environmental incidents as a prompt to sell and instead engage in trading such stocks. We will study in section 3.5 whether hedge funds profit from buying environmental stocks.

Apart from hedge funds, mutual funds engage in significant buying following an incident with an estimated coefficient of 0.022 and a *t*-statistics of 1.99. In a recent study, Beschwitz, Adib, and Schmidt (2023) show that mutual funds only sell stocks with environmental incidents if they have a high proportion of holdings in stocks with environmental incidents, conditional on the stocks having low ESG risk. However, we show that on the aggregate level, mutual funds tend to buy incident stocks. One possible explanation is that mutual funds are committed investors and provide liquidity for investors on the selling side. Lowry, Wang, and Wei (2023) show that committed ESG mutual funds do not exhibit selling behavior following ESG incidents and in aggregate increase ownership in stocks with severe incidents, suggesting liquidity provision channel. In case of non-ESG mutual funds, they may try to derive profits from the expected negative price pressure on incident stocks.

Among other institutional investors banks and insurance companies significantly decrease their positions in stocks with environmental incidents with estimated coefficients of -0.037 and -0.035 and a *t*-statistics of -2.16 and -3.06 respectively. At first, our findings might seem to be controversial with previously documented results in Pastor, Taylor, and Stambaugh (2023), where they document significant brown tilt in banks portfolios. However, they show that large

institutional investors are significantly greener. In our case, we consider aggregate selling by banks, which might be driven by large banks. Banking sector is currently experiencing growing pressure to incorporate ESG screening, with initiatives such as Net-Zero Banking Alliance that already has 144 member banks from 44 countries, including largest American banks like Bank of America, JPMorgan Chase, and Morgan Stanley.[10] In a recent study, Kacperczyk and Peydro (2022) use Science Based Targets Initiative (SBTi) to classify ESG committed banks and show that such banks restrict funding to polluting firms and instead allocate more funds to greener firms. One of the impeding issues that slows down the greening of the banking sector is difficulty in identifying ESG complying firms due to ambiguity and dispersion in existing ESG metrics. Environmental incidents, on the other hand, provide a clear signal about the firms' compliance with ESG attracting banks' attention to poor ESG performance and triggering banks selling.[11] Similarly, insurance industry is taking action to address climate change by allocating capital to green assets. One of the initiatives is UN Principles for Sustainable Insurance, that currently has 162 signatories worldwide.[12]

At last, to cover the scope of all investments, we calculate ownership by non 13F filing institutions. Institutions filing Form 13F must have at least $100 million in equity and other publicly traded securities. Therefore, our sample excludes any investors that do not satisfy the $100 million threshold and all the retail investors. To complement the picture, we proxy ownership by non 13F filing institutions and other investors by taking the difference between stocks' shares outstanding and aggregate ownership across all 13F institutions. We further calculate aggregate trading by non 13F filers for each stock as the change in quarterly

[10] See https://www.unepfi.org/net-zero-banking/members/.

[11] To illustrate, we study two examples of environmental incidents and plot trading by hedge funds and banks around incident dates in Appendix B. We choose two distinct incidents from RepRisk, first one in the early years of our sample period on November 4, 2009, for an oil giant Chevron Corporation (Panel A). RepRisk only provides information on the countries linked to the incidents, and which of the 28 ESG issues, 73 topic tags, or UNGC principles the incident violates. Using available information, we manually searched for news articles related to these incidents. The incident is related to the famous lawsuit between Ecuador government and Chevron's acquired in 2001 subsidiary, Texaco Petroleum, regarding oil pollution in Amazon region. We plot trading 3 quarters before and after the incident. There is a sharp increase in trading by hedge funds following incident, where their holdings increase by 4%. At the same time, banks significantly decrease their holdings in Chevron also by 4%.
Second incident is in the most recent year of our sample period, on January 3, 2021, for Mondelez International, one of the largest snacks company in food and beverage sector (Panel B). Mondelez uses palm oil in production of its well-known Cadbury chocolate bars, Oreos cookies, and Ritz crackers. The palm oil is sourced from Malaysia and Indonesia, which was long linked to the use of child labor, deforestation, and destruction of Orangutan habitat. After the incident date, there is a significant aggregate buying from hedge funds, and simultaneously selling by banks, where the amount of buying trades from hedge funds is roughly similar to the selling from banking sector, around 1% of shares outstanding.

[12] See https://www.unepfi.org/insurance/insurance/signatory-companies/

ownership, divided by shares outstanding. We repeat regression (3) for non 13F filers. Results are reported in Column 9 of Table 2. Strikingly, non 13F filers buy stocks with environmental incidents, with an estimated coefficient on incident dummy of 0.036 and a *t*-statistics of 3.27. These results are not surprising as non-filing investors do not disclose their portfolio holdings and face lower pressure to comply with ESG investing.

[Insert Table 2 here]

4.2 Different trading response by institutions to environmental incidents in stocks with low and high ESG risk

In section 3.3 we find that stocks experience negative drift in returns following environmental incidents. The drift is mostly pronounced in stocks with low ESG risk, that may be partially explained by market underreaction. At the same time we find that hedge funds buy stocks after incidents. If hedge funds are smart investors and trade to profit from environmental incidents, we expect them to avoid buying stocks with low ESG risk after incidents and instead buy stocks with high ESG risk. Meanwhile, if other environmentally-conscious investors underreact to environmental incidents in low ESG risk stocks, we expect them to sell only stocks with high ESG risk profile.

To test, we repeat regression specified in equation (3) and add interaction variable between environmental incident dummy and low or high ESG risk dummy. Table 3 reports the results. Panel A includes results for low ESG risk stocks, and Panel B reports results for high ESG risk stocks. In Panel A, for regression with buy dummy as a dependent variable, the coefficient on the interaction variable for non-PRI hedge funds is statistically insignificant, and even negative. This confirms our hypothesis that hedge funds avoid stocks that experienced environmental incidents if they have low ESG risk. For sell dummy as a dependent variable, the coefficient is positive, indicating that hedge funds on aggregate sell such stocks. In contrast, PRI hedge funds for buy dummy have significant positive coefficient on interaction variable, comprising 0.042 with a *t*-statistics of 2.15. This further highlights the underreaction hypotheses, where PRI signatories rely on the low ESG risk score and do not divest from companies even after experiencing an environmental incident. In a similar fashion, institutional investors that avoided buying environmental incidents on aggregate, including banks, pension funds and insurance companies, exhibit significant buying in regards to low ESG risk stocks.

For hedge funds the picture is opposite in high ESG risk stocks (Panel B of Table 3). Non-PRI hedge funds have significant relation between buy dummy and interaction variable with an estimated coefficient of 0.035 and a *t*-statistics of 1.89. Results align with the idea that hedge funds, as smart investors, recognize that high ESG risk stocks experience a temporary price pressure after incidents, followed by positive returns, highlighting hedge funds profit-driven nature. Unlike their peers, PRI signatory hedge funds do not involve in buying high ESG risk stocks. Strikingly, despite negative coefficient on interaction variable for pension funds and insurance companies, it is statistically insignificant. This indicates that overall these institutions avoid high ESG risk stocks. The main selling force behind high ESG risk stocks following incidents is non-13F filing investors with an estimated coefficient on sell dummy regression of 0.041 with a *t*-statistics of 2.40. Non-13F filers only react to environmental incidents by selling high ESG risk stocks, while there is no such reaction to low ESG risk stocks.

Overall, we find that hedge funds are the buyers of stocks with environmental incidents, if stocks have high ESG risk profile. Hedge funds may act as liquidity providers for other institutional investors, that are selling incident stocks. In the next section we examine whether hedge funds profit from their trading activity around environmental incidents.

[Insert Table 3 here]

5. Hedge funds profiting from trading on environmental incidents

In this section we examine whether hedge funds profit from trading in stocks that experience environmental incidents. Previous studies show that hedge funds engage in strategic trading to profit from downward pressure on stock prices imposed by distressed selling of mutual funds (Chen, Hanson, Hong, and Stein, 2008), non-lockup hedge funds during crisis (Aragon, Martin, and Shi, 2019), and distressed mega hedge funds (Agarwal, Aragon, Nanda, and Wei, 2022). We anticipate hedge funds to buy stocks with environmental incidents that are sold by other institutional investors, to profit from temporary selling pressure imposed on stocks.

5.1 Hedge fund trades and environmental incidents

In the previous section we examine aggregate trading by institutional investors for each stock, where we identified hedge funds to be on the buying side of environmental incident stocks. When measuring aggregate hedge fund trades, it allocates more weight to larger funds

with larger trades, and may net out buy and sell trades across different hedge funds. Individual fund-security level analysis gives equal weight to each hedge fund, which allows us to understand hedge funds behavior and evaluate profitability of their trading.

First, we start our analysis by examining the relation between individual hedge fund trades and occurrence of environmental incidents. Following aggregate results from Section 3.4, we expect hedge funds to buy stocks with environmental incidents. To empirically test the relation between hedge fund trades and environmental incidents using the following regression specification:

$$HFtrade_{j,i,q} = a_0 + b_1 E\_incident_{i,q} + b_2 Controls_{j,i,q-1} + e_{j,i,q} \quad (4)$$

where dependent variable $HFtrade_{j,i,q}$ is the trade of hedge fund *j* in stock *i* in quarter *q*. The main independent variable of interest is $E\_incident_{i,q}$, which is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. Control variables are measured as of the prior quarter *q* - 1 and include hedge fund *j*'s trading in stock *i*, the logarithm of the size of hedge fund *j* measured by its equity portfolio value, and stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. Fund fixed effects and quarter fixed effects are included to control for unobservable institutional characteristics and macroeconomic conditions, respectively. Standard errors are clustered by institution and quarter. We expect coefficient b_1 to be positive if hedge funds buy stocks that experienced an environmental incident in the previous quarter.

Panel A of Table 4 presents the results of regression. In Column (1) we run the regression for the full sample of hedge funds. The relation between hedge fund trades and environmental incident dummy is positive and significant with an estimated coefficient of 0.008 and a *t*-statistics of 3.19. As discussed in section 3.2, there is a certain heterogeneity among hedge funds, which can affect their trading behavior and preferences when it comes to trading on environmental issues. Therefore, we run regression separately for PRI and non-PRI hedge fund samples. Results are presented in Columns (2) and (3) respectively. The coefficient is positive and statistically stronger when we exclude the sample of PRI signatory hedge funds and consider only non-PRI peers in Column (3), with estimated coefficient of 0.009 and a *t*-statistic of 3.7. For PRI hedge funds the relation between hedge fund trades and environmental incident dummy is negative despite being statistically insignificant. Results align with the idea

that PRI signatory hedge funds avoid stocks with environmental incidents. There might still be some heterogeneity in the PRI signatory hedge funds as shown by Liang, Sun, and Teo (2022), but on average they do not engage in trading around environmental incidents unlike their peers.[13]

[Insert Table 4 here]

We hypothesize that hedge funds are motivated to buy stocks that experienced an environmental incident due to the selling pressure from other institutions. However, according to underreaction hypothesis, investors may underestimate the adverse effect incidents may have on long term firm value, which can manifest in negative future stock returns. Cao, Titman, Zhan, and Zhang (2023) show that socially responsible institutions are less likely to react to quantitative mispricing signals, resulting in overpricing of stocks held by such institutions. Therefore, we posit that underreaction to environmental incidents is most likely to happen for stocks with low ESG risk profile. In Section 3.3 we show that stocks experience prolonged negative returns after environmental incidents, where negative returns are concentrated in stocks with low ESG risk profile. The difference in the market reaction to environmental incidents and difference in their impact on stock returns may influence hedge funds behavior towards incident stocks. Previous research shows that hedge funds tend to buy undervalued stocks (Cao, Chen, Goetzmann, and Ling, 2018). Using market misvaluation measure, Kokkonen and Suominen (2015) show that hedge funds invest more in undervalued stocks than overvalued when the misvaluation spread is high, which confirms the argument of Stulz (2007) that hedge funds play a significant role in correcting market mispricing. According to underreaction hypothesis, we expect stocks with low ESG risk to be overvalued following ESG incident. As a result, we hypothesize that hedge funds, as smart investors, avoid buying overpriced stocks with low initial risk profile and might instead sell them due to the expected negative effect on their future returns.

We estimate hedge fund trading in stocks - low ESG risk exposure that experienced an environmental incidents using the following specification:

[13] We also separate the sample of hedge funds based on their equity portfolio size, however, we do not find significant differences in the coefficients. In Table IA4 of internet appendix, we regress hedge fund trades on the environmental incident dummy only for high severity incidents, results are similar to the full incident sample.

$$HFtrade_{j,i,q} = a_0 + b_1 Low\_ESG\_risk_{i,q} * E\_incident_{i,q} + b_2 E\_incident_{i,q} + b_3 Low\_ESG\_risk_{i,q} + b_4 Controls_q + e_q \quad (5)$$

where *Low_ESG_risk* is a dummy variable equal to 1 if RRR of stock *i* in quarter *q* is A or above, and zero otherwise. We use same control variables as in equation (6). If stocks with low initial ESG risk exposure experience an environmental incident, this will have a surprise effect on investors, causing underreaction and long-term negative returns. This in turn, should results in hedge funds selling of such stocks. Therefore, we expect coefficient on interaction variable to be negative.

Results are reported in Panel B of Table 4. Column (1) presents results for the full sample of hedge funds, and Columns (2) and (3) include results for subsamples of PRI and NonPRI signatory hedge funds. The estimated coefficient on the interaction variable between low ESG risk dummy and environment incident dummy is -0.003 with a *t*-statistics of 1.97. The coefficient on incident dummy remains positive and statistically significant. Results indicate that hedge funds avoid incident stocks if they have low ESG rating. The negative relation with interaction variable is more pronounced for PRI signatory hedge funds (Column (2)), while the relation is negative, but statistically insignificant for the sample of NonPRI signatory hedge funds. The significant selling from PRI hedge funds may be due to their larger positions in stocks with low ESG risk exposure, as these are the target firms. Therefore, when such stocks experience an environmental incident, this triggers selling by PRI hedge funds, as incidents may have a significant negative impact on firm value (Derrien, Krueger, Landier, and Yao, 2023; Glossner, 2021).

5.2 Hedge fund trades on the other side of institutional investors

Previously in Section 3.4 we find that institutional investors such as banks and insurance companies sell stocks following environmental incidents. We suggest that hedge funds trade on the other side of investors selling stocks with environmental incidents. Hedge funds may trade strategically to profit from short-term price pressure, at the same time providing liquidity to investors selling the stocks. Unlike other investors, hedge funds have incentives in

We carry out formal tests to empirically identify whether hedge funds buy stocks that are sold by other institutional investors following environmental incidents, providing liquidity. We regress hedge fund trades on the interaction variable between environmental incidents dummy and institutional investors selling dummy for each type of investor. Specifically, we

run the following pooled OLS regression of individual hedge fund trades of stocks *i* in quarter *q* on the interaction variable between institutions selling dummy and environmental incidents in quarter *q*:

$$\begin{aligned} HFtrade_{j,i,q} = {} & a_0 + b_1 Banks\_sell_{i,q} * E\_incident_{i,q} + b_2 MF\_sell_{i,q} * E\_incident_{i,q} \\ & + b_3 Pension\_sell_{i,q} * E\_incident_{i,q} + b_4 Indep\_adv\_sell_{i,q} * E\_incident_{i,q} \\ & + b_5 Insurance\_sell_{i,q} * E\_incident_{i,q} + b_6 Endowment\_sell_{i,q} * E\_incident_{i,q} \\ & + b_7 Controls_{q-1} + e \end{aligned} \quad (6)$$

where $HFtrade_{j,i,q}$ is the trade of hedge fund *j* in stocks *i* in quarter *q*, and *E_incident* is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. *Banks_sell* is a dummy variable equal to 1 if aggregate banks trade in stock *i* in quarter *q* is less than zero, and zero otherwise. Aggregate banks trading is measured as the difference between the shares of stock *i* held by all banks in the end of quarter *q* and shares held in the end of quarter *q* - 1, divided by the shares outstanding in the end of quarter *q*. We include sell dummy for all types of institutional investors, measured in a similar way. Controls are measured as of the prior quarter *q* - 1 and include hedge fund *j*'s trading in stock *i*, the logarithm of the size of hedge fund *j* as measured by its long equity portfolio value, and stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. We also control for each institutional investors sell dummy separately. Fund and quarter fixed effects are included to control for unobservable institutional characteristics and macroeconomic conditions, respectively. We cluster standard errors by institution and quarter.

Table 5 reports the results. Column (1) contains results of the regression for the full sample of hedge funds. According to results, we can suggest that hedge funds provide liquidity to those institutional investors, who sell stocks with environmental incidents, by trading on the other side. Among the selling investors are banks, pension funds, insurance companies, and endowment funds. After controlling for the interaction variables, the coefficient on environmental incident dummy becomes statistically insignificant. Interestingly, PRI hedge funds in Column (2) also trade on the other side of some institutional investors, including mutual funds, banks, pensions funds, and insurance companies. However, the estimated coefficient on the environmental incident dummy remains negative and statistically significant (-0.187 with a *t*-statistic of 1.98). Results may seem contradictory to the aggregate selling by PRI hedge funds we found in section 3.4. However, literature shows that committed mutual

funds do not sell stocks of the firms with environmental incidents and instead provide liquidity to selling investors (Lowry, Wang, Wei, 2023). We observe similar behavior among PRI hedge funds. On the other hand, not all PRI hedge funds may align with ESG principles (Liang, Sun, and Teo, 2022), hence buying incident stocks from selling institutions.

[Insert Table 5 here]

5.3 Performance of hedge funds that trade on environmental incidents

In this section we explore whether hedge funds profit from trading on the negative environmental stock events. It is well documented in the literature, that hedge funds are smart investors and possess skill (Brunnermeier and Nagel, 2004; Kosowski, Naik, and Teo, 2007; Avramov, Kosowski, Naik, and Teo, 2011; Chen, Cliff, and Zhao, 2017; Agarwal, Jiang, Tang, and Yang, 2013; Cao, Bradley, Liang, and Petrasek 2016). Hedge funds also play an important role in liquidity provision, which can partially explain hedge funds' performance (Jame, 2018; Coteliogly, Franzoni and Plazzi, 2021). We suggest that hedge funds trade on the other side of investors selling stocks with environmental incidents. Hedge funds may trade strategically to profit from short-term price pressure, at the same time providing liquidity to investors selling the stocks. We expect hedge funds to profit from such trading activity.

First, we identify hedge funds that trade on environmental incidents using regression specification (5). We estimate the model on a rolling basis using previous four-quarter period as an estimation window. We regress each individual hedge fund trades on the stocks' environmental incident dummy in each quarter, the estimated coefficient is hedge funds environmental incident beta, denoted by $\beta_{j,q}$. Second, we use the estimated environmental betas to examine performance of hedge funds with high betas. Due to the heterogeneity in hedge fund preferences towards brown stocks, we found no significant trading on environmental incidents in hedge funds managed by PRI signatories. Therefore, to separate between these two fund sample, we introduce dummy variable that is equal to 1 if hedge fund is a non-PRI signatory fund and 0 otherwise. This will let us find the clearer relation between hedge fund trading in incident stocks and its impact on their performance. To examine, we run the following regression:

$$RET_{j,q+1} = a_0 + b_1\beta_{j,q} \times NonPRI\_dummy_{j,q} + b_2\beta_{j,q} + \\ + b_3 NonPRI\_dummy_{j,q} + b_4 Controls_{j,q} + e_{j,q} \quad (7)$$

where dependent variable $RET_{j,q+1}$ is the raw returns of hedge fund j's long-equity portfolio in quarter $q + 1$, estimated as the value-weighted aggregate return of its equity holdings. Fund level control variables are estimated at the previous quarter q and include hedge fund returns and logarithm of hedge fund long-equity portfolio size. We include time fixed effect and cluster standard errors at the fund level. If hedge funds are smart investors and buy stocks with environmental incidents to profit from temporary downward price pressure, we expect the coefficient on interaction variable to be significant and positive.

Results are presented in Table 6. In Column (1) the dependent variable is hedge fund returns in the next quarter $q + 1$, and in Column (2) the dependent variable is cumulative returns in the next three quarters. The relation between the interaction variable and fund returns is positive and statistically significant, with the estimated coefficient of 0.161 and a *t*-statistics of 2.43. This implies that non-PRI signatory hedge funds that buy stocks that experienced an environmental incident significantly outperform other funds. Overall, our results indicate that hedge funds are smart investors and strategically choose to trade in stocks with environmental incident, which in turn reflects on the higher performance of such hedge funds.

[Insert Table 6 here]

6. Hedge funds strategic trading around environmental incidents

So far we considered only long equity positions of institutional investors and hedge funds to analyze their trading patterns around environmental incidents. However, long positions do not provide the full picture. Among institutional investors, hedge funds face less strict regulations compared to mutual funds, and use sophisticated arbitrage strategies, including shorting and derivatives usage. If hedge funds anticipate significant downward impact on stock returns following incidents and they do not hold positions of the stocks in their portfolios, they may engage in short selling to profit from anticipated price decrease. In this section we discover whether hedge funds engage in shorting or option trading around environmental incidents.

6.1 Short interest around environmental incidents

Several studies show short sellers informed trading around events such as earnings announcements and corporate news events. Christophe, Ferri, and Hsieh (2010) find that short sellers increase their positions three days prior to the public release of analyst downgrades, which is strongly related to significant downward price movement in the subsequent period.

Engleberg, Reed, and Ringgenberg (2012) analyze short selling around corporate news events and show that short sellers possess superior public information processing skills and able to profit from short selling around news events. We found that stocks experience significant decrease in their returns following environmental incidents, which can attract short sellers. Zhan and Zhang (2022) show that short sellers are unwilling to short overpriced stocks with high ESG scores due to the uncertainty in the long-side investor preferences and trading patterns, which increases synchronization risk (Abreu and Brunnermeier, 2002). However, environmental incidents provide a clear indication about environmental performance of the firms, reducing such risk. RepRisk gathers information on environmental incidents from publicly available news outlets, NGOs and governmental bodies reports. Sophisticated investors, such as hedge funds, may anticipate these events as information may not be necessarily new and unpredictable. We hypothesize that hedge funds, as profit-driven investors, may want to capitalize on the short-term mispricing in stocks with environmental incidents and increase short positions prior to environmental incident.[14]

To examine our hypothesis we obtain stock level short interest data from Compustat. Starting from September 2007, short interest data is reported twice each month. Since our sample period for environmental incidents starts in 2007, we use bi-monthly short interest data for higher frequency analysis. We construct stock level short interest ratio (SI) as the number of shares sold at time *t*, that corresponds to the bi-monthly frequency, divided by shares outstanding at time *t*. We use daily CRSP security data to obtain shares outstanding. To study the short interest around environmental incidents, we follow framework in Engelberg, Reed, and Ringgenberg (2012) and run the following panel regression:

$$SI_{i,t} = a_0 + b_1 E\_incident_{i,t} + b_2 Controls_{i,t-1} + e_{i,t} \quad (8)$$

where $SI_{i,t}$ is short volume ratio of stock *i* at time *t*. Since data on environmental incidents is daily, we align environmental incidents with short interest if they happened between time *t* and time *t* - 1.[15] We control for two daily lag returns to account of the documented short sellers response to previous returns.[16] We also include firm and month fixed effects.

[14] Short selling plays an important role in hedge funds trading strategies (Jiao, Massa, and Zhang, 2016; Hwang, Liu, and Xu, 2019).

[15] For example, if an incident happened on 10th of March, we align it with short interest in the middle of March, and if the incident happened on 20th of March, we align it with short interest at the end of the month.

[16] In untabulated results we also rerun regression with controls for previous 5 day returns, returns for the previous period between t and t-1, and for previous months returns. Results remain unchanged.

Results are reported in Table 7. We run regression for short interest one month before and one month after the incident. We find that for the short interest in t - 2, the estimated coefficient on environmental incident dummy is negative, however, the relation becomes positive and statistically significant for short interest ratio at time t - 1, preceding incident date. In Column (3), where we estimate regression for the SI corresponding to the incident date, the relation remains positive and significant. Results corroborate our hypothesis that institutional investors, such as hedge funds, may anticipate negative environmental news and short sell stocks that may experience negative impact on their stock returns following incidents. Columns (4) and (5) estimate regression for SI at a longer horizon after the incident. We find that there exists a subsequent reversal in the short interest of stocks that experience environmental incidents.

Overall, our results show that institutional investors may trade not only on the long side, but also use short selling to profit from the negative impact environmental incidents may have on the stock returns. Some events can be anticipated, therefore, short sellers may open short positions right before and during the incident time, and cover their short positions soon after the incident.

[Insert Table 7 here]

6.2 Options usage by hedge funds

Hedge funds use options as part of their arbitrage strategies. Aragon and Martin (2012) show that that hedge funds engage in option trading to profit from volatility timing and stock selection skills. There is also an evidence of hedge funds skillful use of options in green stocks. Aragon, Jiang, Joenvaara, and Tiu (2024) show that bullish option positions of hedge funds in green stocks predict stocks poor performance. In this section we investigate hedge funds options use around environmental incidents. Zhan and Zhang (2022) highlight the unwillingness of short sellers to bet against overpriced ESG stocks. Due to uncertainty in investors reaction to environmental performance of firms, we expect hedge funds to use options to hedge their long and short positions in stocks with environmental incidents.

We follow Aragon and Martin (2012) and calculate the following variables: 1) $Dir_{i,q}$ is the the proportion of hedge fund advisors disclosing directional option position on underlying security i at the end of quarter q; 2) $NonDir_{i,q}$ is the proportion of advisors disclosing non directional option position. Similarly, we define $Bull_{i,q}$ for directional call option positions,

$Bear_{i,q}$ for directional put option positions, $PPut_{i,q}$ and $Straddle_{i,q}$ for protective puts and straddles respectively. We then run the following regression for each stock *i* in quarter *q*:

$$Bull_{i,q} = a_0 + b_1 E\_incident_{i,q} + b_2 Controls_{i,q-1} + e_{i,q} \quad (9)$$

We repeat regression for all types of option positions and for the next quarter q. Results are reported in Table 8. Panel A include results for quarter *q*, and Panel B – for quarter *q* + 1. In Panel B from Columns (1) and (2), the coefficient on environmental incident dummy for directional options positions is insignificant, while the coefficient for non-directional options is positive and statistically significant. When decomposing further, results suggest that hedge funds tend to hold straddle positions in stock with environmental incidents in the quarter corresponding to the incident quarter. This confirms our assumption that hedge funds avoid directional option trading in stocks with environmental incidents due to existing uncertainty in market reaction, and instead use straddle positions that allow hedge funds to profit from stock price volatility following the incident regardless of the direction. In Panel B we repeat analysis for option positions in quarter *q* + 1. Results remain largely the same with the relation being statistically significant and positive for the proportion of advisors holding straddles. One striking difference is that in Column (4), the coefficient on bull options positions is now positive and statistically significant. This indicates that hedge funds increase holdings in directional call positions one quarter after the incident. This may suggest that hedge funds anticipate prices to go up on a longer horizons after the incident.

Overall, in this section we show that hedge funds try to capitalize on the stock price movements following environmental incidents by employing straddles and call option positions.

[Insert Table 8 here]

7. Conclusion

In conclusion, our study sheds light on the intricate dynamics of institutional investors' trading behaviors around environmental incidents, with a particular focus on hedge funds. We find that while banks, pension funds, and insurance companies tend to divest from high ESG risk profiles following environmental incidents, hedge funds often act as liquidity providers by purchasing these stocks. This behavior underscores hedge funds' strategic approach to capitalizing on the temporary price depressions caused by selling pressures from more

environmentally conscious investors. Our findings suggest that hedge funds exploit these opportunities to generate significant positive returns, particularly when trading non-PRI hedge funds' portfolios. Conversely, PRI signatory hedge funds do not exhibit the same trading patterns, highlighting a divergence in strategy based on ESG commitments.

Furthermore, our research contributes to the broader understanding of ESG incidents' impact on market dynamics and institutional investors' strategic responses. By examining the prolonged negative return drift following environmental incidents and the varied responses of different investor types, we provide nuanced insights into the financial implications of climate-related risks. Our study reveals that hedge funds' trading strategies around such incidents are driven by profit motives, as they anticipate and respond to the market movements created by other institutional investors' divestment actions. This strategic behavior not only impacts the immediate market response to environmental incidents but also underscores the critical role of hedge funds in the evolving landscape of ESG investing.

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Appendix A: Variable Definitions

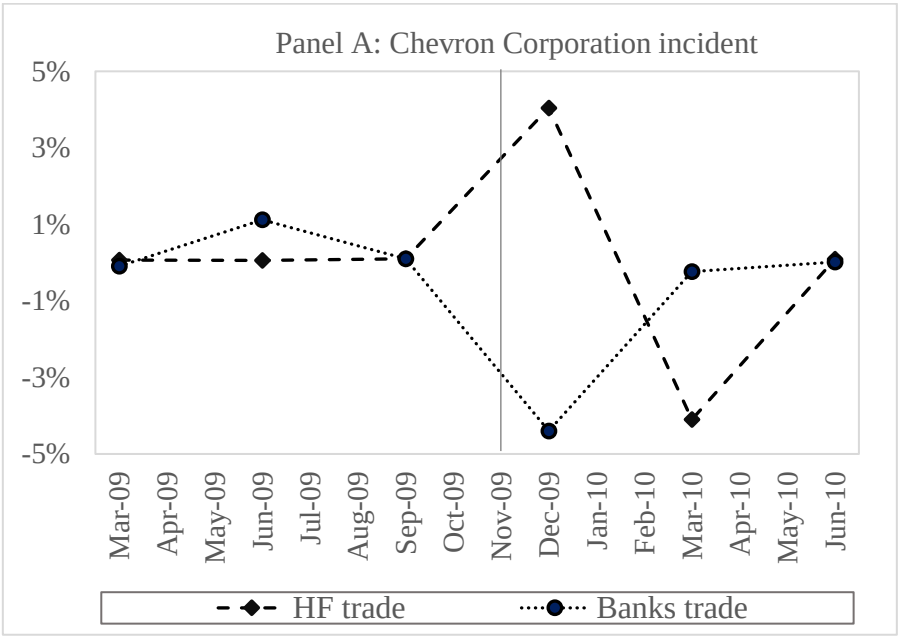
Variable	Definition
Environmental Incidents *(Source: RepRisk)*	
$E\_incident_{i,t}$	Dummy variable equal to one, if stock *i* in month *t* experienced an environmental incident, and zero otherwise. We use environmental incident flag in RepRisk to identify environmental incidents.
$Low\_ESG\_risk_{i,t}$	Dummy variable equal to one if stock *i* in month *t* has RepRisk Rating (RRR) of A, AA, or AAA, and zero otherwise.
$High\_ESG\_risk_{i,t}$	Dummy variable equal to one if stock *i* in month *t* has RepRisk Rating (RRR) of BBB or below, and zero otherwise.
Hedge funds data *(Source: Thomson Reuters 13F, Principles for Responsible Investment, Whale Wisdom)*	
HF $trade_{j,i,q}$	Individual hedge fund *j* trades of stock *i* in quarter *q*, measured as the change in shares held by hedge fund *j* (i.e., number of shares bought minus the number of shares sold by all hedge funds) from quarter *q*-1 to quarter *q* divided by total shares outstanding of stock *i* at the end of quarter *q*.
Buy $dummy_{i,q}$	Dummy variable equal to one if aggregate hedge funds trade of stock *i* in quarter *q* is greater than zero, and zero otherwise. Where aggregate hedge funds trades is measured as the changes in shares held by all hedge funds from quarter *q*-1 to quarter *q* divided by total shares outstanding at the end of quarter *q*.
Sell $dummy_{i,q}$	Dummy variable equal to one if aggregate hedge funds trade of stock *i* in quarter *q* is less than zero, and zero otherwise.
Dir/NonDir	Proportion of hedge fund advisors that disclose a directional/non-directional option position on the underlying security out of all advisors that report at least one stock or option position in the security.
Bear/Bull	Proportion of hedge fund advisors that disclose a directional put/call option position on the underlying security out of all advisors that report at least one stock or option position in the security. A put option position is classified as directional if the advisor does not simultaneously report a position in a call option or a common stock. A call option position is classified as directional if the advisor does not simultaneously report a position in a put option on the same underlying security.
Straddle/PPut	Proportion of hedge fund advisors that disclose a straddle/protective put option position on the underlying security out of all advisors that report at least one stock or option position in the security.

Appendix: Variable Definitions - *Continued*

Variable	Definition

Other institutional investors data *(Source: Thomson Reuters 13F)*	
Buy $dummy_{i,q}$	Dummy variable equal to one if aggregate institutional trade of stock *i* in quarter *q* is greater than zero, and zero otherwise. We measure buy dummy variable for each type of institution, including banks, pension funds, mutual funds, independent investment advisors, pension funds, insurance companies, and endowments.
Sell $dummy_{i,q}$	Dummy variable equal to one if aggregate institutional trade of stock *i* in quarter *q* is less than zero, and zero otherwise.
Short Interest data *(Source: Compustat)*	
SI	Short interest ratio measured as the ratio between the number of shares sold short at the end of the quarter and the total number of shares outstanding.
Stock data *(Source: CRSP, Compustat)*	
log(SIZE)	Firm size measured as the log of market capitalization.
log(B/M)	Log of book-to-market ratio where the book value is measured as of the preceding fiscal year, and market value is measured as of the end of that calendar year. We define book equity, *B*, as the Compustat book value of stockholders' equity (SEQ) plus balance-sheet deferred taxes (TXDITC) minus the book value of preferred stock. Depending on availability, we use redemption (PSTKRV), liquidation (PSTKL), or par value (PSTK) to estimate the value of preferred stock. We exclude negative *B/M* firms.
$Ret_{i,t-1}$	Cumulative returns in the previous month.
$Ret_{i,t-2:t-12}$	Cumulative return over 11 months preceding the beginning of the last month.
ROE	Ratio of net income and book equity, where book equity is defined as shareholders' equity minus preferred stock.
ROA	Ratio of net income to total assets
Gross profits over assets	Revenue minus costs of goods sold divided by total assets
Illiquidity	Stock illiquidity defined as the average ratio of the daily absolute return to the (dollar) trading volume on that day.
Volatility	Standard deviation of stock returns in the past 12 months.
Sales growth	Dollar change in annual firm revenues normalized by previous month's market capitalization.
EPS growth	Dollar change in annual earnings per share, normalized by the firm's equity price.

Appendix B: Institutional trading around incidents



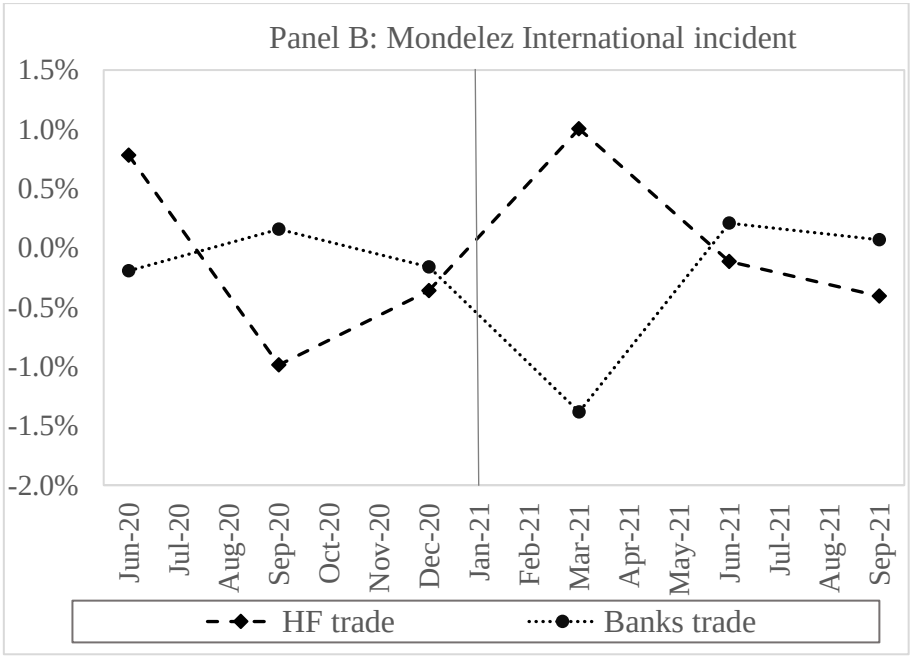


Figure B.1: Institutional trading around environmental incidents: case studies
This figure shows two cases of trading by hedge funds and banks around environmental incidents. Environmental incidents data is gathered from RepRisk dataset. Panel A shows trading around incident of Chevron Corporation on November 4, 2009, and Panel B shows trading around incident of Mondelez International on January 3, 2021. Trading is calculated as the quarterly change in aggregate shares held by hedge funds (banks), scaled by stock's shares outstanding.

Table 1: Environmental incidents and stock returns

This table presents the results of regressions of monthly stock returns on the occurrence of environmental incidents. $RET_{i,t}$ is the returns of stock *i* in month *t*. $E\_incident_{i,t}$ is a dummy variable equal to 1 if stock *i* experienced an environmental incident in month *t* and 0 otherwise. *Controls* are measured as of the prior month *t* - 1 and include previous one- and eleven-month returns, log of market capitalization, book-to-market ratio, volatility, ROE, investments, log of PPE, sales growth, and EPS growth. Year/month fixed effects are also included, and standard errors are clustered at the firm and year levels. Panel B includes interaction variable with low risk dummy variable, and Panel C includes interaction variable with high risk dummy variable. Low (high) risk dummy variable is equal to 1 if stock's RepRisk Rating is A and above (BBB and below), and 0 otherwise. The sample period is January 2007 to December 2021. ∗,∗∗, ∗∗∗ indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Unconditional test				
Dep Vars	**$Ret_{i,t}$**	**$Ret_{i,t+1}$**	**$Ret_{i,t+2}$**	**$Ret_{i,t+3}$**
	(1)	(2)	(3)	(4)
$E\_incident_{i,t}$	**-0.521****	**-0.514*****	**-0.454***	-0.314
	(-2.19)	**(-2.83)**	**(-1.68)**	(-1.60)
Controls	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Adj R^2	0.171	0.170	0.170	0.172
Panel B: Conditional on low ESG risk				
Dep Vars	**$Ret_{i,t}$**	**$Ret_{i,t+1}$**	**$Ret_{i,t+2}$**	**$Ret_{i,t+3}$**
	(1)	(2)	(3)	(4)
$E\_incident_{i,t}$ x $Low\_ESG\_risk_{i,t}$	-0.065	**-0.488****	**-0.692****	-0.310
	(-0.16)	**(-2.23)**	**(-2.15)**	(-0.85)
$E\_incident_{i,t}$	-0.305	-0.137	0.013	0.005
	(-0.89)	(-0.80)	(0.04)	(0.03)
$Low\_ESG\_risk_{i,t}$	**0.364*****	**0.371*****	**0.373*****	**0.379*****
	(2.95)	**(3.71)**	**(2.90)**	**(3.30)**
Controls	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Adj R^2	0.171	0.170	0.171	0.172
Panel C: Conditional on high ESG risk				
Dep Vars	**$Ret_{i,t}$**	**$Ret_{i,t+1}$**	**$Ret_{i,t+2}$**	**$Ret_{i,t+3}$**
	(1)	(2)	(3)	(4)
$E\_incident_{i,t}$ x $High\_ESG\_risk_{i,t}$	-0.026	**0.414***	**0.552***	0.194
	(-0.07)	**(1.75)**	**(1.86)**	(0.50)
$E\_incident_{i,t}$	-0.405	**-0.659****	**-0.693****	-0.327
	(-1.69)	**(-2.51)**	**(-2.09)**	(-0.91)
$High\_ESG\_risk_{i,t}$	**-0.283****	**-0.301*****	**-0.263****	**-0.292****
	(-2.43)	**(-3.61)**	**(-2.54)**	**(-2.30)**
Controls	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Adj R^2	0.171	0.170	0.171	0.172

Table 2: Aggregate Institutional Trades and Environmental Incidents

This table presents the results of regressions of aggregate institutional trades on the environmental incidents. Dependent variable is buy trade dummy in panel A, and sell dummy in panel B. Buy (sell) dummy variable is equal to one if aggregate institutional trade of stock *i* in quarter *q* is greater (less) than zero, and zero otherwise. We conduct analysis for each type of institutional investor, where HFs separated into PRI and NonPRI HF signatories. In Column (9) we include aggregate trade for investors that are not 13F filing institutions. *E_incident* is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. *Controls* measured as of the prior quarter *q* - 1 include stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. We include time fixed effect. Standard errors are clustered by firm and quarter. The sample period is from January 2007 to December 2021. ∗,∗∗, ∗∗∗ indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep Var	**Panel A: Buy dummy$_{i,q}$**								
	PRI HFs	**NonPRI HFs**	**Banks**	**Mutual funds**	**Independent investment advisors**	**Pension funds**	**Insurance companies**	**Endowments**	**Non 13F**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
E_Incident$_{i,q}$	-0.037**	0.023*	-0.037**	0.022**	-0.013	-0.001	-0.035***	0.004	0.036***
	(-2.15)	(1.74)	(-2.16)	(1.99)	(-1.08)	(-0.08)	(-3.06)	(0.25)	(3.27)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.173	0.022	0.100	0.052	0.030	0.064	0.051	0.112	0.059
Dep Var	**Panel B: Sell dummy$_{i,q}$**								
	PRI HFs	**NonPRI HFs**	**Banks**	**Mutual funds**	**Independent investment advisors**	**Pension funds**	**Insurance companies**	**Endowments**	**Non 13F**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
E_Incident$_{i,q}$	0.027	-0.025*	0.020	-0.026**	0.010	-0.001	0.025**	-0.034**	-0.037***
	(1.60)	(-1.83)	(1.15)	(-2.38)	(0.81)	(-0.09)	(2.22)	(-2.45)	(-3.31)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.178	0.022	0.099	0.054	0.030	0.065	0.053	0.122	0.059

Table 3: Aggregate Institutional Trades and Environmental Incidents of low and high ESG risk firms

This table presents the results of regressions of aggregate institutional trades on the environmental incidents for stocks with low ESG risk profile in Panel A, and high ESG risk profile in Panel B. Dependent variables are buy and sell trade dummies. Buy (sell) dummy variable is equal to one if aggregate institutional trade of stock *i* in quarter *q* is greater (less) than zero, and zero otherwise. We conduct analysis for each type of institutional investor, where HFs separated into PRI and NonPRI HF signatories. In Column (9) we include aggregate trade for investors that are not 13F filing institutions. *E_incident* is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. Low (high) risk dummy variable is equal to 1 if stock's RepRisk Rating is A and above (BBB and below), and 0 otherwise. *Controls* measured as of the prior quarter *q* - 1 include stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. We include time fixed effect. Standard errors are clustered by firm and quarter. The sample period is from January 2007 to December 2021. ∗,∗∗, ∗∗∗ indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Low ESG risk firms									
Dep var	**Buy dummy$_{i,q}$**								
	PRI HFs	**NonPRI HFs**	**Banks**	**Mutual funds**	**Independent investment advisors**	**Pension funds**	**Insurance companies**	**Endowments**	**Non 13F**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low_ESG_risk$_{i,q}$ x E_Incident$_{i,q}$	0.042**	-0.029	0.039**	-0.003	0.018	0.046***	0.036**	-0.021	-0.013
	(2.15)	(-1.65)	(2.05)	(-0.17)	(1.16)	(2.68)	(2.02)	(-1.31)	(-0.93)
E_Incident$_{i,q}$	-0.056***	0.029*	-0.055***	0.012	-0.024	-0.025	-0.049***	0.000	0.048***
	(-2.86)	(1.88)	(-2.73)	(0.87)	(-1.61)	(-1.40)	(-3.16)	(-0.01)	(3.65)
Low_ESG_risk$_{i,q}$	-0.009	-0.007**	-0.011**	-0.021***	-0.011***	-0.018***	-0.004	-0.026***	0.015***
	(-1.53)	(-2.53)	(-2.38)	(-5.99)	(-3.03)	(-3.5)	(-0.87)	(-3.99)	(3.13)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.173	0.022	0.100	0.052	0.030	0.065	0.051	0.112	0.059

Dep Var	**Sell dummy$_{i,q}$**								
	PRI HFs	**NonPRI HFs**	**Banks**	**Mutual funds**	**Independent investment advisors**	**Pension funds**	**Insurance companies**	**Endowments**	**Non 13F**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low_ESG_risk$_{i,q}$ x E_Incident$_{i,q}$	-0.034*	0.030*	-0.031*	0.006	-0.018	-0.047***	-0.030*	-0.009	0.014
	(-1.73)	(1.68)	(-1.68)	(0.31)	(-1.13)	(-2.78)	(-1.78)	(-0.50)	(0.99)
E_Incident$_{i,q}$	0.043**	-0.030*	0.037*	-0.017	0.021	0.024	0.037**	-0.022	-0.049***
	(2.30)	(-1.94)	(1.84)	(-1.20)	(1.40)	(1.33)	(2.53)	(-1.62)	(-3.69)
Low_ESG_risk$_{i,q}$	0.011*	0.008***	0.013***	0.022***	0.011***	0.020***	0.006	0.020***	-0.015***
	(1.80)	(2.84)	(2.99)	(6.26)	(3.19)	(4.00)	(1.45)	(3.13)	(-3.12)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.178	0.022	0.099	0.054	0.030	0.066	0.053	0.122	0.059

Panel B: High ESG risk firms									
Dep var	**Buy dummy$_{i,q}$**								
	PRI HFs	**NonPRI HFs**	**Banks**	**Mutual funds**	**Independent investment advisors**	**Pension funds**	**Insurance companies**	**Endowments**	**Non 13F**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
High_ESG_risk$_{i,q}$ x E_Incident$_{i,q}$	0.006	0.035*	0.003	0.036**	0.009	-0.026	-0.023	0.035**	-0.042**
	(0.28)	(1.89)	(0.16)	(1.98)	(0.54)	(-1.33)	(-1.12)	(2.09)	(-2.47)
E_Incident$_{i,q}$	-0.021	-0.002	-0.024	0.003	-0.011	0.016	-0.016	-0.025	0.046***
	(-1.26)	(-0.13)	(-1.54)	(0.23)	(-1.09)	(1.14)	(-1.53)	(-1.63)	(4.05)
High_ESG_risk$_{i,q}$	-0.042***	0.004	-0.030***	-0.010*	-0.016**	0.000	-0.009	0.013*	0.036***
	(-6.36)	(0.76)	(-4.15)	(-1.85)	(-2.55)	(0.000)	(-1.40)	(1.69)	(5.64)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.174	0.022	0.100	0.052	0.030	0.064	0.051	0.112	0.059
Dep Var	**Sell dummy$_{i,q}$**								
	PRI HFs	**NonPRI HFs**	**Banks**	**Mutual funds**	**Independent investment advisors**	**Pension funds**	**Insurance companies**	**Endowments**	**Non 13F**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
High_ESG_risk$_{i,q}$ x E_Incident$_{i,q}$	-0.011	-0.036*	-0.007	-0.037**	-0.009	0.024	0.019	0.001	0.041**
	(-0.56)	(-1.95)	(-0.37)	(-2.07)	(-0.55)	(1.23)	(1.00)	(0.05)	(2.40)
E_Incident$_{i,q}$	0.017	0.002	0.012	-0.005	0.008	-0.017	0.010	-0.026	-0.046***
	(1.01)	(0.11)	(0.80)	(-0.37)	(0.80)	(-1.26)	(1.00)	(-1.64)	(-4.05)
High_ESG_risk$_{i,q}$	0.036***	-0.005	0.024***	0.007	0.015**	0.000	0.003	-0.018**	-0.036***
	(5.41)	(-0.83)	(3.26)	(1.31)	(2.41)	(0.04)	(0.56)	(-2.24)	(-5.70)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.178	0.022	0.099	0.054	0.030	0.065	0.053	0.122	0.059

Table 4: Individual Hedge Fund Trades and Environmental Incidents

This table presents the results of regressions of individual hedge fund trades of stocks *i* in quarter *q* on the environmental incidents. Panel A presents results for the full sample of environmental incidents, Panel B includes the interaction variable of Low risk dummy and environmental incidents. *HF trade*$_{j,i,,q}$ is the trade of hedge fund *j* in stocks *i* in quarter *q*. *E_incident* is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. *Low_ESG_risk* is a dummy variable equal to 1 if a company's RepRisk rating in quarter *q* is AAA, AA, or A, and zero otherwise. We also repeat regression for the subsample of PRI, Non-PRI, Small, and Large hedge funds. *Controls* measured as of the prior quarter *q* - 1 include hedge fund *j*'s trading in stock *i*, the logarithm of the size of hedge fund *j* as measured by its equity portfolio value, and stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. Fund fixed effects and quarter fixed effects are included to control for unobservable institutional characteristics and macroeconomic conditions, respectively. Standard errors are clustered by institution and quarter. The sample period is from January 2007 to December 2021. *,**, *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Unconditional test			
Dep Var	**HF trade$_{j,i,q}$**		
	All HFs	**PRI HFs**	**NonPRI HFs**
	(1)	(2)	(3)
E_Incident$_{i,q}$	**0.008*** **	-0.038	**0.009*** **
	(3.19)	(-1.28)	**(3.70)**
Controls	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj R-sq	0.014	0.245	0.013
Panel B: Conditional on low ESG risk			
Dep Var	**HF trade$_{j,i,q}$**		
	All HFs	**PRI HFs**	**NonPRI HFs**
	(1)	(2)	(3)
Low_ESG_risk$_{i,q}$ x E_Incident$_{i,q}$	**-0.003***	**-0.011****	-0.002
	(-1.97)	**(-2.03)**	(-1.51)
E_Incident$_{i,q}$	**0.003*** **	-0.011	**0.003****
	(2.99)	(-0.88)	**(2.53)**
Low_ESG_risk$_{i,q}$	0.001	0.017	0.000
	(0.69)	(1.61)	(-0.21)
Controls	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj R-sq	0.010	0.282	0.007

Table 5: Hedge Funds trade on the other side of institutional investors

This table presents the results of regressions of individual hedge fund trades of stocks *i* in quarter *q* on environmental incidents and institutional sell trades. *HF trade*$_{j,i,,q}$ is the trade of hedge fund *j* in stocks *i* in quarter *q*, and *E_incident* is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. We interact incident dummy with sell dummy for each institution type, where sell dummy equal to one if aggregate institutional trade is less than zero in quarter *q*, and zero otherwise. We also repeat regression for the subsample of PRI and Non-PRI hedge funds. *Controls* measured as of the prior quarter *q* - 1 include hedge fund *j*'s trading in stock *i*, the logarithm of the size of hedge fund *j* as measured by its equity portfolio value, and stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. Fund fixed effects and quarter fixed effects are included to control for unobservable institutional characteristics and macroeconomic conditions, respectively. Standard errors are clustered by institution and quarter. The sample period is from January 2007 to December 2021. ∗,∗∗, ∗∗∗ indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep Var	**HF trade$_{j,i,q}$**		
	All HFs	**PRI HFs**	**NonPRI HFs**
	(1)	(2)	(3)
Banks_sell$_{i,q}$ x E_Incident$_{i,q}$	**0.010*** **	**0.087** **	**0.008*** **
	(2.75)	**(2.34)**	**(2.76)**
MF_sell$_{i,q}$ x E_Incident$_{i,q}$	0.003	**0.037** **	0.000
	(0.74)	**(2.09)**	(-0.16)
Pension_sell$_{i,q}$ x E_Incident$_{i,q}$	**0.012*** **	**0.048*** **	**0.009*** **
	(3.28)	**(2.61)**	**(4.49)**
Indep_adv_sell$_{i,q}$ x E_Incident$_{i,q}$	-0.002	0.013	-0.004
	(-0.48)	(0.94)	(-1.28)
Insurance_sell$_{i,q}$ x E_Incident$_{i,q}$	**0.009***	**0.088** **	**0.003***
	(1.67)	**(2.20)**	**(1.82)**
Endowment_sell$_{i,q}$ x E_Incident$_{i,q}$	**0.004** **	-0.006	**0.003** **
	(2.22)	(-0.47)	**(1.99)**
Banks_sell$_{i,q}$	-0.013	-0.123	-0.007
	(-2.03)	(-1.84)	(-2.51)
MF_sell$_{i,q}$	-0.003	-0.076*	0.002
	(-0.58)	(-1.72)	(0.67)
Pension_sell$_{i,q}$	-0.013***	-0.071**	-0.009***
	(-2.96)	(-2.10)	(-3.84)
Indep_adv_sell$_{i,q}$	0.005	-0.037	0.007***
	(1.39)	(-1.29)	(2.92)
Insurance_sell$_{i,q}$	-0.009	-0.109*	-0.003*
	(-1.54)	(-1.85)	(-1.89)
Endowment_sell$_{i,q}$	-0.005***	-0.032*	-0.004**
	(-2.98)	(-1.94)	(-2.80)
E_Incident$_{i,q}$	-0.016	-0.187**	-0.006
	(-1.50)	(-1.98)	(-1.26)
Controls	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj R-sq	0.014	0.263	0.022

Table 6: Trading on environmental incidents and hedge fund performance

This table presents the results from regressions of hedge funds' long-equity portfolio performance during quarter $q + 1$ or quarters $q + 1$ through $q + 3$ on their environmental incident β measured as of quarter q. The dependent variables are the raw returns of hedge fund j's long-equity portfolio. The independent variables include environmental incident β and its interaction term with an indicator variable denoting NonPRI signatory hedge funds. We regress hedge fund trading on the stocks' environmental incident dummy to estimate individual HFs' environmental incident βs in each quarter. One-quarter lagged control variables include the logarithm of a fund's long-equity portfolio value, and raw fund returns, and a dummy variable indicating NonPRI signatory. t-statistics computed with standard errors clustered by fund are reported in parentheses. The sample period is January 2007 to December 2021. *,**, *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep Vars	**$Ret_{j,\ q+1}$**	**$Ret_{j,q+1:q+3}$**
	(1)	(2)
$Beta_{j,q}$ x $NonPRI\_Dummy_{j,q}$	**0.161****	0.279
	(2.43)	(0.94)
$Beta_{j,q}$	**-0.160*****	-0.238
	(-3.16)	(-0.92)
$NonPRI\_Dummy_{j,q}$	0.325	1.069
	(1.50)	(1.12)
Fund Controls	Yes	Yes
Time FE	Yes	Yes
Adj R^2	0.495	0.479

Table 7: Short interest around environmental incidents

This table presents the results from regressions that examines stocks' short interest around environmental incidents. In each regression specification the dependent variable is bi-monthly short interest ratio of a stocks. Since short interest in Compustat is reported on a bi-monthly period, we denote this time period as *t.* All regressions include firm and time fixed effects. We include past two daily lags of returns to control for previously documented response of short sellers to past returns. t-statistics computed with standard errors clustered by firm and time and reported in parentheses. The sample period is January 2007 to December 2021. ∗,∗∗, ∗∗∗ indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep vars	**SI (t-2)**	**SI (t-1)**	**SI (t)**	**SI (t+1)**	**SI (t+2)**
	(1)	(2)	(3)	(4)	(5)
$E\_incident_{i,t}$	-0.314***	0.314***	0.315***	-0.300***	0.172**
	(-3.72)	(3.63)	(3.78)	(-3.41)	(2.15)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes
Adj R-sq	0.355	0.355	0.355	0.355	0.355

Table 8: Options use by hedge funds around environmental incidents

This table presents the results from regressions that examines options usage by hedge funds in stocks that experienced an environmental incident. The dependent variables are the proportion of hedge fund advisors disclosing certain option positions. *Dir* is the proportion of advisors disclosing a directional option position on underlying security *i* among all advisors that holds at least one stock or option position in that security. We similarly define the proportion of advisors disclosing nondirectional (NonDir), directional call (Bull), directional put (Bear), straddle (Straddle), and protective put (PPut) option positions. In Panel A dependent variable are measure as of quarter $q - 1$, preceding the quarter of environmental incident, Panel B repeats regression for option positions in concurrent quarter *q*. *E_incident* is a dummy variable equal to 1 if a company had an environmental incident in quarter *q*. *Controls* measured as of the prior quarter *q* - 1 include stock *i*'s quarterly returns, cumulative returns in the prior four-quarter period, logarithm of market capitalization, book-to-market ratio, and Amihud illiquidity measure. All regressions include firm and time fixed effects. t-statistics computed with standard errors clustered by firm and time and reported in parentheses. The sample period is January 2007 to December 2021. ∗,∗∗, ∗∗∗ indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Options use in quarter *q* - 1						
Dep vars	**Dir**	**NonDir**	**Bear**	**Bull**	**Straddle**	**PPut**
	(1)	(2)	(3)	(4)	(5)	(6)
$E\_incident_{i,q}$	0.061	**0.253*** **	0.027	0.034	**0.223*** **	0.031
	(1.28)	**(4.23)**	(0.92)	(0.81)	**(4.72)**	(1.11)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-sq	0.278	0.437	0.213	0.249	0.420	0.136
Panel B: Options use in quarter *q*						
Dep vars	**Dir**	**NonDir**	**Bear**	**Bull**	**Straddle**	**PPut**
	(1)	(2)	(3)	(4)	(5)	(6)
$E\_incident_{i,q}$	0.082	**0.321*** **	0.003	**0.079***	**0.285*** **	0.035
	(1.52)	**(4.91)**	(0.12)	**(1.72)**	**(5.29)**	(1.59)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-sq	0.276	0.440	0.182	0.249	0.423	0.136