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Corporate Environmental Liabilities' Impact on Companies' Stock Returns

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Abstract

This study examines the financial implications of corporate environmental violations on stock returns within the U.S. market, focusing on the market's reaction to disclosure events. Using data from the EPA's ECHO database and Refinitiv's financial data, an event study methodology is employed to assess the impact of environmental violation announcements on cumulative abnormal returns (CAR). The findings reveal significant negative reactions in stock returns following such announcements, suggesting that investors respond unfavorably to companies' environmental infractions, particularly when penalties are high. Regression analysis further identifies that firm size, profitability, and penalty severity are critical determinants of CAR, underscoring the market's sensitivity to environmental non-compliance. This study contributes to the literature by demonstrating the tangible financial consequences of regulatory non-compliance, highlighting the importance of sustainable practices for corporate financial stability.

Keywords : Environmental Violations, Stock Market Reaction, Cumulative Abnormal Returns (CAR), Environmental Penalties, ESG (Environmental, Social, and Governance), EPA (Environmental Protection Agency), US Financial Market

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INTRODUCTION

Corporate environmental responsibility has grown in importance in the global business environment in recent years. Businesses are being held more and more responsible for their environmental impact in addition to their financial performance. Investors, regulators, and customers are now more interested in companies' environmental activities due to growing knowledge of sustainability issues, climate change, and environmental damage. The United States Environmental Protection Agency (EPA) is a key player in enforcing environmental regulations and penalising businesses that do not adhere to the set standards as part of its endeavours to guarantee corporate accountability. The financial markets' reaction to these regulatory moves, which are frequently made public, can have a serious impact on companies. With an emphasis on the immediate market responses when such violations are announced, this thesis investigates the effect of corporate environmental infractions on stock returns in the US market. The study uses an event study approach to evaluate the cumulative abnormal returns (CAR) surrounding the event date of the violation disclosures by examining financial data from Refinitiv and data from the EPA's ECHO database.

The EPA's ECHO database is a comprehensive repository of environmental enforcement data, providing information on inspections, violations, enforcement actions, and penalties under key environmental laws in the United States. It includes details at both the facility and corporate levels, such as the name of the company involved, the date of the violation, the type of violation, and the associated enforcement actions. The database also covers geographic information, allowing for an analysis of regional patterns in regulatory compliance. Additionally, it tracks follow-up actions, such as penalty assessments and remediation requirements, and provides insights into the progression of cases over time. This rich dataset enables researchers to link violations to specific companies, their financial impact, and corporate accountability measures. This preview helps to contextualize the financial and reputational risks associated with regulatory non-compliance.

This study examines whether environmental violations, reported in regulatory disclosures, have a negative impact on the market and, if so, how the severity of penalties and the characteristics of the company affect the magnitude of the impact.

Although previous research has looked at how corporate misconduct affects market performance, less attention has been paid to environmental infractions, especially within the context of U.S. regulations. Using the EPA's ECHO database, this study addresses this gap by examining how the market reacts to information about environmental violations, focusing on

the short-term financial effects of such disclosures and the potential long-term consequences for stock prices, investor sentiment, and corporate value. While the ECHO database provides comprehensive data for this analysis, it is not without limitations, as it requires significant effort to organize and extract meaningful insights due to its complex structure. For instance, the database does not directly provide information on parent companies, requiring researchers to link facilities to their corporate owners through additional data sources like the Facility Registry Service (FRS). However, its extensive coverage and integration of enforcement data make it a valuable resource for studying environmental compliance in the U.S. market. Compared to other databases, such as the U.S. Coast Guard's National Response Center database, which focuses on specific environmental incidents such as oil spills, ECHO provides a broader insight into environmental enforcement under key federal laws. This study, therefore, leverages ECHO's strengths to make a unique contribution to understanding how regulatory disclosures influence market behavior.

Environmental violations can result in direct financial penalties, such as fines and remediation costs, as well as reputational damage, which can affect customer loyalty and investor confidence. As a result, the disclosure of such violations provides a unique opportunity to observe market behavior in response to regulatory oversight and public accountability. Through this research, we aim to provide empirical evidence on the financial consequences of environmental violations and contribute to the broader understanding of the relationship between corporate governance, environmental responsibility, and market performance.

This study looks at how several variables, such company size, penalty severity, and market conditions, influence the level of market reactions. The study's conclusions are intended to provide policymakers, investors, and business leaders with insightful information on the financial effects of environmental governance and the growing demand for sustainable business practices. Understanding how these infractions impact stock returns is crucial for setting the company strategy and regulatory policies, as investor expectations for environmental, social, and governance (ESG) issues rise.

The thesis is structured into three chapters to systematically address the research objectives. The first chapter establishes the theoretical framework of corporate environmental liabilities, exploring their origins, legal context, and consequences, while also reviewing key literature on financial and reputational impacts of non-compliance. The second chapter describes the data collection process and offers a statistical overview of the dataset, detailing the key variables, sources, and the methodological approach applied in this research, particularly the event study methodology. The final chapter presents the results and analysis, focusing on the market

reaction to environmental violations, including cumulative abnormal returns (CAR) and the determinants of these financial impacts, as revealed by the regression model. Together, these chapters provide an in-depth understanding of how environmental infractions influence corporate stock performance, offering valuable insights for investors, policymakers, and corporate leaders.

CHAPTER I: Theoretical Framework of Corporate Environmental Liabilities

This chapter lays the theoretical groundwork for understanding corporate environmental liabilities, focusing on their origins, types, and implications. It aims to explore the legal, financial, and reputational dimensions of these liabilities, taking into account the role of key regulatory agencies, particularly the U.S. Environmental Protection Agency (EPA). In doing so, it provides a contextual background for the subsequent analysis of the study.

1. Corporate Environmental Liabilities

Environmental liabilities refer to the legal, financial, and operational responsibilities that corporations and individuals bear for the environmental damage caused by their activities. Numerous factors, such as pollution, improper waste management, habitat damage, and disregard for environmental rules and regulations, can result in these liabilities. Fundamentally, a complicated system of national and international laws that hold companies accountable for the environmental effects of their operations governs environmental responsibilities (Environmental Liabilities Best Practices Guide, 2014).

Environmental liabilities come in a variety of forms and can be broadly divided into two categories: civil and regulatory liabilities. When a business disregards environmental laws enforced by the government, regulatory liabilities result. In the United States, organizations such as the Environmental Protection Agency (EPA) frequently impose fines, penalties, or required corrective actions as a result of non-compliance with these obligations. Conversely, civil liabilities occur when environmental destruction leads to lawsuits by private parties, such as nearby towns or environmental advocacy groups, who want to recover losses brought on by corporate malfeasance or negligence. Reputational harm and hefty cash compensation are possible outcomes of these litigations (Environmental Liabilities Best Practices Guide, 2014).

From a business perspective, environmental liabilities extend beyond legal obligations. They are becoming more and more entwined with environmental and corporate social responsibility (CSR) objectives. Businesses are expected to actively reduce their environmental impact in addition to complying with current regulations. This proactive strategy involves reducing pollutants, implementing sustainable resource management techniques, and lowering carbon emissions (International Journal of Corporate Social Responsibility, 2024).

As investors and financial institutions increasingly consider environmental performance in their decision-making, ineffective management of environmental liabilities can result in significant financial risks, including reduced shareholder value, investor divestment, and higher borrowing costs (Environmental Liabilities: Causes & Impact | StudySmarter, n.d.).

These responsibilities also include indirect effects such as damage to reputation and loss of customer confidence. Environmental infractions can cause public outcry in today's globally networked world, which can have long-term financial consequences that go well beyond the original fines imposed by the government.

In today's globally connected society, environmental violations can spark public outrage, which can have long-term financial repercussions that far outweigh the initial fines levied by the government. As environmental accountability becomes an essential component of corporate governance to ensure long-term and sustainable growth, businesses must consider environmental liabilities in their risk management plans (Environmental Liabilities: Causes & Impact | StudySmarter, n.d.).

Strong monitoring programs and regulatory actions are crucial to reducing the catastrophic effects of corporate pollution. Monitoring systems are essential for tracking company adherence to environmental regulations. One example is the Enforcement and Compliance History Online (ECHO) database maintained by the Environmental Protection Agency (EPA). Regulators, legislators, and the general public can learn more about environmental responsibility from ECHO's comprehensive records of inspections, infractions, and enforcement actions. However, the limitations of this systems in terms of speed and scope highlight the need for cutting-edge technologies to support traditional monitoring initiatives.

Emerging satellite technologies have begun to transform the landscape of environmental monitoring, offering real-time and global insights into corporate pollution. For instance, satellites developed by organizations such as GHGSat can track methane emissions from industrial facilities with remarkable precision. These technologies not only enhance transparency but also allow regulatory agencies and non-governmental organizations to identify pollution hotspots and enforce compliance more effectively. As noted by the World Economic Forum, satellite tracking represents a game-changing solution for tackling climate emissions, providing independent and accurate data on industrial pollution (Satellite Tracking Is Helping Scientists Pinpoint the Worst Emissions Offenders, 2024).

The integration of satellite technology with existing platforms like ECHO could significantly strengthen regulatory oversight and improve corporate accountability. This hybrid approach offers the potential for timely detection of violations, enabling faster corrective action and fostering a culture of proactive environmental stewardship among corporations.

At the regulatory level, combining state of the art technologies with conventional enforcement instruments like fines and corrective actions is in line with more general global sustainability objectives. Programs such as the Paris Agreement depend on accurate data to guide global climate policies, highlighting how crucial it is to track progress in meeting environmental protection goals. Companies are required by these regulations to reduce pollution, avoid environmental harm, and, if required, clean up contaminated regions.

Corporate responsibility in environmental issues has broadened beyond only adhering to the law to encompass proactive actions that surpass the bare minimum of regulations. Companies voluntarily adopting sustainable business practices to lessen their environmental impact, such as reducing greenhouse gas emissions, cutting waste, and using renewable energy, is the larger idea of Corporate Social Responsibility (CSR). These initiatives show a change in environmental stewardship from reactive to proactive, with companies trying to meet social norms for ethical governance and sustainability.

2. Corporate Violations

Environmental infractions occur when companies or individuals knowingly or unknowingly violate environmental laws and regulations designed to protect natural resources and ecosystems. These violations can include activities such as illegal dumping of hazardous waste, deforestation without proper permits, unauthorized discharges of pollutants into waterways, and the illegal exploitation of wildlife or their habitats. Negligence, inadequate environmental management systems, cost-cutting strategies, or deliberate disobedience of regulations in the sake of increased profits are frequently the reasons for these infractions.

Because of the nature of their operations and the impact they have on the environment, different industries have quite different sorts of environmental infractions. Common infractions in heavy industry and manufacturing include releasing dangerous pollutants into the atmosphere, such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), or volatile organic compounds (VOCs), in excess of allowed limits for air emissions. Acid rain, climate change, and deteriorating air

quality can all be caused by these emissions. The release of untreated or insufficiently treated effluent into rivers, lakes, or seas is another common infraction in these sectors. This can result in water contamination, which can have an adverse effect on aquatic ecosystems and human health. Usually, operational shortcuts or antiquated infrastructure that doesn't adhere to environmental regulations are the cause of these violations (Alloway & Ayres, 1997).

The incorrect use of fertilizers or pesticides, which can degrade soil, contaminate water, and harm wildlife, is a common cause of environmental infractions in the agriculture sector. Nutrient runoff from overuse of chemicals, such as nitrogen-based fertilizers, can cause eutrophication in surrounding water bodies, where an abundance of nutrients results in algal blooms that destroy marine life and deplete oxygen. Deforestation, the clearing of land for the production of crops or cattle, is another prevalent problem in agriculture that results in habitat damage, biodiversity loss, and elevated carbon emissions (Tilman, Cassman, Matson, Naylor, & Polasky, 2002).

These violations typically indicate systemic shortcomings in the business's environmental management procedures rather than being individual occurrences. Repeated infractions are frequently caused by inadequate staff training, a lack of investment in sustainable technologies, and poor oversight. These problems highlight how crucial regulatory supervision and strong company governance are. Businesses who don't set up thorough environmental compliance programs run the danger of facing fines and long-term harm to their reputation. A proactive strategy is needed to prevent these infractions, which includes integrating cutting-edge monitoring technology, conducting frequent audits, and demonstrating a dedication to ongoing environmental practice improvement (Epstein & Buhovac, 2014).

The process of handling an environmental breach usually starts with detection, which can be done by external regulatory inspections or internal monitoring systems. The firm investigates the infringement internally after it is discovered to determine its extent and seriousness.

Following the identification of the problem, the business must take remedial measures to repair the environmental harm. This could entail cleaning up pollutants, repairing machinery, or updating procedures. External environmental specialists may be hired to handle contamination in cases of major infractions, especially where dangerous materials are involved (U.S. Environmental Protection Agency [EPA], 2023).

Following remediation, the business may be subject to financial and legal repercussions. Fines, penalties, and settlements with the EPA are a few examples of these. The business may occasionally negotiate a Consent Decree that specifies the corrective actions that must be taken over time. Lawsuits from impacted areas could also result in higher financial obligations. Companies usually bolster their compliance processes and personnel training to prevent future violations, and they may designate an Environmental Compliance Officer to supervise long-term regulatory compliance. In order to guarantee future adherence to environmental regulations, improvements are frequently made to monitoring and reporting (U.S. Environmental Protection Agency [EPA], n,d)..

3. The Role of the Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) plays a crucial role in protecting the environment and public health by regulating and enforcing laws aimed at reducing pollution and promoting sustainable practices (Smith & Roberts, 2021). Established in 1970, the EPA is responsible for developing and implementing regulations under environmental statutes passed by Congress, including the Clean Air Act (CAA), Clean Water Act (CWA), and the Resource Conservation and Recovery Act (RCRA), among others (U.S. Environmental Protection Agency [EPA], n,d).

One of the EPA's primary functions is to establish national standards for air quality, water quality, and hazardous waste management, ensuring that industries, businesses, and local governments follow federal environmental regulations. The agency conducts research to analyze environmental problems, develops policies to address these issues, and monitors regulatory enforcement through inspections and penalties for noncompliance (U.S. Environmental Protection Agency [EPA], n,d).

A critical tool supporting these monitoring efforts is the **Enforcement and Compliance History Online (ECHO)** database. ECHO is an online platform that consolidates detailed records of environmental inspections, violations, and enforcement actions. This database enables regulators, researchers, and the public to track compliance across various facilities and companies, ensuring transparency and accountability. The ECHO platform provides data on key environmental statutes such as the Clean Air Act and Clean Water Act, allowing users to evaluate trends in enforcement and compliance at the local, regional, and national levels (Environmental Protection Agency [EPA], 2023). For this research, ECHO data was

instrumental in analyzing corporate violations, linking parent companies to their facilities, and examining patterns of non-compliance.

The EPA also actively participates in cleaning up contaminated areas through the Superfund program, addressing pollution from previous industrial activity, and making polluters liable for clean-up expenditures. Furthermore, the organization aims to prevent future environmental problems by encouraging the use of greener technology and improving energy efficiency. Another key responsibility of the EPA is to provide funds and support to state and local governments, as well as educational initiatives, to assist communities in improving their environmental practices and resistance to climate change. The EPA encourages energy-saving goods and practices through initiatives such as the Energy Star program, helping to minimize greenhouse gas emissions and contribute to national sustainability goals (U.S. Environmental Protection Agency [EPA], n.d).

The agency works in close collaboration with state and tribal governments, environmental organizations, and the private sector to ensure effective enforcement and compliance with environmental laws. The EPA's responsibility goes beyond regulation; it also engages in environmental education and advocacy, creating public awareness about environmental issues and encouraging conservation activities (Anderson et al., 2023).

To ensure compliance, the EPA uses a number of enforcement tools, such as fines, legal settlements, and, in extreme circumstances, criminal prosecution. Civil penalties are a regular result of noncompliance, with the EPA assessing fines based on the severity of the offense, the company's compliance history, and the environmental impact. In some cases, firms may enter into consent decrees, which are legally enforceable agreements in which they conduct corrective activities and pay fines to settle infractions (Anderson et al., 2023)

These orders frequently include detailed action plans to get the corporation back in line with environmental rules. For more egregious offenses, particularly where a corporation intentionally violates regulations or falsifies environmental data, the EPA may pursue criminal charges. This can lead to large penalties, prison sentences for company executives, or both. Furthermore, the EPA may force corporations to perform Supplemental Environmental Projects (SEPs) as part of a settlement. SEPs are voluntary undertakings that go above and beyond the legal requirements to improve the environment or public health. These projects enable businesses to offset some penalties by investing in environmental improvements such

as renewable energy projects, pollution control technologies, or habitat restoration initiatives (U.S. Environmental Protection Agency [EPA], n.d).

The EPA conducts inspections and audits to ensure ongoing compliance, which may be routine or triggered by specific incidents or complaints. Through these enforcement mechanisms, it ensures that companies are held accountable for environmental violations, promoting compliance and encouraging proactive environmental management.

Beyond enforcement, the EPA also plays a proactive role in helping companies improve their environmental performance through compliance assistance programs. These programs offer guidance, training, and resources to help businesses better understand regulatory requirements and develop strategies to meet them.

For example, the EPA's Audit Policy encourages businesses to proactively uncover, disclose, and fix environmental issues, with lower penalties for those that self-report and take corrective action. This policy is intended to foster openness and a culture of compliance inside organizations (Investopedia. n.d.).

The EPA also promotes corporate compliance by developing Environmental Management Systems (EMS). EMS provides a standardized framework for businesses to assess and manage their environmental effect. Businesses that implement EMS frameworks can proactively identify possible hazards, create environmental targets, and regularly analyze their performance to ensure compliance with relevant requirements. The EPA frequently works with businesses to create these systems, assisting them in incorporating environmental concerns into their day-to-day operations (Delmas, M. A., & Toffel, M. W. 2021).

Partnerships with state and municipal governments are an important part of the EPA's role in corporate compliance. While the EPA establishes national guidelines, much of the day-to-day enforcement and supervision falls to state environmental agencies. These collaborations enable more localized and personalized compliance efforts, as state agencies gain a greater understanding of the specific environmental concerns and regulatory needs in their jurisdiction. However, the EPA retains the right to interfere when state agencies fail to sufficiently enforce environmental laws, or when offenses raise interstate or national issues (U.S. Environmental Protection Agency [EPA], n.d).

In recent years, the EPA's involvement in corporate compliance has extended to incorporate Environmental, Social, and Governance (ESG) standards, as investors and consumers demand greater transparency in company environmental performance. The EPA promotes this change by urging businesses to go beyond compliance and implement more environmentally friendly business practices. By increasing transparency through public reporting systems such as the Toxic Release Inventory (TRI) and emissions data disclosure, the EPA assists stakeholders ranging from consumers to investors in making educated decisions regarding a company's environmental effect (Delmas, M. A., & Toffel, M. W, 2021).

4. Financial and Reputational Impacts of Non-Compliance: Literature Review

Non-compliance with environmental standards can have serious financial and reputational ramifications for corporations. The financial consequences frequently begin with direct charges, such as fines, penalties, and clean-up expenses. Fines can go up to millions of dollars, depending on the severity of the infringement, the company's compliance history, and the amount of environmental harm produced.

Companies that violate environmental regulations may suffer severe financial and reputational consequences. The EPA's ECHO database, which keeps account of monetary penalties levied on firms for environmental breaches, details the direct charges, such as fines and penalties, that often initiate the financial repercussions. Cleanup expenditures, however, such those related to ecosystem restoration, remediation, or community compensation, are often excluded from the ECHO database. Estimating these costs frequently necessitates the use of extra data sources or company-specific reporting. Depending on how serious the violation was, how well the corporation has complied, and how much environmental damage was caused, ECHO fines can amount to millions of dollars.

For instance, large firms in the oil and gas or manufacturing industries have been penalized hundreds of millions of dollars for accidents such as oil spills, hazardous waste mismanagement, or illegal emissions. Companies are frequently required to shoulder the costs of rehabilitation in addition to fines. This includes cleaning up contaminated areas, restoring ecosystems, and compensating impacted communities. These repair activities can be complex and time-consuming, increasing the financial strain. Furthermore, enterprises may suffer higher insurance premiums and less access to funding as investors and lenders recognize the increased

risks associated with environmental infractions. The indirect financial consequences can be just as severe, particularly in the form of reputational damage (Xu et al. 2012).

Studies show that Environmental, Social, and Governance (ESG) metrics have become a key consideration for institutional investors, with global ESG assets expected to exceed $50 trillion by 2025 (Bloomberg, 2021). Regulatory bodies such as the U.S. Environmental Protection Agency (EPA) enforce compliance with stringent environmental laws, while customers demonstrate growing preference for sustainable products, as evidenced by a Nielsen report indicating that 73% of global consumers would change their consumption habits to reduce environmental impact (Nielsen, 2019). These trends reflect a broad societal shift towards prioritizing sustainability in both market and regulatory contexts.

Public awareness of environmental issues has increased, and companies that fail to comply with environmental regulations are frequently subjected to negative media coverage and public outcry, which can result in immediate and significant market reactions, affecting a company's stock price, reputation, and investor relationships. When a firm is found to have violated environmental standards, the financial markets often react quickly, with investors selling off shares, resulting in a significant decline in the company's stock price. This first market reaction usually reflects investor concerns about prospective fines, litigation fees, and business disruptions (Wu et al., 2022).

In addition to stock market swings, reputational damage influences market behavior. News of environmental infractions can spread quickly through media coverage, ruining the company's reputation and triggering public outrage. This unfavorable attention can result in consumer boycotts, decreased customer loyalty, and lost brand equity, all of which have financial consequences. Investors tend to react badly to reputational damage, particularly those with short-term market outlooks, which contributes to volatility in the company's stock performance (Anderson-Weir, Charles H, 2010).

Furthermore, the reaction of investors, particularly those who prioritize Environmental, Social, and Governance (ESG) standards, might exacerbate the financial consequences. Noncompliance with environmental rules is frequently interpreted as evidence of weak corporate governance, prompting ESG focused investors to cut or divest their holdings (Hossain et al, 2023).

Companies with a history of infractions may have their ESG ratings downgraded, resulting in considerable divestment from institutional investors, particularly ESG funds. This alteration in investor attitude may have an impact on the company's market valuation and limit its capacity to attract future investment.

Xu et al. (2012) examine the stock market's reaction to the disclosure of environmental violation events (EVEs) in the Chinese market. Using an event study methodology, in order to evaluate how investors react to environmental infractions revealed by companies, the study examines abnormal returns (AR) and cumulative abnormal returns (CAR). The Ministry of Environmental Protection, media reports, and financial data from the CSMAR database were the sources of information for the dataset, which comprises 57 listed businesses from the Chinese stock market in 2010. In contrast to developed markets, the results show that the Chinese market's response to EVEs is comparatively muted, reflecting both a lack of effective enforcement measures and a lower level of investor sensitivity to environmental hazards. This study demonstrates how investor sentiment and local regulatory environments impact market reactions to environmental infractions.

Wu et al. (2022), on the other hand, showed how environmental infractions result in a comparable decline in market returns, but the procedure varies because of China's regulatory framework. Investors in China frequently respond to environmental disclosures with a cautious, protracted sell-off, which is a reflection of worries about the company's long-term financial viability and more stringent government regulation. Wu et al. discovered that higher borrowing costs and limited access to capital exacerbate this decline in stock returns, further undermining the company's valuation. These results highlight that whereas environmental infractions have a major initial impact on returns, they also have long-term repercussions on financial health, which lead to persistent stock underperformance.

Hossain et al. (2023) investigate the reputational costs of corporate environmental underperformance using a unique regulatory setting in China, where financial penalties for environmental violations are relatively small. By employing an event study methodology, the authors examine stock market reactions to public announcements of corporate environmental breaches. The results demonstrate a significant negative stock price reaction following these events, indicating substantial reputational damage despite minimal regulatory fines. Notably, firms with strong voluntary environmental commitments experience less severe market reactions, suggesting that proactive environmental strategies play a role in mitigating

reputational losses. Furthermore, the study highlights the moderating effects of ownership structure, showing that state- and foreign-owned firms face different levels of reputational consequences. These findings underscore the importance of voluntary environmental strategies in managing stakeholder expectations and preserving corporate reputation in emerging markets.

Referring to the studies above, which highlight how environmental violation disclosures significantly impact companies' stock performance across various global markets, it is evident that much of the existing research has concentrated on the chinese market. Building on this foundation, we propose a hypothesis specifically focusing on the US market, where the interplay between environmental violations and stock performance remains an area ripe for further investigation.

Hypothesis 1: There is a direct negative impact of the announcement of environmental violation in the U.S. market on companies' stock return.

This hypothesis aims to investigate whether and how quickly the U.S. market reacts to such disclosures and to quantify the potential decline in stock returns immediately following the announcement, reflecting investor sentiment and risk assessment specific to environmental non-compliance.

In recent years, researchers have increasingly sought to understand the corporate factors that may exacerbate the negative impact of environmental violations on a company's Cumulative Abnormal Returns (CAR). While prior research has established that violations of environmental laws typically lead to negative CAR, there is a growing body of work examining how various corporate characteristics such as penalty severity, corporate governance, and prior reputation can influence the magnitude of the negative stock price reaction.

A central theme in the literature is the role of penalties (both financial and legal) associated with environmental violations in determining the extent of CAR. Numerous studies have found that firms subject to larger penalties for violations tend to experience a more significant decline in stock price. For example, the work of Xu et al. (2012) suggests that violations leading to heavy fines or corrective actions result in greater abnormal returns (AR) losses, as investors factor in the potential future liabilities and the financial burden of complying with regulatory demands. This finding is consistent with the broader literature on financial penalties, where the

anticipated costs of litigation, remediation, and future regulatory scrutiny have been shown to negatively affect firm valuation.

The severity of penalties may signal to investors that the company has not only violated environmental regulations but also that its management may be incapable of preventing such issues, thus increasing perceived operational and reputational risks. As a result, stockholders may reassess their expectations regarding the firm's future profitability, leading to a more pronounced negative impact on CAR. In extreme cases, this can also lead to liability concerns, which include both legal costs and reputational damage, further depressing stock returns.

Referring to this, we propose a second and deeper hypothesis.

Hypothesis 2:

The severity of environmental penalties negatively impacts Cumulative Abnormal Returns (CAR) following the announcement of an environmental violation.
This hypothesis posits that companies facing more substantial penalties due to environmental violations experience a greater negative CAR, as market reaction.

Notably, this concept emphasises how environmental penalties affect Cumulative Abnormal Returns (CAR); yet, the timing of information disclosure is crucial. The timing of the announcements may affect how the financial markets respond. For example, investors may change their expectations sooner if the environmental breach is made public before the formal penalty announcement. The revelation of the penalties themselves, however, frequently introduces a degree of "surprise," especially when the actual fines differ from what the market had anticipated. CAR fluctuations are directly impacted by this surprise, whether it is favourable or negative. In order to comprehend and analyse the financial market's response to environmental infractions, it is crucial to differentiate between earlier media coverage and the official penalty announcement.

Chapter II: Data Collection and Statistical Overview

This chapter examines the process of constructing a dataset to analyze the financial market's reaction to corporate environmental violations. data on EPA enforcement cases specific to the U.S. market. The chapter begins with an explanation of the data collection process and sources, followed by a presentation of key descriptive statistics and variables. It then outlines the sample selection process and details the methodology used to collect stock market data and conduct an event study. Finally, it concludes with a discussion of statistical testing to assess the market's response to environmental violation disclosures.

1. Data Collection Process and Data Sources

Drawing inspiration from studies that utilized the U.S. Environmental Protection Agency's (EPA) Enforcement and Compliance History Online (ECHO) database, such as Lel (2023), which analyzed enforcement actions to assess their impact on CEO labor market outcomes, we extracted data on civil, judicial, and administrative federal enforcement cases to construct a comprehensive database. Lel (2023) effectively used the ECHO database to link detailed enforcement information, such as violations and penalties, with corporate governance outcomes, highlighting the broader implications of regulatory actions. Similarly, our database contains specific information on inspections, violations, and enforcement actions under key environmental rules, providing valuable insights into corporate compliance and enforcement patterns.

This data enables us to record pertinent information such as firm names, facility locations, violation kinds, enforcement actions, and penalty amounts, as well as compliance and mitigation expenses at the facility level. The dataset also contains data from the Toxics Release Inventory (TRI), which provides extensive coverage of environmental compliance at the plant level (U.S. Environmental Protection Agency [EPA], 2023).

We use the EPA's Facility Registry Service (FRS) connection file to aggregate enforcement data at the parent business level, connecting specific facilities to their respective parent firms. This allows for a broader evaluation of corporate-level environmental behavior, even while enforcement efforts are focused on single sites.

Once aggregated, we match this data with financial information from Refinitiv, allowing the creation of a comprehensive regression sample that examines both environmental violations

and their financial impacts on the parent companies. Refinitiv provides data on stock prices, accounting and financial data, and ESG (Environmental, Social, and Governance) scores, enabling a deeper analysis of how violations affect corporate valuation and market behavior.

2. Descriptive Statistics and Data Variables

2.1. Key variables of EPA's ECHO database

Numerous crucial variables found in the EPA's ECHO database offer comprehensive details on environmental enforcement cases. To keep track of and refer to certain acts during the course of the investigation and settlement process, each case is given a unique Case Number. The case name identifies the business or establishment in question and frequently provides a synopsis of the infraction.

Depending on the enforcement authority and the seriousness of the infraction, Case Category makes a distinction between administrative, judicial, and criminal measures. Criminal cases deal with more serious infractions that can result in fines or jail time, judicial cases are formal lawsuits filed in court, and administrative cases are non-judicial actions taken by the EPA or other agencies, such as administrative orders or notices of violation.

Based on the most recent milestone activity, the Case Status Description shows the present state of each civil enforcement action. While the Settlement Date denotes the moment a settlement is reached and becomes enforceable, the Date Filed indicates the actual start of the enforcement action, whether it is court or administrative.

The Federal Penalty, excluding sums shared with state entities or lessened by SEPs, is the monetary penalty imposed in a civil judicial or administrative enforcement action for each case. The term "SEP Cost" is the financial investment made by a business in a voluntary Supplemental Environmental Project that is carried out as part of a settlement to improve the environment.

Lastly, the Value of Complying Actions represents the costs a defendant incurs to meet legal obligations and restore compliance, excluding penalties and costs associated with SEPs. This comprehensive data offers a clear picture of the nature, progression, and financial impact of each enforcement case (U.S. Environmental Protection Agency [EPA], 2023).

2.2. Dataset description

We created a dataset of environmental enforcement actions recorded in the fiscal years 2022, 2023, and 2024, obtaining 10,714 recorded cases.

Table 1: Case Category Statistics

	Administrative - Formal	Judicial	Criminal	Total
Number	10048	546	119	10713
Percentage	93.79258844	5.096611593	1.110799963	100

Notes: This table presents a breakdown of cases based on their category: Administrative - Formal, Judicial, and Criminal. The "Number" row shows the total count of cases in each category, while the "Percentage" row provides the proportion of each category relative to the total number of cases.

In terms of Case Category as in **Exhibit 1** pie chart, the vast majority, 94%, were Administrative Cases (10,048), while 5% were Judicial Cases (546), and 1% were criminal cases (119). This highlights the dominance of non-judicial enforcement actions in this dataset.

Table 2: Case Status Statistics

	Number	Percentage
Closed	6394	60.98
Final Order Issued	3589	34.23
Final Order Lodged	35	0.33
Final Order Entered	310	2.96
Demand for Stipulated Penalties	32	0.3
Complaint Filed	53	0.51
Compliance Achieved	23	0.21
Complaint Filed/AO Issued	50	0.48
Total	**10486**	**100**

Notes: This table provides an overview of the distribution of cases based on their current status. The "Number" column represents the count of cases in each status category, while the "Percentage" column shows the proportion of each status relative to the total number of cases (10,486).

Exhibit 2 shows that the majority of cases, 60.98% (6,394 cases)**,** were Closed**,** followed by 34.23% (3,589 cases) with Final Orders Issued.

Table 3 : Primary Law Violation Statistics

	Number	Percentage
CWA	2333	21.93
CERCLA	503	4.73
CAA	1228	11.54
EPCRA	211	1.98
RCRA	831	7.81
TSCA	498	4.68
FIFRA	3910	36.76
AIM	46	0.43
SDWA	1077	10.13
Total	10637	100

Notes: This table summarizes the distribution of environmental violations based on the primary laws under which the violations occurred. The "Number" column indicates the total number of violations for each law, while the "Percentage" column represents the proportion of violations relative to the total (10,637 cases).

The top three categories Pesticide (FIFRA), Clean Water Act (CWA), and Clean Air Act (CAA) represent the most significant contributions to violations, while other laws are comparatively minor in terms of proportion as highlighted in **Exhibit 4.**

Table 4 : Federal Penalty Statistics

Ranges	Number
0	6782
0-1,000	369
1,000-10,000	1254
10,000-100,000	1188
100,000-1,000,000	670
1,000,000-10,000,000	74
10,000,000-100,000,000	12
More than 100,000,000	3
Total	**10352**

Notes: This table categorizes federal penalties imposed for violations into various monetary ranges, showing the number of cases within each range. The "Ranges" column lists penalty brackets, while the "Number" column represents the total count of penalties issued within each bracket, summing up to 10,352 cases in total.

The dataset also provides a breakdown of Federal Penalties. **Exhibit 4** Histogram chart shows that the majority of cases (6,782) incurred zero penalties. Exhibit 4 reveals a sharp decline in cases as penalties increase, with the bulk concentrated in the lower ranges.

Table 5: Value of Complying Actions Statistics

Ranges	Number
0	5807
0-1,000	1275
1,000-10,000	1609
10,000-100,000	791
100,000-1,000,000	383
1,000,000-10,000,000	488
10,000,000-100,000,000	154
More than 100,000,000	68
Total	**10575**

Notes: This table provides a breakdown of the monetary value associated with complying actions undertaken in response to violations, categorized into various ranges. The "Ranges" column specifies the monetary brackets, while the "Number" column indicates the total count of complying actions within each range, summing up to 10,575 actions in total.

Similarly, in **Exhibit 5** Histogram chart, the Value of Complying Actions is categorized by monetary ranges. Most actions (5,807 cases) incurred zero cost.

3. Sample Characteristics

3.1. Sample Selection Process

We started by filtering data from the EPA's ECHO database to produce a targeted dataset for examining how the financial market responded to environmental breaches. In this first step, instances from EPA Region 09 as my sample, due to its unique combination of environmental challenges, regulatory significance, and diversity. The region encompasses diverse ecosystems, including coastal areas, deserts, and islands, each facing distinct environmental issues such as water scarcity, air pollution, and climate change impacts like wildfires and rising sea levels. Additionally, Region 9 is a leader in environmental governance, with California's strict environmental laws serving as a model for the U.S. The region's emphasis on environmental justice, particularly regarding underserved communities and Native American tribes, further underscores its importance.

In terms of time frame, fiscal years 2022, 2023, and 2024 were chosen. We limited the sample to cases with available federal fines, but still included all case kinds and categories. After this initial filtering, 247 cases were found in the dataset.

3.2. Linking Parent Companies and Publicly Traded Firms

Using the EPA's Facility Registry Service (FRS) link file, which links specific facilities to their parent businesses, we then connected the violations to the corresponding parent companies. This connection was established by selecting companies' data corresponding to the settlement date of the violations, ensuring alignment between the timing of the violations and the companies' status as either privately held or publicly traded.

We noted the ticker symbols and stock exchanges (such as NYSE and NASDAQ) where publicly traded corporations were listed. Following this step, we identified 53 publicly traded companies in the dataset, of which 38 were listed on American stock exchanges as shown in **Exhibit 6 and 7** pie charts.

Exhibit 8 shows that in the final sample of 38 publicly traded companies on the American stock exchange, the majority of violations are under the Clean Air Act (34.21%) and Resource Conservation and Recovery Act (34.21%), focusing on air emissions and hazardous waste.

The Clean Water Act and Safe Drinking Water Act each account for 10.53%, while pesticide (FIFRA) and toxic substances (TSCA) violations are less common at 7.89% and 2.63%, respectively. This distribution underscores air quality and hazardous waste as the most prevalent compliance challenges in the sample.

3.3. Market Reaction Data Collection

We used the Refinitiv Eikon database to get stock return information for each of the 38 companies analyzed for the financial market research. For the time period beginning 100 days prior to the violation announcement (D=-100) and ending 10 days following the news (D=+10), we obtained daily stock returns. In order to provide a market benchmark, we also gathered the returns of the S&P 500 index for the same time frame.

An Excel file containing the gathered data was arranged using columns for Company returns, which were determined using each company's daily stock price and market returns, as determined by the S&P 500 index's daily prices.

3.4 Event Study Methodology

We assessed the financial market's reaction to environmental infractions using Stata software. In order to quantify the effect of particular events on stock prices, we used an event research methodology, which is popular in the finance industry. Calculating normal returns and predicting abnormal returns during the event window were the two primary steps in the analysis process.

Normal returns are the anticipated profits a business would make in a normal market, without the impact of environmental violations. The market model that links the company's stock returns to overall market performance represented by the S&P 500 index was used to estimate these returns in the estimation period: From date -100 to date -10.

$$\mathbf{R_i = \alpha + \beta R_m + \epsilon}$$

Where:

R_i : the return on the asset (i) that you are analyzing.

R_m : the return on the market or market index (e.g., S&P 500).α\alpha : the intercept term (also called alpha), representing the excess return of the asset not explained by the market movements (also known as "alpha" in asset pricing models).

β\beta : the beta of the asset, which measures the asset's sensitivity to overall market returns. A higher beta means the asset moves more in line with the market.

ϵ\epsilon : the error term, accounting for the part of the asset's return not explained by the market return.

The model assessed how much of the company's stock return could be explained by normal market fluctuations, allowing us to predict what the returns would have been in the absence of the violation.

The difference between the expected normal returns and the observed stock returns within the event window and the time frame surrounding the violation announcement is known as abnormal returns. This discrepancy illustrates the particular effect of the infraction on the stock performance of the company. With day 0 as the announcement date, the event window was defined as the five days prior to and five days following the violation announcement.

$$\mathbf{AR_t = R_t - E(R_t)}$$

Where:

$\mathbf{AR_t}$: Abnormal return on day t

$\mathbf{R_t}$ **:** Observed (actual) return on day t

$\mathbf{E(R_t)}$ **:** Expected return on day t

We determined the Cumulative Abnormal Returns (CAR) by adding the abnormal returns for every day throughout the event time frame. This metric gives a general idea of how much the violation news caused the company's stock price to diverge from typical market activity.

$$\mathbf{CAR}\ (t_1, t_2) = \sum_{t=t_1}^{t_2} \mathbf{AR}$$

Where:

$\mathbf{CAR[t_1,t_2]}$ **:** Cumulative Abnormal Returns over the event window from day t1 to day t2.

$\mathbf{AR_t}$ **:** Abnormal return on day t.

$\mathbf{t_1}$ and $\mathbf{t_2}$ are the starting and ending days of the event window (e.g., day -5 to day +5, where day 0 is the violation announcement).

3.5 Statistical Testing

We performed statistical tests to see whether the abnormal returns and cumulative abnormal returns means were significantly different from zero. The purpose of these tests was to ascertain whether the stock price responses during the event window were significant enough to suggest that the environmental infractions had a significant impact on the market. The market may have responded to the violation notification by influencing the company's stock price if the anomalous returns deviated sufficiently from zero.

With a special emphasis on stock market performance in reaction to regulatory non-compliance, this research sheds light on the immediate financial effects of environmental infractions on publicly traded corporations.

CHAPTER III: Results and Analysis

Building upon the data collection and methodology established, and utilizing event study analysis and regression modeling, we delve in this chapter into the financial market's reaction to corporate environmental violations, analyzing stock performance around the announcement dates. By examining abnormal returns (AR) and cumulative abnormal returns (CAR) over two event windows, it explores both immediate and prolonged investor responses. The chapter further investigates the factors influencing these reactions, such as the severity of penalties, company size, and other financial and environmental characteristics, offering a deeper understanding of how markets respond to environmental non-compliance.

1. Event Study Analysis

The results of our event study analysis, which attempts to assess how the stock market reacts to notifications of environmental violations, are shown in this section. The abnormal returns (AR) and cumulative abnormal returns (CAR) around the announcement date are calculated for each firm.

Two distinct event windows are used in our analysis to record both short-term and long-term stock market reactions:

Event Window for 5 Days around the event [-5, +5]: By recording quick investor adjustments in the days leading up to and following the announcement, this condensed window aids in our understanding of the first market shock.

10-Day Event Window [-10, +10]: By extending the window, we can see if there are any long-lasting repercussions or delayed market reactions, which helps us better comprehend how these announcements will affect stock returns in the long run.

1.1. Return Analysis

Variations in daily returns around the announcement date are depicted in the graph of the Return Curve in **Exhibit 9** for the event period. Starting from day -5, the return curve shows a slight upward trend, peaking around day -3. At day 0, the market briefly increases, reflecting initial uncertainty or mixed investor reactions. However, immediately following the announcement, a sharp decline occurs, highlighting market concerns over the financial and

reputational consequences of the violation. Despite minor recovery attempts after day 3, the returns remain below baseline, indicating persistent negative sentiment.

1.2. Abnormal Return Analysis

The Abnormal Return Curve **in Exhibit 10** shows deviations from expected returns over the event period, it reflects a significant decline on day 1, indicating the immediate negative market reaction to the announcement of the environmental violation. This drop highlights investor concerns regarding potential costs and reputational risks. While fluctuations occur in the days following the event, the curve remains negative overall, indicating sustained market apprehension about the company's future performance.

1.3. Event Study Results and Significance Testing

To statistically validate these observations, one-sample t-tests were conducted on both the abnormal returns (AR) and cumulative abnormal returns (CAR) to test if they are significantly different from zero over the selected windows. The results are as follows:

5-Day Event Window Results

In the [-5, +5] day event window, we conducted two t-tests:

Abnormal Returns (AR) shown in Exhibit 11: The mean abnormal return was calculated at **-0.0071**. With a t-value of **-3.42** and a p-value of **0.0007**, the results are statistically significant. The negative mean abnormal return indicates that, on average, companies experienced a drop in stock returns around the time of the environmental violation announcement. This statistically significant result suggests that investors react to these announcements, adjusting their valuation of the company based on anticipated costs and potential risks.

Cumulative Abnormal Returns (CAR) shown in Exhibit 12: We also examined the cumulative abnormal return over this event window, which combines the daily ARs into an overall measure. The mean CAR for this window was **-0.0776,** with a t-value of **-3.85** and a p-value of **0.0001**. The significant negative CAR further emphasizes that the market response to environmental violations extends beyond a single day. This sustained negative reaction suggests a market response, as investors likely consider both direct costs (such as fines and clean-up expenses) and indirect consequences (such as reputational damage) when valuing the affected companies.

10-Day Event Window Results

Expanding the analysis to a [-10, +10] day window provides insights into the longer-term impact of the announcements:

Cumulative Abnormal Returns (CAR2) shown in Exhibit 13: In this broader window, the mean cumulative abnormal return was **-0.12**. With a t-value of **-4.24** and a p-value of **0.0000**, the results are highly significant. This prolonged negative CAR indicates that the impact of environmental violation announcements lingers well beyond the immediate event, affecting investor sentiment and market valuations over an extended period.

This finding reinforces the hypothesis that the market not only reacts immediately to such announcements but also continues to account for the potential financial and reputational consequences of non-compliance with environmental regulations.

The market responded clearly and significantly to the announcement of environmental infractions, according to the results from both event periods. A persistently negative CAR in the days after the news, along with the initial decline in abnormal returns, indicates that investors believe these infractions will materially harm the company's prospects going forward.

2. Model Analysis: The determinants of cumulative abnormal returns

This section examines the direct impact of environmental violations on stock returns, focusing on how specific financial and environmental variables influence cumulative abnormal returns (CAR) following the announcement of an environmental violation. The objective is to identify which factors have a statistically significant effect on CAR, shedding light on the financial consequences for companies after disclosing environmental infractions. Using multiple regression analysis, we aim to understand the relationship between CAR and a selection of financial, market, and environmental variables that may influence investor sentiment and market behavior.

The analysis begins with a review of descriptive statistics, providing insight into the range and distribution of the variables included in the model. Next, to ensure that each predictor adds distinct information to the model, a correlation matrix is then shown to check for multicollinearity among independent variables. The findings of the regression analysis show how each variable affects CAR separately, providing a more nuanced view of how elements

like the severity of the penalty, the company's financial situation, its position in the market, and its environmental performance influence market reactions. These findings provide important new information about how investor sentiment, business financial metrics, and regulatory fines interact in response to environmental infractions.

2.1. Model Equation

Referring to the literature review of hypothesis 2, the regression model applied in this study is designed to measure the effect of selected variables on CAR, formulated as follows:

$$\mathbf{CAR_i = \alpha + \beta_1 \cdot logpenalties_i + \beta_2 \cdot roa_i + \beta_3 \cdot leverage_i + \beta_4 \cdot logmarketcap_i + \beta_5 \cdot envscore_i + \epsilon_i}$$

Where:

- CAR_i: Cumulative abnormal return for company i, the dependent variable reflecting market response to the environmental violation.
- α: Intercept term.
- β_1, β_2, β_3, β_4, β_5: Coefficients estimating the impact of each predictor variable.
- ϵ_i: Error term representing unobserved influences for company i.

2.2. Variables

In this model, variables are divided into **dependent** and **independent** categories, representing different aspects of corporate financial performance, company size, profitability, and environmental governance.

2.2.1 Dependent Variable

Cumulative Abnormal Return (CAR): It quantifies the sum of the abnormal returns during the event window surrounding the announcement of an environmental violation, capturing the stock market's response relative to normal performance.

2.2.2 Independent Variables

logpenalties: This variable represents the natural logarithm of financial penalties imposed due to the environmental violation. Log order to ensure proportional representation in the model, log transformation aids in managing the penalty scale. Serious infractions may be indicated by higher penalties, which could have a bigger detrimental effect on CAR.

ROA (Return on Assets): As a gauge of a company's financial health, ROA calculates profitability in relation to its assets. Because profitability tends to reassure investors, companies with higher ROA may see a less negative market response to infractions.

Leverage: This variable gives information about financial risk by comparing the company's debt to equity. Leveraged businesses may seem more susceptible to financial strain from fines and penalties, which could intensify unfavorable reactions in cases of environmental infractions.

logmarketcap (Log of Market Capitalization): This variable represents the logarithm of the company's market capitalization, reflecting company size. Larger firms may have more resources to mitigate reputational damage, which could moderate market responses to violations compared to smaller firms.

Envscore (Environmental Score): This score evaluates a company's environmental, social, and governance (ESG) performance, focusing on environmental aspects. A higher environmental score indicates proactive environmental practices, which may positively influence investor perception and partially offset negative impacts of violations.

2.3. Empirical Results

2.3.1. Statistical Description

Table 6: Regression Model Summuary Statistics

Variables	Mean	Median	St. deviation	Minimum	Maximum
car	0.0805	0.0768	0.068	-0.058	0.235
logpenalties	10.793	11.146	2.89	6.669	19.008
roa	0.0453	0.055	0.126	-0.638	0.222
leverage	1.57	0.989	6.897	-15.288	39.489
logmarketcap	23.42	23.99	1.798	18.281	26.687
envscore	10.979	11.5	6.250	1.2	20.8

Notes: This table presents the summuary statistics of the key variables of the model. Each variable is described using its mean, median, standard deviation, minimum, and maximum values to provide a clear understanding of its distribution and variability.

In this study, the variables were summarized using their mean, standard deviation, minimum, and maximum values to provide a comprehensive overview of the dataset. The cumulative abnormal return (CAR), which represents the main dependent variable, exhibited a mean of

0.0805 and a standard deviation of 0.068, with values ranging from -0.058 to 0.235 shown in **Exhibit 14**.

2.3.2. Correlation Matrix

Table 7: Correlation Between Explanatory Variables

	car	logpealties	roa	leverage	logmarketcap	envscore
car	1					
logmarketcap	0.2312	1				
leverage	0.1243	0.1796	1			
roa	-0.0660	0.0958	0.1744	1		
logpenalties	-0.0681	0.1907	-0.1325	0.2168	1	
envscore	-0.2702	-0.4432	-0.1902	-0.2840	-0.02773	1

Notes: This table presents the correlation matrix between the variables used in the regression analysis, including cumulative abnormal return (CAR), log penalties, ROA, leverage, log market capitalization, and environmental score.

The correlation matrix shown in the table above empirically highlight the relationships among the variables used in this analysis, including cumulative abnormal return (CAR), log penalties, ROA, leverage, log market cap, and environmental score shown in **Exhibit 15.**

CAR and Log Penalties: The correlation between CAR and log penalties is -0.0686, indicating a negative relationship, as a preliminary result confirming hypothesis 2 shown in **Exhibit 16**.

Overall, these low correlation coefficients (lower than 0.5) confirm the absence of multicollinearity among the variables in this dataset. According to this empirical data, each independent variable makes a distinct contribution to the model without having overlapping effects.

2.3.3. Regression Results

Table 8: Model Regression Results Using OLS Estimation.

Variables	car	P-Value
logpenalties	-0.00852	0.036**
roa	0.4019	0.091*
leverage	-0.00039	0.789
logmarketcap	0.0228	0.013**
envscore	0.00052	0.775
Constant	-0.413	0.048
R-squared	0.4164	
Prob > F	0.0221	

Notes: This table presents regression results examining the impact of various corporate characteristics on cumulative abnormal returns (CAR) following announcements of environmental violations. p-values are reported alongside coefficients, with *, **, and *** indicating statistical significance at the 10%, 5%, and 1% levels, respectively.

Log penalties has a significant negative impact on CAR, with a negative coefficient of -0.0852 (p-value = 0.036). This implies that higher penalties imply lower cumulative abnormal returns, indicating that investors are sensitive to the severity of financial penalties levied on businesses for environmental infractions.

Log market cap is also found to significantly affect CAR, with a positive coefficient of 0.0228 (p-value = 0.013). This suggests that investors may view larger organizations as more resilient to environmental infractions due to their financial strength and market position, as larger companies, reflected by higher market capitalisation, tend to incur less negative or even positive CAR.

ROA (Return on Assets), with a coefficient of 0.4019 and a p-value of 0.091, shows a positive but only marginally significant relationship with CAR. This suggests that companies with higher profitability, as measured by ROA, may experience less negative or slightly positive abnormal returns following announcements of environmental violations. The result implies that more profitable firms might be better positioned to absorb financial shocks associated with penalties or violations, potentially reducing the negative perception among investors.

However, the coefficients associated leverage and environmental score are not significant, suggesting that the market reaction do not take into account corporate financial or environmental performance.

We can conclude that when a company commits an environmental violation, the market reacts negatively. Investors perceive it as bad news, which immediately impacts the stock return. This reaction is more pronounced when the penalty is higher but is mitigated for the larger and the more profitable companies.

CONCLUSION

The primary objective of this study is to investigate the impact of corporate environmental violations on stock returns in the U.S. market, focusing on the market's response to the disclosure of such violations. By using an event study methodology, this research examines the immediate financial effects of EPA enforcement actions and assesses whether environmental violations have a significant impact on shareholder value. The results reveal that the announcement of environmental violations results in a notable negative market reaction, with cumulative abnormal returns (CAR) showing a significant decline following the disclosure of violations.

The results highlight the significant role of penalty severity in shaping market reactions to corporate environmental violations. Higher financial penalties are associated with more pronounced declines in cumulative abnormal returns (CAR). This suggests that investors perceive such penalties as a signal of increased financial strain and operational risk, adjusting their valuations accordingly. Penalties represent not only immediate costs, such as fines and legal fees, but also potential long-term consequences, including remediation expenses and stricter regulatory oversight. These findings underscore the importance of regulatory enforcement mechanisms in influencing investor sentiment and shaping corporate accountability.

Additionally, the analysis reveals that company size mitigates the negative impact of environmental violations on stock returns. Larger firms experience smaller declines in CAR, likely due to their greater financial resilience, diversified operations, and stronger market positions, which reassure investors of their ability to absorb the financial shock. On the other hand, smaller firms, with fewer resources and lower market visibility, are more vulnerable to reputational and financial consequences. Interestingly, while size plays a mitigating role, profitability though marginally significant also emerges as a factor that can reduce the market's adverse response. Firms with higher profitability appear better equipped to manage the financial implications of penalties, which helps stabilize investor confidence.

Overall, by offering empirical data on the monetary repercussions of environmental infractions, this study adds to the body of knowledge on environmental governance. The results demonstrate how important environmental responsibility is becoming to business strategy and market performance. Businesses must understand the financial risks associated with

environmental misconduct and take proactive measures to align their operations with sustainable standards as global legislative frameworks continue to change and investors demand more transparency on environmental issues. Future research could further explore the long-term effects of environmental violations on firm performance, as well as the broader implications for corporate reputation and investor behavior in the context of the growing emphasis on ESG factors.

APPENDIX :

Exhibit 1: Case Category Statistics

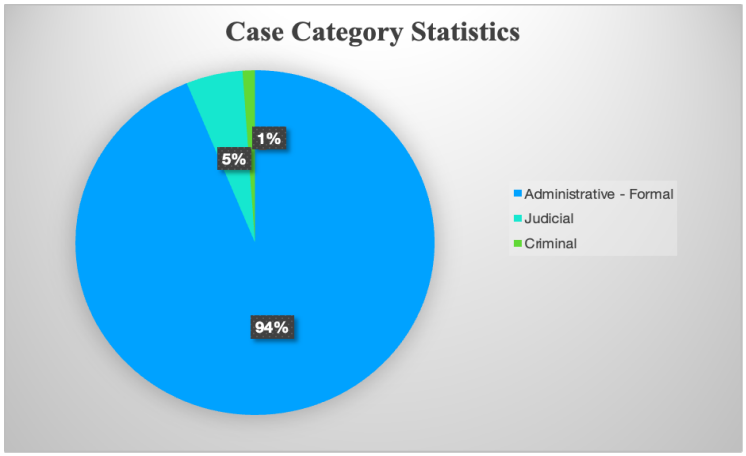

Exhibit 2: Case Status Statistics

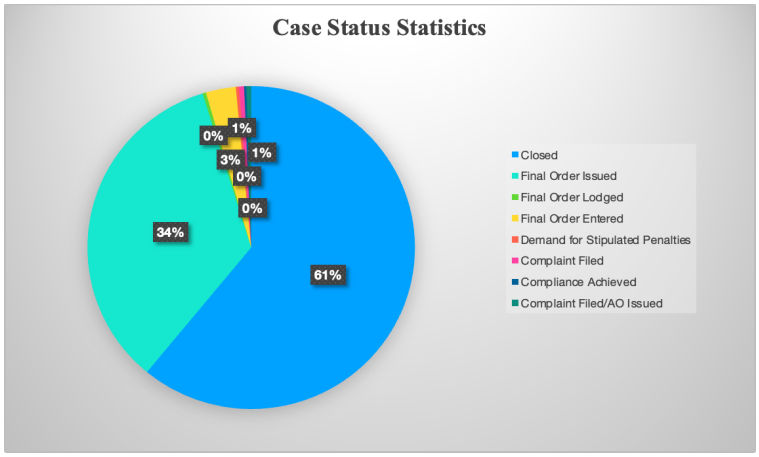

Exhibit 3 : Primary Law Violation Statistics

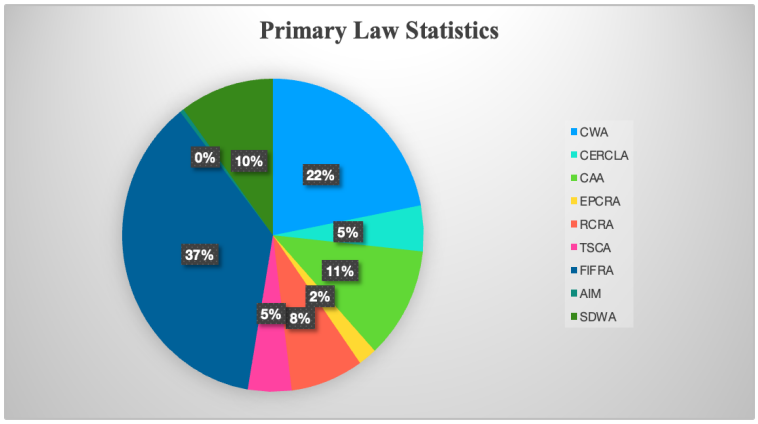

Exhibit 4 : Federal Penalty Statistics

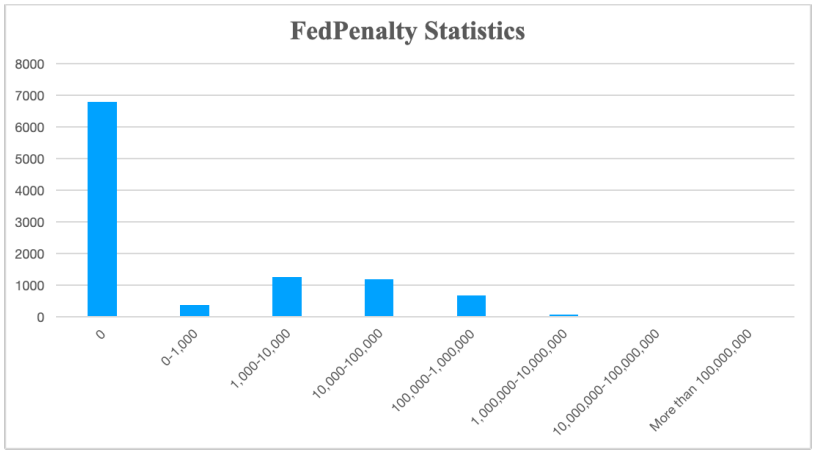

Exhibit 5: Value of Complying Actions Statistic

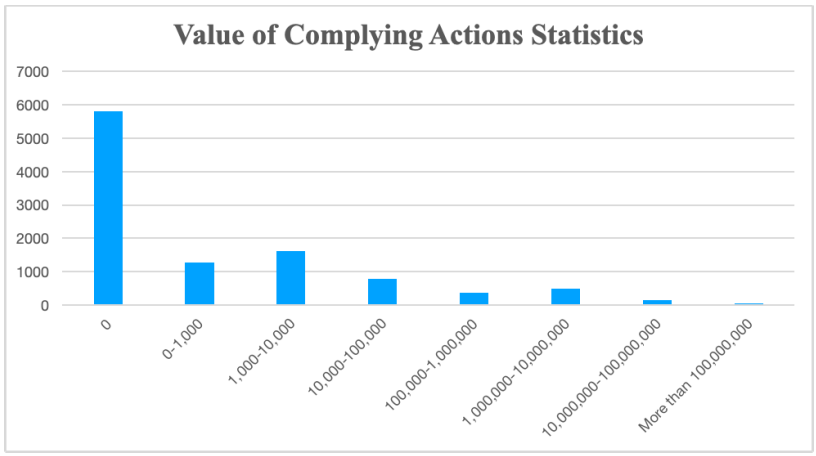

Exhibit 6 : Companies Status Statistics

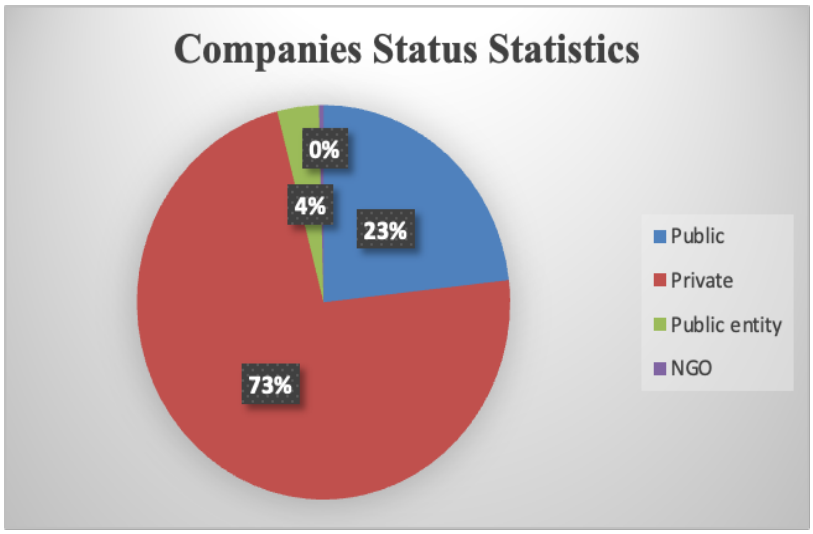

Exhibit 7: Stock Exchange Statistics

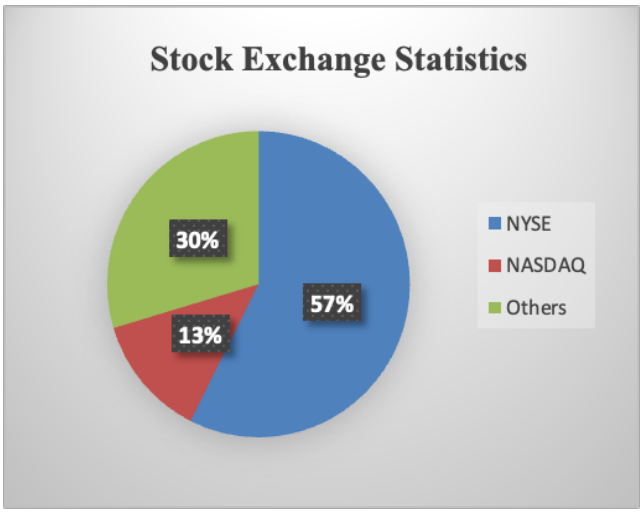

Exhibit 8: Primary Law Violation Sample Statistics

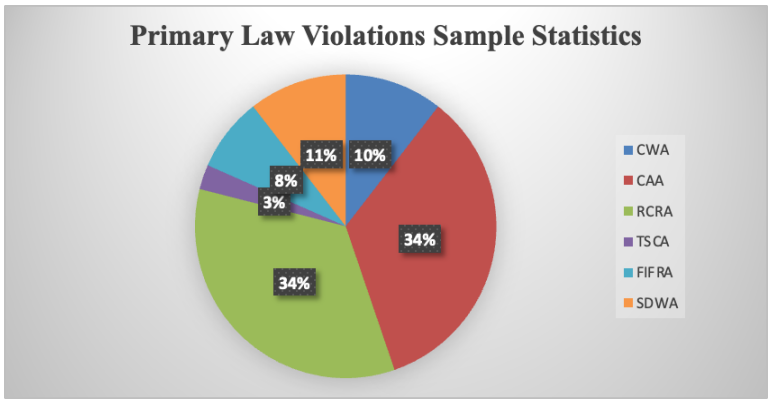

Exhibit 9: Return Curve On the Event Period

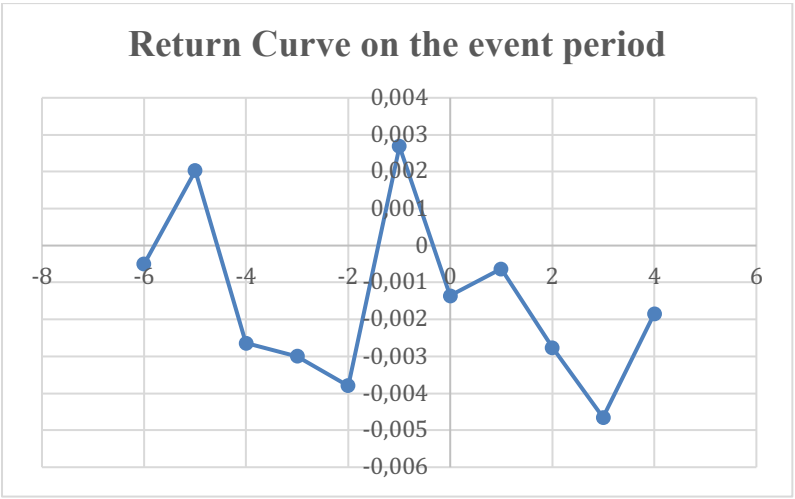

Exhibit 10: Abnormal Return On the Event Period

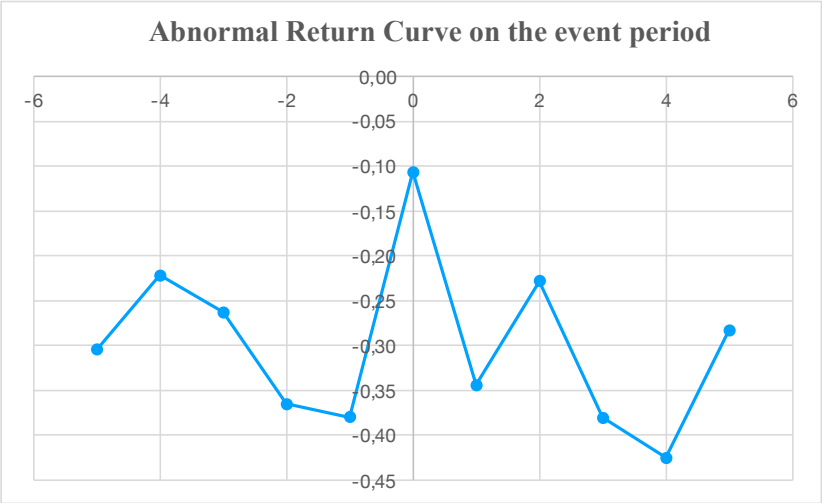

Exhibit 11: One-Sample t-Test Results for Abnormal Returns (AR) During the Event Window

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      ra |     462   -.0070567    .0020645    .0443744   -.0111137   -.0029997
------------------------------------------------------------------------------
    mean = mean(ra)                                           t =  -3.4181
Ho: mean = 0                                     degrees of freedom =      461

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
 Pr(T < t) = 0.0003         Pr(|T| > |t|) = 0.0007          Pr(T > t) = 0.9997
```

Exhibit 12: One-Sample t-Test Results for Cumularive Abnormal Returns (CAR) During the Event Window

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
     CAR |     462   -.0776238    .0201874    .4339108   -.1172945   -.0379532
------------------------------------------------------------------------------
    mean = mean(CAR)                                          t =  -3.8452
Ho: mean = 0                                     degrees of freedom =      461

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
 Pr(T < t) = 0.0001         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 0.9999
```

Exhibit 13: One-Sample t-Test Results for Cumulative Abnormal Returns (CAR2) During the Extended Event Window

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
    CAR2 |     882   -.1199807    .0282979    .8404051   -.1755199   -.0644416
------------------------------------------------------------------------------
    mean = mean(CAR2)                                             t =  -4.2399
Ho: mean = 0                                     degrees of freedom =      881

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Exhibit 14: Regression Model Summuary Statistics

```
    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
         car |         38    .0805803    .0678493  -.0584532   .2350353
logmarketcap |         37    23.41963    1.798187   18.28142   26.68677
    leverage |         38    1.570712    6.897363  -15.28882   39.48962
         roa |         38    .0453397    .1265042  -.6384008   .2221031
logpenalties |         38    10.79353    2.890183   6.669498   19.00847
-------------+---------------------------------------------------------
    envscore |         29    10.97931    6.250222        1.2       20.8
```

Exhibit 15 : Correlation Between Explanatory Variables

```
             |      car logmar~p leverage      roa logpen~s envscore
-------------+------------------------------------------------------
         car |   1.0000
logmarketcap |   0.2312   1.0000
    leverage |   0.1243   0.1796   1.0000
         roa |  -0.0660   0.0958   0.1744   1.0000
logpenalties |  -0.0681   0.1907  -0.1325   0.2168   1.0000
    envscore |  -0.2702  -0.4432  -0.1902  -0.2840   0.0273   1.0000
```

Exhibit 16 : Regression Model Summuary Statistics

```
      Source |       SS           df       MS      Number of obs   =        29
-------------+----------------------------------   F(5, 23)        =      3.28
       Model |  .043554908         5  .008710982   Prob > F        =    0.0221
    Residual |  .061042968        23  .002654042   R-squared       =    0.4164
-------------+----------------------------------   Adj R-squared   =    0.2895
       Total |  .104597876        28  .003735638   Root MSE        =    .05152

------------------------------------------------------------------------------
         car |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
logmarketcap |   .0227735    .008492     2.68   0.013     .0052064    .0403406
    leverage |  -.0003923   .0014494    -0.27   0.789    -.0033907    .0026061
         roa |   .4018887    .227896     1.76   0.091    -.0695502    .8733275
logpenalties |   -.008528    .003833    -2.22   0.036    -.0164571   -.0005989
    envscore |   .0005238    .001811     0.29   0.775    -.0032225    .0042701
       _cons |   -.413068   .1973009    -2.09   0.048     -.821216     -.00492
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