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Paying for Failure: Director Compensation, Oversight Lapses, and Network Effects

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December 2025

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Keywords: Director compensation, Board accountability, Oversight failures, Network governance

JEL Classifications: G34, J33, G32, M14

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Abstract. We examine how director compensation functions both as a mechanism for board accountability and as a strategic tool to divert shareholder attention from high pay packages following major oversight failures. Analyzing various corporate incidents, we find that the consequences are contingent on the nature of the failure. For events with diffuse responsibility, such as major environmental breaches, the entire board experiences a significant compensation reduction. In contrast, for failures with clear accountability, like financial misstatements, pay cuts are precisely targeted at directors on the responsible committees. We also provide evidence of a network governance channel: environmental failures, perceived as systemic risks, trigger preemptive pay reductions on connected boards that share a director with the violating firm. Importantly, these pay cuts are not merely strategic gestures; they are followed by substantive improvements in environmental performance at both the focal and connected firms, demonstrating that risk perceptions transmitted through director networks can drive meaningful governance and operational changes.

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1. Introduction

Shareholder scrutiny of corporate boards has intensified, extending beyond financial performance to encompass a wide range of non-financial risks—from environmental compliance to product defects.[1] Companies are now expected to address such non-financial risks with the same diligence as they apply to financial matters. However, the extent to which shareholders can hold board members accountable for a failure of oversight on these matters remains unclear. Legal experts have long believed that board members' exposure to legal action due to a failure of oversight (known as *Caremark Duties*) is limited because these claims are hard to prove in litigation.[2]

A notable development in the last few decades is the growing significance of director compensation, which has increased at a rate surpassing that of CEO pay (Fang and Huang, 2024). According to the authors, board compensation in publicly listed companies rose from $133,930 in 2000 to $342,030 in 2020. For non-executive directors with multiple board appointments, the average total compensation for those serving on at least one S&P1500 company board could now approach half a million dollars. Such high levels of pay make the loss of board positions significantly more consequential, while also drawing shareholder attention to board pay, especially when boards are perceived as failing in their oversight responsibilities. Notably, board compensation is particularly vulnerable to shareholder scrutiny because *boards set their own pay*. This raises concerns about "self-dealing" and invites litigation, a *governance* issue that has become increasingly prominent in recent years as board pay continues to grow.[3]

[1] For example, Aggarwal, Dahiya, and Yilmaz (2024) document that companies' performance on environmental, social, and governance (ESG) issues is increasingly under shareholder scrutiny.

[2] See, e.g., 2024 Caremark Developments: Has the Court's Approach Shifted?, Harvard Law School Forum on Corporate Governance (May 20, 2024), https://corpgov.law.harvard.edu/2024/05/20/2024-caremark-developments-has-the-courts-approach-shifted/.

[3] See, for example, In re Tyson Foods, Inc. Consolidated Shareholder Litigation, 919 A.2d 563 (Del. Ch. 2007), Seinfeld v. Slager, 2012 WL 2501105 (Del. Ch. June 29, 2012), Calma v. Templeton, 114 A.3d 563 (Del. Ch. 2015), In re Investors Bancorp, Inc. Stockholder Litigation, 177 A.3d 1208 (Del. 2017), In re 3M Company Derivative Litigation 0:18-cv-01119 (D. Minn. 2018).

In this paper, we provide evidence that the rapid growth of director pay has had a positive effect on board accountability, with compensation becoming more responsive to oversight failures. By accepting curbs on compensation, directors demonstrate accountability for oversight failures, which may help preserve their reputation and mitigate the risk of pay-related shareholder lawsuits or low voting support when shareholders are dissatisfied with the board's monitoring performance. However, we also find that this mechanism of accountability is not uniform; rather, it is contingent on the nature of the corporate failure. We provide evidence that the consequences for the board—specifically through director compensation—systematically differ depending on whether responsibility for the failure is concentrated within a specific committee, diffused across the entire board, or even falls within the purview of the board's oversight duties. This distinction helps explain why boards react forcefully to some non-financial shocks but not others, offering a new perspective on how governance adapts to diverse corporate challenges.

We first analyze incidents where responsibility is diffuse and cannot be easily assigned to a specific committee. Examining major environmental breaches from the EPA's enforcement database, we find that the average compensation for all non-executive directors (henceforth, NEDs) on the board declines significantly following an incident. This finding is replicated using data on major product recalls, where the board as a whole also bears the financial consequences. These results are consistent with the "many hands" problem as theorized by Thompson (1980). This problem occurs when a collective decision is made by a group, and no specific individual can be clearly identified as responsible. In such cases, the entire group or organization must bear the responsibility for the outcome as a whole. In stark contrast, when we examine incidents with clear lines of accountability—namely, financial misstatements from SEC enforcement actions—the consequences are precisely targeted. Our director-level analysis reveals that the negative pay effect

is concentrated exclusively among directors serving on the audit committee or the nominating & governance committee, with no corresponding pay reduction for other board members. These findings support the argument that when identifiable individuals are responsible, the financial repercussions are localized to them. Interestingly, we find that not all diffuse shocks trigger this response. There is no significant change in total director pay following major cyber-attacks. We argue that this is likely because the board itself is not directly held accountable for major cybersecurity breaches—such events are likely to be regarded more as the result of external malice rather than internal negligence. The board, in fact, may be seen as a victim of an attack rather than the sole perpetrator of a failure.

Shareholders can also penalize boards for oversight failure via the voting mechanism in director elections.[4] We find, however, that voting outcomes remain stable following oversight failures, with no significant decline in support for directors after environmental breaches or financial misstatements.[5] A possible reason for this could be that signaling accountability by restraining their own compensation appeases shareholders. However, director turnover patterns diverge by failure type. For diffuse-responsibility incidents (e.g., environmental violations), overall turnover is unchanged. For failures with clear accountability (e.g., financial misconduct), all directors face elevated turnover risk, but forced turnover concentrates on audit/nominating committee members receiving low (<90%) votes. This targeted turnover, alongside broader voluntary departures by non-culpable directors, highlights that accountability operates through exit threats when responsibility is assignable.[6]

[4] Even though directors are generally re-elected and the percentage of dissent votes is typically small (Cai, Garner, and Walkling, 2009), some studies find that negative votes are consequential and associated with career and reputational consequences for board members (Aggarwal, Dahiya, and Prabhala, 2019, Deng, Feng, Masulis, 2024).
[5] Our results differ from those of Deng, Feng, and Masulis (2024), who find that negative votes in director elections increase following major E&S incidents reported by *Reprisk*. We discuss these differences later.
[6] Accountability encompasses not just self-imposed consequences (like director pay cuts) but also the board's exercise of authority to enforce responsibility on others, such as management. Consistently, we find that CEO turnover and

In our empirical analysis, we consider in detail the consequences of major environmental breaches on directors' compensation, and then use a similar methodology to study the impact of other types of incidents on directors' compensation. We conduct a more extensive analysis on the impact of environmental incidents because our main data—which comes from the enforcement action database of the Environmental Protection Agency (EPA)[7]— enables us to examine incidents that are more comparable, and also some consequences of these incidents. Under a stacked difference-in-differences framework that includes cohort × firm fixed effects and cohort × year fixed effects, we find that the average director compensation of the boards in violating firms declines following these incidents compared to control boards.[8] For external validation, we also examine a sample of major environmental incidents from *RepRisk* and find very similar results.[9]

One of our most striking findings concerns the spillover effects of environmental incidents on director compensation across interconnected boards. Specifically, we observe that first-tier boards, which share at least one NED with an affected board but are not directly implicated in environmental violations, also reduce director pay. We hypothesize that this reaction stems from the *affected board's* decision to curtail compensation in response to a major environmental breach. Such a decision not only signals the board's accountability and willingness to accept responsibility but also reflects a strategic concern about attracting shareholder scrutiny and pay-related activism. The concern of being targeted for awarding high pay-packages to themselves is likely to be passed

pay cuts also occur for both failure types. Such actions show that the board is not passive or entrenched, and signal that it is effectively "owning" the failure at a governance level and committing to improvement.

[7] We obtain data on all enforcement actions from the EPA's Integrated Compliance Information System (ICIS), which contains civil, judicial, and administrative federal EPA enforcement cases. We only consider enforcement actions that reach a conclusion and result in major fines.

[8] We find similar results when we consider director-level compensation using cohort × firm × director fixed effects and cohort × year fixed effects.

[9] *RepRisk* is a data science company that focuses on environmental, social, and governance (ESG) risk research. It collects and analyzes data from a wide range of public sources, such as news articles, social media, and regulatory filings, and maintains a repository of historical ESG issues. *RepRisk* assigns severity levels to each documented issue or incident, ranked low, medium, and high.

on to other boards that the affected firm's board members also sit on. The connected boards then preemptively adjust pay to signal enhanced oversight and mitigate potential reputational damage. The pay-reduction effects are more pronounced in connected boards (i) operating within the same industry as the affected firm (where the likelihood of similar environmental incidents may be higher), and (ii) when a greater number of directors from the affected board serve on the connected board, amplifying the salience of the message.

We further examine whether second-tier and third-tier connected boards experience a pay cut.[10] For the EPA violations, we find that the effects on director compensation attenuate as we move to the second and third tier connections, suggesting that the greater the distance from the directly affected board, the less clear the message becomes.

As a robustness test, we examine whether major environmental incidents reported by *Reprisk* generate similar spillover effects. Affected boards experience compensation declines, reflecting accountability for oversight failures. Connected boards also see significant pay reductions, which do not attenuate even at second- and third-tier connections, indicating that *Reprisk* events are larger in scale, attract greater shareholder attention, and produce stronger spillovers compared to EPA enforcement actions. Unlike EPA cases, which are usually local and addressed by proactive pay cuts, *Reprisk* incidents often have broader, cross-border impacts, where pay cuts alone may not restore shareholder confidence, leading to negative outcomes in director elections.[11]

[10] Second-tier connected firms are those that share at least one director with first-tier connected firms and have not experienced any incidents in prior years. Third-tier connected firms are those that share at least one director with second-tier connected firms and likewise have not experienced any incidents in the past.

[11] The difference between EPA incidents and *Reprisk* incidents helps explain why our results differ from those of Deng, Feng, and Masulis (2024).

We find no such spillover effects for financial misconduct or product recalls. We argue that this is because environmental failures are perceived not as firm-specific lapses, but as revealing a sector-wide vulnerability. Given that firms in the same industry often rely on similar technologies and are subject to the same regulatory standards, a major violation at one company signals that its peers are likely exposed to the same latent risks. In an era of increasing shareholder activism and rising frequency of pay-related litigation, high-compensation boards may perceive themselves as vulnerable to similar pressures should environmental violations occur within their own firms. In contrast, financial or product-related failures are likely viewed as more firm-specific, creating little incentive for connected boards to react preemptively.

If boards reduce their own pay due to heightened awareness of risks from shareholder actions following environmental incidents, we would expect them to take concrete steps to mitigate those risks. To examine this, we analyze whether both the affected firms and their connected firms—linked via shared directors—reduce toxic emissions after the violation events. This analysis is limited to the EPA enforcement sample, as its homogeneity and the EPA's monitoring of harmful chemical emissions provide a reliable metric for assessing environmental performance.

Our findings reveal that emissions of harmful chemicals decrease (relative to control firms) not only for the violating firms but also for the connected firms, with the reductions being particularly pronounced when the connected firm operates in the same industry as the violator. These results suggest that the pay cuts are not merely symbolic or strategic gestures aimed at deflecting shareholder scrutiny or stabilizing investor sentiment. Instead, they indicate a genuine commitment to improved governance and stronger environmental performance. This finding underscores how environmental enforcement actions can trigger broader changes, driving

improvements not only in governance (G) but also in environmental (E) outcomes across both affected and connected firms.

Our paper makes several contributions to the literature on corporate governance and board accountability. First, we propose and empirically validate a new mechanism for understanding how board accountability functions for oversight failures. In particular, we establish director compensation as a primary, flexible tool for accountability, particularly when traditional mechanisms like shareholder voting prove ineffective, and Caremark claims blunt the force of litigation. We show that the accountability mechanism is not uniform; it is contingent on whether responsibility for the failure can be concentrated on specific directors or is diffused across the entire board. Moreover, when the reason for failure is external and the board is seen as a victim rather than a responsible party, there is no effect on board compensation structure. This perspective helps explain why boards react differently to various non-financial shocks. Second, we identify a novel channel of network governance, whereby the reputational risk from certain types of failures seen as more systemic than firm-specific spills over to connected firms, prompting preemptive governance adjustments. Finally, we show that governance mechanisms are interconnected: failure of oversight on one dimension (e.g., environment) may drive boards to strengthen their efforts in another (e.g., governance) as a means of maintaining stakeholder trust.

We also expand the existing research on ESG performance by focusing on the direct impact of major environmental breaches on director compensation. While previous research has explored executive compensation in relation to environmental performance (e.g., Flammer, 2013), our study provides novel insights into non-executive director pay. The rise in board compensation (Fang and Huang, 2024) and increasing litigation related to board pay underscore the importance of our findings in holding directors accountable for ESG oversight failures. Specifically, we show

how director compensation can serve as a mechanism for shareholders to exert pressure on boards, particularly in light of growing concerns about "self-dealing" and the potential for litigation over board pay. Moreover, unlike previous studies that have examined the relationship between overall ESG scores and financial performance (e.g., Friede, Busch, and Bassen, 2015), or specific ESG factors and firm value (e.g., Matsumura, Prakash, and Vera-Muñoz, 2014), our work isolates the effect of environmental failures on board governance. This is particularly relevant given the heightened scrutiny of ESG issues by shareholders (Aggarwal, Dahiya, and Yilmaz, 2024).

Finally, we contribute to the understanding of spillover effects in corporate governance by demonstrating how environmental incidents at one firm can influence director compensation across interconnected boards. This phenomenon highlights the interconnected nature of ESG risks within director networks and the potential for reputational concerns and shareholder activism to drive governance changes beyond the affected firm. Notably, our findings suggest that directors serving on multiple boards can facilitate these spillover effects by advocating for preemptive pay moderation to mitigate potential shareholder dissatisfaction and litigation risks. Importantly, our analysis shows that the board pay cuts following environmental breaches are not merely symbolic or strategic, but are associated with tangible improvements in environmental performance. Boards likely take “real” risk-mitigating steps that lead to lower toxic emissions by both affected and connected firms.

2. Related Literature

2.1 Board Compensation: Determinants, Structure, and Governance

Early literature from the late 1990s to the mid-2000s primarily examined the determinants of director compensation. Traditional determinants resemble those identified for CEO pay, such as

firm size (Ryan and Wiggins, 2004; Linn and Park, 2005; Brick, Palmon, and Wald, 2006), firm performance (Yermack, 2004; Brick, Palmon, and Wald, 2006), and directors' skills (Hillman and Dalziel, 2003). Other studies highlight that the degree of board independence and the level of CEO pay are also closely correlated with outside directors' compensation (Bebchuk et al., 2002; Ryan and Wiggins, 2004; Palmon and Wald, 2006).

The traditional design of director compensation consisted mainly of fixed cash retainers with little variation across firms (Yermack, 2004). To encourage directors to actively engage in their monitoring role and align their incentives with shareholders, early compensation practices often included meeting fees as rewards for attending board meetings. Adams and Ferreira (2008) find that director attendance at board meetings responded positively to these modest monetary rewards. Over time, however, meeting fees fell out of favor, and equity-linked compensation became the dominant component of director pay (Farrell, Friesen, and Hersch, 2008; Fang and Huang, 2024).

A number of studies connect director compensation to firm outcomes such as performance (Brick, Palmon, and Wald, 2006), disclosure and audit quality (Archambeault, DeZoort, and Hermanson, 2008; Engel, Hayes, and Wang, 2010; Sengupta and Zhang, 2015), and related-party transactions (Hope, Lu, and Saiy, 2019). These findings suggest that compensation design has tangible consequences for various aspects of firm operations.

With the rapid growth of director pay over the last two decades and the increasing dominance of equity-based compensation, shareholders have filed suits against boards for excessive pay and for the potential conflict of directors setting their own compensation. To mitigate such lawsuits, boards have generally argued that their pay packages were approved by shareholders at annual meetings. However, several landmark rulings in Delaware courts—such as

Seinfeld v. Slager (2012), Calma v. Templeton (2015), and In re Investors Bancorp (2017)—clarified that equity awards to directors must include specific limits. These rulings weakened the defense that shareholder approval alone guarantees fairness (Fang and Huang, 2024).

Chen, Chien, and Huang (2024) show that, after these Delaware rulings, Delaware-incorporated firms became more likely to disclose their director pay peers and tended to select peer groups with higher compensation. These dynamics interact with increased investor scrutiny of board pay and, where relevant, say-on-pay style activism, thereby heightening the reputational stakes of compensation decisions. Fang and Huang (2024) further find that Delaware-incorporated firms significantly reduced equity-based compensation to directors relative to non-Delaware firms. This pattern demonstrates how the judicial environment can reinforce the view that compensation is a flexible margin through which boards signal accountability after governance failures.

Taken together, earlier studies established the cross-sectional determinants of director compensation and documented how pay structures evolved over time, linking them to important firm-level outcomes. More recent work focuses on the governance dimension of director compensation. In particular, Fang and Huang (2024) and Chen, Chien, and Huang (2024) provide evidence that director pay is both a target of investor scrutiny and a responsive governance mechanism. This perspective aligns with findings that boards adjust compensation practices following oversight failures, which, in turn, may attract greater shareholder attention to directors' fiduciary duties.

2.2 Shareholder and Market Reactions to Director Failures

Another strand of literature that our paper contributes to is how markets and shareholders discipline directors who fail to fulfill their fiduciary duties. Theoretically, shareholder voting in

director elections is a key channel of board accountability, but is often a weak disciplining device in practice. Cai, Garner, and Walkling (2009) document that director elections are typically uncontested, and directors' support rates remain high even after poor firm performance. Fos and Tsoutsoura (2014) emphasize that plurality rules and limited contestability blunt removal threats, while Aggarwal, Dahiya, and Prabhala (2019) and Deng, Feng, and Masulis (2024) both show that even a 1% increase in negative votes is associated with a significantly higher likelihood of board turnover or removal from key positions. Another body of work highlights how the career prospects of outside directors can change following large-scale governance failures. Fich and Shivdasani (2007) and Srinivasan (2005) both document that directors associated with financial misrepresentation or shareholder class action lawsuits experience a significant decline in subsequent board appointments.

Taken together, these findings suggest that even if formal voting outcomes remain stable, reputational forces in the external labor market for directors can impose meaningful discipline. This pattern aligns with our evidence that voting outcomes remain largely unchanged following environmental enforcement or financial misstatements, while compensation adjusts more flexibly and, for misstatements, turnover rises—especially for audit and nominating/governance committee members.

2.3 Event-based governance responses and heterogeneous accountability

Our framework builds on event studies showing that non-financial incidents trigger reputational costs and investor reactions. We contribute by distinguishing heterogeneity in accountability across incident types and by tracing the response margin to director compensation. The main idea is closely related to Thompson (1980), who discusses the responsibility of public officials. When

the decision is made collectively, it becomes difficult to attribute accountability to any single individual. Environmental enforcement and major product recall diffuse responsibility across oversight domains and business functions; it is difficult to pinpoint culpability to any one committee. Accordingly, boards face pressure as a collective, and we find broad-based reductions in non-executive director pay after such incidents. Consistent with this argument, Deng, Feng, and Masulis (2024) do not find that specific committees face more negative votes in director elections following a firm's experience with major E&S incidents, as all directors share the responsibility.

On the other hand, financial misstatements concentrate accountability on committees responsible for financial reporting and governance integrity, namely the audit and the nominating & governance committees. Consistent with committee-specific responsibility, we find targeted pay cuts and higher forced turnover probabilities for the audit and the nominating & governance committee members, with little effect on pay for other directors. Cybersecurity breaches—when caused by external hacking or malware—are more plausibly attributed to specialized operational lapses rather than board-level negligence. Consistent with this view, we find no systematic reduction in director pay, echoing evidence that CEO bonuses, rather than total pay, are the component most sensitive to such shocks (e.g., Kamiya et al., 2021).

These patterns map to the logic that investors and courts discipline boards where failures are credibly interpreted as oversight lapses within the board's purview. When responsibility is diffuse but governance-salient (environment enforcement and product recalls), accountability operates at the full-board level through compensation. When responsibility is specific (misstatements), accountability is targeted to responsible committees via compensation and turnover. When incidents are perceived as external malice (cyberattacks), boards are less likely to be sanctioned.

2.4 Spillover effects across firms and boards interlocks

Spillover effects are widely documented in the literature on how firm behavior is influenced, including innovation (Matray, 2021), CEO compensation (Denis, Jochem, and Rajamani, 2020; Bereskin, Byun, and Oh, 2023), corporate governance (Albuquerque et al., 2019), and ESG performance (Schiller, 2018; Dai, Liang, and Ng, 2021; Dasgupta, Huynh, and Xia, 2023). These effects can propagate through various channels, such as peers in the same industry (Denis, Jochem, and Rajamani, 2020), geographic proximity (Dasgupta, Huynh, and Xia, 2023), supply chain relationships (Schiller, 2018; Dai, Liang, and Ng, 2021), or board connections (Chiu et al., 2013; Cai and Sevilir, 2012). Prior research highlights that firms are not isolated in their decisions: they often respond to pressures, incentives, or best practices observed in their networks, leading to coordinated improvements or strategic adjustments across connected firms.

In the context of board interlocks, studies show that connected directors can influence executive compensation, earnings management, disclosure policies, M&A activity, director career concerns and overall firm performance (Hadlock, 1997; Chiu et al., 2013; Cai et al., 2014; Cai and Sevilir, 2012; Geng et al., 2021; Zhang, 2021). The underlying assumption is that directors' monitoring ability and governance expertise can be transferred across boards. A separate but related strand of literature discusses the monitoring effectiveness of independent directors, showing how board composition and access to information shape their oversight ability (Duchin, Matsusaka, and Ozbas, 2010; Coles, Daniel, and Naveen, 2014). However, directors have limited attention capacity. Masulis and Mobbs (2014) examine how directors rank their board positions and allocate their efforts primarily to more prestigious boards, which results in negative

externalities for other boards. These connections create a channel through which governance practices and behaviors can diffuse across firms.

Building on this literature, our paper demonstrates that both governance and environmental performance spillovers occur through board connections. Specifically, we find that following EPA enforcement of a focal firm, connected firms preemptively adjust director pay to signal greater accountability. Moreover, both the focal and connected firms improve their environmental performance after the enforcement event, suggesting that board interlocks transmit not only governance norms but also environmental responsibility practices. These findings provide new evidence of spillover effects in managing section-wise risks and highlight the role of board networks in amplifying impacts beyond directly affected firms.

3. Data, variable construction, and sample selection

Our empirical analysis is designed to isolate the effect of different corporate oversight failures on director compensation. For this purpose, we categorize incidents based on whether accountability is diffuse across the entire board or can be attributed to specific committees. We examine four distinct types of failures: 1) major environmental enforcement actions from the EPA and 2) significant product recalls from the FDA, which serve as examples of events with diffuse responsibility; 3) financial misstatements from the SEC, which represent failures with clear, concentrated accountability, and 4) cybersecurity breaches, which likely do not belong to the purview of board oversight and hence the board is unlikely to be held accountable for such incidents. This section proceeds by detailing the data sources and selection criteria for each incident type, the construction of our director- and firm-level variables from vendors like BoardEx, Compustat, and CRSP, and the final sample selection process for our empirical models.

3.1 Incidents

EPA Enforcement. We obtain data on all enforcement actions from the EPA's Integrated Compliance Information System (ICIS), which records civil, judicial, and administrative federal EPA enforcement cases.[12] From this database, we collect all formal EPA enforcement cases that reach a conclusion (i.e., a final decision). These enforcement actions are recorded at the plant level, and we aggregate them to the firm level by identifying whether the firm has any plant subject to enforcement actions in a given year, on the basis that all plants are overseen by the same board members. We classify an EPA enforcement action as a major one if it meets any of the following criteria: (1) a violation of an environmental law or regulation; (2) illegal disposal of chemicals or discharge without a permit; or (3) illegal use of chemicals. For firms in our EPA sample, we also collect plant-level toxic emissions data from the EPA's Toxics Release Inventory (TRI) program and aggregate it to the firm level. Our final sample includes 362 major EPA enforcement cases from 2000 to 2021.

Product Recalls. We collect data on product recalls from the Food and Drug Administration's (FDA) Weekly Enforcement Reports, which provide detailed information on recalls of food, drugs, medical devices, and other regulated products. Each recall record includes the name of the manufacturer of the product, the product being recalled, the date of the recall, and, where available, the quantity recalled. To identify major product recall incidents, we link recall events to media coverage using RavenPack, a leading provider of news analytics data. For incidents that can be

[12] ICIS provides historical records of all enforcement actions taken by the EPA under the following environmental statutes: the Clean Air Act (CAA), the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313, the Toxic Substances Control Act (TSCA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), the Safe Drinking Water Act (SDWA), and the Marine Protection, Research, and Sanctuaries Act (MPRSA).

found in RavenPack, we classify a recall event as a major one if more than ten news or media articles report on the incident within a seven-day window before and after the recall announcement date. Ten corresponds to the median number of articles for incidents covered in RavenPack. We eventually identify 31 major FDA recall incidents during the 2000 - 2012 period.

Financial Misstatements. Financial misstatement incidents are collected from the Accounting and Auditing Enforcement Releases (AAER) published by the Securities and Exchange Commission (SEC). The formal AAER database is compiled and constructed by Dechow et al. (2011), who collect all AAERs available on the SEC website and provides details such as the incident type, the release date, a short description of the incident, and an AAER release number that can be linked to the original AAER documents on the SEC website. As reported by Karpoff et al. (2017), the release date of an AAER occurs, on average, 1008 days later than the first public revelation (the "trigger event" date). Therefore, following the methods of Karpoff et al. (2017) and Banerjee et al. (2024), we rely on the AAER release number to identify the original AAER document and manually review the enforcement proceedings to determine the trigger event date. For these incidents, we do not classify them as major or minor, because such incidents are less frequent than EPA enforcement actions or product recalls, and when they do occur, they generally constitute very significant events and generate substantial reputational harm to the firm. Our final sample includes 42 financial misconduct cases, with the trigger event years ranging from 2000 to 2009, corresponding to AAER release years ranging from 2000 to 2014.

Cybersecurity Breaches. Our sample of cyber-attacks comes from the Data Breach Chronology Database, which is compiled and maintained by the Privacy Rights Clearinghouse (PRC). PRC is a non-profit organization that has tracked timely data breach notifications reported to government agencies across the U.S. since 2005. For each breach notification, PRC provides information on

when the breach occurred or was discovered, the reporting time, the breach type, a description of the incident, the total number of affected individuals, and other relevant details. Following the methods of Kamiya et al. (2021) and Florackis et al. (2023), we consider only incidents involving information loss due to external hacking or malware, as these are more likely to represent unexpected external shocks. We define a cyber-attack incident as a major one if it affects more than one individual (the median).[13] Using this criterion, we identify 152 major incidents occurring between 2005 and 2021.

3.2 Board Compensation, Characteristics, and Firm Performance

We mainly rely on BoardEx to obtain board-level and director-level information, including directors' roles on the board, tenure, and compensation. BoardEx also provides an indicator to distinguish executive directors (EDs) from non-executive directors (NEDs), and we focus primarily on non-executive directors. Following the methods of Fang and Huang (2024), we examine U.S. publicly listed firms, excluding firms in the financial industry (SIC 6000–6999), and measure five components of director compensation: total compensation, salary plus bonus, equity-like compensation, stock-based pay, and option-based pay.[14] For each measure, we also construct the firm-level average compensation of all non-executive directors to capture the average pay level for NEDs on the board. Firm financial information is obtained from CRSP and Compustat. After combining Boardex, Compustat and CRSP, our initial sample covers 973 U.S. public listed firms, including 11,856 non-executive directors and 2,954 executive directors, from 1999 to 2021. Table

[13] In our final sample of cyber-attack incidents, more than 40% do not report any information on the total number of affected individuals. In such cases, we treat it as 0, so that one affected individual represents the sample median.
[14] When constructing the sample for cyber-attacks, we do not exclude firms in the financial industry, as they constitute the majority of victims.

1 presents the firm-level and director-level summary statistics. Details of the variable definitions can be found in Appendix A.

The average NEDs' total compensation is approximately $287,035 per year, with about 23% consisting of salary plus bonus, 53% consisting of stock-based pay, and 24% consisting of option-based pay. Each board consists of an average of eight NEDs and only one or two executive directors, who are typically the CEO or CFO. Panel B reports director compensation for NEDs and EDs separately, showing that across all measures, executive directors receive much higher compensation than non-executive directors. Figure 1 plots the changes in NED and ED compensation from 2000 to 2021. Although executive directors' compensation is consistently higher, both move in parallel, and NED compensation shows a remarkable increase over the period. Lastly, NEDs tend to hold more outside board seats than EDs.

3.3 Industry Peers

Furthermore, to identify a firm's competing peers in the same product market, we employ Hoberg and Phillips's (2016) Text-based Network Industry Classifications (TNIC). TNIC is based on firm-level pairwise similarity scores derived from textual analysis of product descriptions in 10-K filings. We use TNIC2 which approximates the two-digit SIC classifications.

3.5 Empirical Methodology

After combining all data, we construct cohorts of treated and control boards for each type of incident under a stacked difference-in-differences (DiD) framework. The analysis centers on the three years before and after each incident, excluding the event year itself. Stacked DiD is particularly suitable for our setting because the incidents considered in this paper tend to occur

across different firms and at different time periods. Using a traditional DiD approach could induce estimation bias, as previously treated ones might later become controls. Therefore, we follow prior literature and implement a stacked DiD, restricting the control group to boards that are never treated (Angrist and Pischke, 2009; Gormley and Matsa, 2011, 2016; Baker, Larcker, and Wang, 2022; Dasgupta, Huynh, and Xia, 2023). If a control board overseeing a firm experiences the incident within the following three years, we exclude it from the sample starting in that year. The details of constructing the treated and control boards for each cohort will be described in Section 4.

We estimate the following year-cohort-firm level panel regression:

$$Director\_compensation_{i,c,t} = \beta_0 + \beta_1 Treat_{i,c} \times Post_{c,t} + \gamma_{i,c} + \delta_{c,t} + \epsilon_{i,c,t} \quad (1),$$

where D$irector_compensation$ represents the different components of compensation. Under the firm-level regression, this variable represents the board average compensation. $Treat_{i,c} \times Post_{c,t}$ is our primary explanatory variable, which takes a value of one for treated board-year observations in the three years after the incident, and 0 otherwise. $\gamma_{i,c}$ and $\delta_{c,t}$ are the cohort × firm fixed effects and cohort × year fixed effects, respectively. We expect β_1 to be negative after the incident.

To mitigate the potential "bad control" problem described by Angrist and Pischke (2009), which could distort our coefficient estimates, we follow the method of Gormley and Matsa (2011, 2016) and do not include control variables in this baseline regression. We verify that none of our conclusions change when additional firm-level controls are included.

4. Results

This section presents the empirical findings of our study, unfolding in four main parts. We begin in Section 4.1 by establishing the direct effect of oversight failures on director compensation,

demonstrating that the consequences are contingent on whether accountability is diffuse (as in environmental violations and product recalls), specific (as in financial misstatements), or limited (as in cybersecurity breaches). In Section 4.2, we contrast these compensation-based penalties with other governance mechanisms, namely director election voting and turnover, to show how different tools are deployed for different failures. Subsequently, in Section 4.3, we provide evidence of a novel network governance channel, documenting significant spillover effects where environmental incidents trigger preemptive pay cuts on connected boards. Finally, in Section 4.4, we investigate the real impact of these governance responses, showing that the compensation reductions are followed by tangible improvements in environmental performance at both the directly affected and the connected firms.

4.1 Direct Effects of Incidents on Board Director Compensation

In this section, we empirically test our central hypothesis: that the impact of an oversight failure on director compensation is contingent on the nature of the incident and the extent to which accountability can be assigned. We structure our analysis around three distinct categories of corporate failures to demonstrate how boards respond differently depending on the context. First, in Section 4.1.1, we examine events with diffuse accountability—major environmental breaches and product recalls—where responsibility is spread across the entire board. For these incidents, we predict a broad-based reduction in compensation for all non-executive directors. Second, in Section 4.1.2, we analyze failures with specific accountability, focusing on financial misstatements where oversight duties are clearly concentrated in the audit and nominating & governance committees. Here, we expect pay cuts to be precisely targeted at directors serving on these responsible committees. Finally, in Section 4.1.3, we investigate events with limited

accountability—major cybersecurity breaches—which are often perceived as external attacks rather than internal governance lapses. In this scenario, we hypothesize that there will be no significant change in director compensation, as the board is less likely to be held directly responsible. By comparing how board compensation responds differently under these distinct contexts, we aim to provide robust evidence that director compensation serves as a flexible and targeted mechanism for accountability.

4.1.1. Events with Diffuse Accountability and Board Compensation

Firms that experience negative ESG events generally suffer reputational damage and such events trigger negative reactions from shareholders and the financial markets (Krüger, 2015; Capelle-Blancard and Petit, 2019; Nicolas et al., 2024). In the context of EPA enforcement actions, affected firms face not only reputational loss but also increased regulatory scrutiny and potential penalties. These consequences are likely to place pressure on the board of directors to strengthen monitoring mechanisms. Such pressure is likely to be reflected in director compensation, either as a penalty for oversight failures or as a commitment for improved monitoring in the future.

In this section, we examine whether and how EPA enforcement actions affect the average compensation of the NEDs of treated boards as a group. We focus on average NED pay because such an average is the most obvious metric in terms of which external observers could assess how the board rewards itself. Some might be concerned that focusing on the average NED pay could raise the possibility that our results are driven by changes in board composition: for example, highly paid NEDs leaving the board could bring the average down after the enforcement event. However, NED pay within the same board is fairly uniform, and unreported tables show that the standard deviation of NED pay within the same board does not change after the event. Furthermore,

we ensure that our results on EPA enforcement remain unchanged when we use director-level compensation instead of firm averages, as shown in Table B.1.

For each event year, we construct a cohort of treated and control boards for the 3 years before and the 3 years after the event, removing the event year, and use stacked DiD as our main identification strategy. For each cohort, treated boards are those overseeing firms that directly experience a major EPA enforcement in a given year. Control boards must meet the following criteria: (1) their firms should not have experienced any EPA enforcement events in any prior cohort, including the current cohort; (2) their firms must be in the same TNIC2 industry as the treated firms; and (3) control boards should not be first-, second-, or third -tier connected to the treated boards in the event year. While treated and control boards are not required to have available observations for the entire six-year window surrounding the event year, they must have available data points for at least one year in the pre-period and one year in the post-period. Table 2 presents the results, and we confirm that there are no pre-trends, as shown by Figure B.1.

The dependent variables from column (1) to column (5) measure different components of director compensation and the independent variable of interest is $Treat \times Post$, which equals 1 for treated boards in the three years following EPA enforcement actions. For each specification, we include cohort × firm fixed effects and cohort × year fixed effects. Our results show that following EPA enforcement actions, NEDs from the treated boards, on average, experience a significant decrease in compensation relative to those from the control boards, regardless of whether the compensation is measured by equity-like compensation, salary-plus-bonus, or total compensation. The results are also economically meaningful. Taking total compensation as an example, after EPA enforcement actions, treated board's average director compensation tends to decrease by 14.79% (i.e., exp (-0.16) −1), corresponding to approximately $42,450, relative to the

sample mean of board compensation. As a robustness check, we examine whether director compensation changes following major environmental incidents reported by *Reprisk.* Panel A of Table B.6 in the Appendix shows that the results are similar to those observed under EPA enforcement.

Another type of incident likely to generate diffuse responsibility is product recalls. A product recall typically occurs when a firm is found to have distributed defective products, such as those with design flaws or toxic, potentially life-threatening components, following scrutiny or investigation by the FDA or other U.S. authorities. Existing literature has shown that product recalls impose additional costs on firms beyond the direct costs of removing defective products (Jarrell and Peltzman, 1985; Barber and Darrough, 1996). Because these incidents often stem from inadequate oversight of the production process, the board of directors may be held responsible for failing to provide sufficient supervision.

Similar to the previous analysis, we employ a stacked DiD framework for identification. For each event year, we construct a cohort of treated and control boards. Treated boards are those whose firms experience a major product recall incident in a given year. Control boards are drawn from firms that (1) have not experienced any product incidents in prior cohorts, and (2) operate in the same TNIC2 industry as the firms of the treated boards. Table 3 presents the results.

Across different components of director compensation, except for option compensation, directors on the boards of firms that experience a product recall face a significant pay cut on average, relative to boards in the control group. In terms of magnitude, the board's average total compensation tends to decrease by 13.67% (i.e., exp (-0.147) − 1) following a product recall, compared to the control group.

4.1.2. Events with Specific Accountability and Board Compensation

For the two types of incidents considered above, oversight failure is unlikely to be attributed to specific directors, leading the entire board to share accountability. In contrast, financial misstatements or auditing failures are more targeted events that indicate insufficient oversight by specific committees. These incidents typically arise when the internal audit committee or the nominating & governance committee fails to exercise adequate supervision or implement enough internal controls.

In the context of financial misconduct, treated boards are those whose firms experience a financial misconduct incident in a given year. Control boards are drawn from firms that (1) have not experienced any financial misconduct incidents in prior cohorts, and (2) operate in the same TNIC2 industry as the firms of the treated boards.

Panel A of Table 4 reports the average board compensation following a financial misstatement. Except for salary-plus-bonus, the other four components of compensation do not exhibit significant changes after such events. This contrasts with the results in Tables 2 and 3, and suggests that when an incident can be attributed to specific directors, the overall average board pay is not significantly affected.

To examine whether compensation effects are concentrated among directors in the audit or nominating & governance committees, we conduct director-level stacked DiD regressions by splitting the sample into two groups: one including only directors serving on at least one of the two committees, and the other including directors not serving on either committee. Panels B and C of Table 4 present the results. Panel B shows that overall equity-like compensation, particularly option-based pay, is significantly reduced for members of these committees, along with salary-plus-bonus, leading to a notable decline in total compensation. In contrast, for directors not on

these committees, as shown in Panel C, total compensation does not exhibit significant changes. These findings indicate that directors on the audit or nominating & governance committees experience more pronounced pay reductions compared with directors who do not serve on them.

4.1.3 Events with Limited Accountability and Board Compensation

In this section, we examine how cybersecurity breaches affect board compensation, as we consider such breaches to be incidents for which the board itself is less likely to be held responsible. Cyber-attacks initiated by outside parties are typically unexpected and difficult to prevent entirely, even when firms have invested in cybersecurity protection. If anything, the management team (in particular, the Chief Information Security Officer) should be held responsible, as it is their duty to develop and reinforce information protection systems to safeguard the firm's operations and clients' financial information. Kamiya et al. (2021) document how CEOs' compensation is affected following external cyber-attack incidents. They find that the CEO's total compensation is generally unaffected; the only component impacted is the bonus. Another observation is a structural adjustment of the CEO compensation: option-like compensation decreases while stock-like compensation increases, suggesting that the CEO's downside protection is reduced. However, non-executive directors are not involved in day-to-day management, and such events should not be considered within their purview of governance, unlike financial misconduct or product recalls. Therefore, we would not expect to see a significant change in director compensation following such incidents.

Similar to previous analysis, we employ a stacked DiD framework for identification. For each event year, we construct a cohort of treated and control boards. Treated boards are those whose firms experience a major external cyber-attack incident in a given year. Control boards are

drawn from firms that (1) have not experienced any cyber-attack incidents in prior cohorts, and (2) operate in the same TNIC2 industry as the firms of the treated boards. Table 5 presents the results.

Across all five measures of different components of NED compensation, only salary-plus-bonus shows a weakly significant decrease; the other components are all insignificant. These results support our argument that cyber-attacks, due to their highly specialized technical or operational nature, are largely beyond the board's direct control, unlike other incidents where oversight failures are easily attributed, which explains why director compensation is largely unaffected.

Combining results from the four types of incidents, we observe a clear distinction in how accountability is allocated. For events such as EPA enforcement and product recalls, responsibility is diffuse, as these failures typically arise from systemic issues spanning multiple functions and are difficult to attribute to any single director. Consequently, the entire board bears the consequences, leading to compensation reductions across all NEDs. In contrast, financial misstatements are more likely to reflect lapses in specific oversight roles, such as the audit or nominating & governance committees. Because the responsible directors are identifiable, broader pay cuts for other directors are less necessary, concentrating financial and reputational penalties on those with direct accountability. Finally, for incidents largely outside the board's governance purview, average board compensation does not respond significantly.

Directors' willingness to reduce their compensation following accountability-triggering events serves two purposes. First, the pay cut acts as a signal to shareholders, demonstrating that directors accept responsibility and are willing to bear some cost for oversight failure, which could imply stronger commitment to future oversight. Second, while *Caremark* standards make it difficult to hold boards responsible for failure of oversight in court, as several recent pay-related

shareholder lawsuits suggests, boards—in setting their own pay—remain vulnerable to shareholder pay-related lawsuits. . Failing to curb their pay when shareholder attention is triggered could invite such lawsuits, leading to greater penalties from the director labor market.

Although our findings for director compensation suggest that boards accept accountability for failure of oversight in anticipation of shareholder attention, shareholders can also penalize boards for oversight failure via the voting mechanism in director elections. In Appendix Table B.7, we examine whether voting support for directors in uncontested elections and the likelihood of director turnover change following the incidents studied above. We mainly compare the consequences of EPA enforcement and financial misconduct. We do not observe any significant changes in voting support for directors, nor in the likelihood of their election being approved, for either type of incident. Furthermore, for EPA enforcement, we do not observe any changes in the likelihood of director turnover compared with directors in the control group. For financial misconduct, we do observe director are more likely to leave, especially those in the audit or nominating & governance committees who receive voting support lower than 90%.

Some might argue that for these incidents, CEOs should bear greater responsibility than directors, as they are the ones responsible for daily operations. Although CEOs are not the main focus of this paper and an extensive body of literature has already discussed the consequences for CEOs after negative incidents, in Tables B.4 and B.5 we examine how CEO compensation and turnover change following these two types of incidents. We find that after EPA enforcement, CEO compensation declines—especially equity-based compensation—and the likelihood of forced turnover increases. For financial misconduct, CEO compensation drops significantly, and CEOs are more likely to leave the firm. Such actions represent another form of board accountability, showing that the board is not passive or entrenched, and signaling that it is attuned to the failure's

severity and willing to make tough decisions to realign the company. This contrasts with inaction, which could erode shareholder trust entirely. By holding the CEO accountable, the board is effectively 'owning' the failure at a governance level and committing to improvement.

4.2 Spillover Effects on the Connected Boards

As argued in the introduction, the rapid growth in director pay has not only made board seats more valuable; it has also intensified shareholder scrutiny of board compensation, especially in the wake of corporate failures. We hypothesize that when a major oversight failure occurs—particularly one seen as systemic rather than firm-specific, like an environmental breach—it transmits a powerful signal about latent risks and potential shareholder backlash across director networks. By contrast, product recalls and financial misstatements are generally seen as localized failures—recalls stemming from weaknesses in a firm's quality assurance system, and auditing failures arising from deficiencies in internal auditing controls. Because responsibility is largely confined to the affected board, these events do not trigger the same sector-wide reputational spillovers as environmental breaches.

In the case of sector-wide threats like EPA enforcement, directors on the affected board, having faced direct consequences, carry this message about heightened shareholder vigilance and litigation risk to other boards on which they serve. Faced with this credible threat of scrutiny, and aware that their own high pay is vulnerable to claims of "self-dealing," these connected boards have a strong incentive to act preemptively. By reducing their own compensation, they can signal a commitment to enhanced oversight and mitigate reputational damage before becoming a target of shareholder activism themselves.

We now provide evidence of this spillover effect, whereby governance adjustments are transmitted through shared directors, representing a novel channel of network governance. As noted, an important consideration here is that the oversight failure risk is perceived as *systemic* rather than *firm-specific*. Environmental breaches are a good candidate because here, this perception of systemic oversight failure risk stems from several factors. Unlike financial misconduct, which is often viewed as a firm-specific failure of internal controls or culture, environmental violations frequently reveal vulnerabilities common to an entire sector. Firms within the same industry often rely on similar operational technologies and processes, meaning a violation at one company signals a latent technological or operational risk for its peers. The high cost of perfect compliance often means that an entire sector operates with a degree of latent violation risk, making a crackdown on one firm a credible threat to all. Furthermore, environmental regulations are applied uniformly across industries, so a significant enforcement action against one firm serves as a credible warning that regulatory scrutiny is intensifying for all. This shared exposure to technological and regulatory risks makes the threat contagious, prompting connected boards to react preemptively.

To examine the effects on connected boards following an EPA enforcement action, we construct new cohorts of treated and control boards under the stacked DiD framework. Treated boards are defined as those that oversee firms that experience no EPA enforcement in the past six years but share at least one director with a board whose firm directly experiences a major EPA enforcement action in that year. If a treated board's firm experiences an EPA enforcement directly in the following three years, it is dropped from our sample starting that year. Control boards must meet the following criteria: (1) their firms should not have experienced any EPA enforcement events in any prior cohort, including the current cohort; (2) their firms must be in the same TNIC2

industry as the treated firms; and (3) control boards should not be first-, second-, or third -tier connected to the treated boards in the event year. Panel A of Table 6 reports the results.

For firms connected with those firms that directly experience EPA enforcement ("first-tier connected boards"), the board as a whole also experiences a wide range of pay cuts, with the magnitude smaller than that of the directly affected board. For example, the average total compensation of the first-tier connected boards decreases by 11% (i.e., exp (-0.117) − 1) in the three years after the focal firm experiences the EPA enforcement action, relative to control boards. These results provide evidence supporting our argument that first-tier connected boards also experience a wide range of pay cuts after their connected boards directly experience EPA enforcement, as the connected directors bring this message to the boards. In Panel B of Table 6, we examine whether first-tier connected firms in the same TNIC2 industry as the focal firms experience larger pay cuts, since connected boards in the same TNIC2 industry as the focal firms are expected to be more likely under the regulator's scrutiny in the future. From Panel B, we can see that first-tier connected firms in the same industry as the focal firms experience larger pay cuts, especially on stock compensation.

Furthermore, we also examine the effect of connectedness strength, measured by the number of directors that the first-tier connected boards share with the focal firms. When there are more shared directors, the connection is stronger, and the message conveyed by these common directors becomes clearer and more salient. Panel C of Table 6 shows that as the number of shared directors with the affected boards increases, the magnitude of the pay cut also gradually becomes larger.

In Appendix Table B.3, we also examine how the compensation of first-tier connected boards changes after financial misconduct and product recalls, and we find no such spillover

effects.[15] This is possibly because environmental failures are perceived not as firm-specific lapses but as indicators of a sector-wide vulnerability. Since firms in the same industry often rely on similar technologies and are subject to the same regulatory standards, a major violation at one company signals that its peers may face similar latent risks. In an era of increasing shareholder activism and rising frequency of pay-related litigation, high-compensation boards may view themselves as vulnerable to similar pressures if environmental violations occur within their own firms. In contrast, financial or product-related failures are generally viewed as more firm-specific, creating little incentive for connected boards to react preemptively.

As an extension of the analysis for our EPA sample, we also examine whether second-tier and third-tier connected boards experience a pay cut following the EPA enforcement, as shown in Appendix Table B.2 We find that the effects on director compensation attenuate as we move to the second- and third- tiers of connection. In Panels B and C of Appendix Table B.6, we re-examine these spillover effects using major environmental incidents reported by *Reprisk*, showing that the effects persist for first-, second-, and third-tier connected boards. Unlike the EPA enforcement sample, these effects do not appear to attenuate, which may be because *Reprisk* events tend to be larger in scale and attract broader shareholder attention, resulting in stronger and more pronounced spillovers to connected firms.

4.3. Real Improvements After EPA Enforcement Actions

In the previous section, we show that both directors on the affected boards and their first-tier connected boards experience compensation decreases to signal their recognition of oversight

[15] We do not detail the effects on connected boards for cyber-attack incidents, as we do not observe any direct effects on the boards that experience the attacks, making it difficult to imagine any spillover effects. In untabulated results, we confirm that connected boards are not affected even after the boards to which they are connected experience a cyber-attack.

failures and their commitment to greater accountability in the future. A natural question is whether these pay cuts are primarily a tool for reputational management, or if they signal a genuine commitment that leads to real improvements in environmental performance.

To examine this, we use harmful toxic emissions as a measure of firms' environmental performance and report the findings in Table 7. Panel A reports the results for changes in emissions for firms that directly experience enforcement actions, and Panel B reports the corresponding results for first-tier connected boards.

For directly affected firms, we observe a significant reduction in emissions following enforcement actions, indicating that the firms take concrete steps to improve their environmental performance. For first-tier connected firms, the improvement is especially pronounced among those in the same TNIC2 industry as the directly affected firms, as these firms may face a higher probability of future investigation by the authorities.

Taken together, these results imply that the pay cuts are not merely symbolic gestures. Rather, they are followed by tangible actions to reduce toxic emissions, both by firms directly affected by enforcement and firms with boards connected to them.

5. Conclusion

This paper investigates how director compensation serves as a mechanism for board accountability in the aftermath of major corporate oversight failures. We began by asking whether shareholders can hold boards accountable for a growing range of non-financial risks, especially when traditional tools like litigation or director elections prove blunt or ineffective. Our findings reveal that director compensation has emerged as a primary and highly flexible instrument for accountability, but its application is contingent on the nature of the failure.

Our analysis demonstrates a clear distinction in how boards adjust compensation in response to different types of incidents. For failures with diffuse responsibility, such as major environmental breaches or widespread product recalls, the entire board shares the financial consequences through a significant, board-wide reduction in pay. In stark contrast, for failures with clear lines of accountability, like financial misstatements, the penalties are precisely targeted, with pay cuts concentrated exclusively on directors serving on the responsible committees. Furthermore, when the failure is perceived as the result of external malice rather than internal negligence, as in the case of major cybersecurity breaches, the board is not held financially accountable. These results not only show that the board accepts accountability by bearing the personal cost of a compensation cut, but they also suggest that such pay reductions may reflect a strategic decision by directors to deflect potential shareholder criticism of their pay packages, particularly following recent monitoring failures and an increasing risk of director-pay-related lawsuits.

Perhaps our most striking contribution is the identification of a novel channel of network governance. We find that the consequences of environmental violations—a risk seen as systemic to an industry—extend beyond the directly affected firms and spill over to connected firms through shared directors. Boards that are merely connected to a firm experiencing an environmental failure preemptively reduce their own pay, signaling an enhanced commitment to oversight in anticipation of shareholder scrutiny. This suggests that director networks act as conduits not just for information, but for governance norms and reputational risk.

Crucially, these pay cuts are not merely symbolic gestures. We provide evidence that they are followed by substantive improvements in environmental performance, with both the directly-affected and the connected firms reducing their toxic emissions. This demonstrates that governance

adjustments, driven by the risk of shareholder action, can lead to tangible and positive changes in a firm's operational footprint, effectively linking the "G" in ESG to real-world "E" outcomes.

Our research has significant implications for investors, directors, and regulators. For shareholders, it confirms that scrutiny of board pay is a powerful tool for influencing board behavior, even without resorting to proxy contests. For directors, it highlights the interconnected nature of reputational risk; serving on multiple boards means that a failure at one company can have direct financial and governance repercussions at another. For regulators, our findings suggest that enforcement actions have a multiplier effect, propagating improved governance and operational standards across entire industries through director networks.

While our findings are robust, future research could explore the precise mechanisms within the boardroom that lead to these pay adjustments and the role specific influential directors play in transmitting these governance changes across networks. Nonetheless, our study provides compelling evidence that in an era of heightened stakeholder expectations, director compensation has become a critical lever for ensuring board accountability, and that the shockwaves from a single corporate failure can drive meaningful governance and environmental improvements far beyond the firm where the incident occurred.

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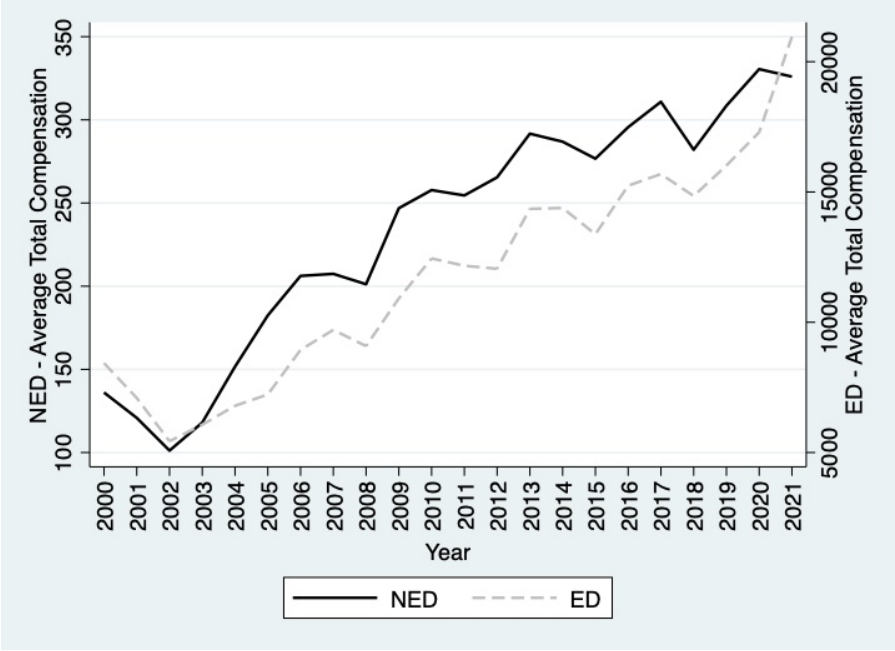

Figure 1: Changes in Director Compensation from 2000 to 2021

This figure presents how total compensation for NEDs and EDs changes over time. The solid line represents compensation changes for NEDs, and the dashed line represents the average compensation changes for EDs. The left-hand and right-hand Y-axes measure the total compensation for NEDs and EDs, respectively. Compensation is winsorized at the 1% level on both tails.

Table1: Summary statistics

This table presents the summary statistics for key variables. Panel A reports firm-level summary statistics and Panel B reports director-level summary statistics. Details of variable definitions could be found in Appendix A.

Panel A: Firm-level characteristics

Variable	N	Mean	p25	p50	p75	SD
avg_equitycomp_ned	11406	221.623	41.538	121.101	202.000	2096.197
avg_stockpay_ned	11406	151.242	0.000	73.167	156.857	2022.377
avg_optpay_ned	11406	70.381	0.000	0.000	29.444	561.175
avg_slrbns_ned	11406	65.413	29.667	57.429	93.364	49.847
avg_totcomp_ned	11406	287.035	86.500	197.873	289.300	2098.078
ned_num	11406	8.464	7.000	9.000	10.000	2.467
ed_num	11406	1.369	1.000	1.000	2.000	0.702
Size	11406	8.624	7.542	8.733	9.796	1.679
lnSale	11405	8.305	7.344	8.440	9.414	1.720
ROA	11397	0.135	0.089	0.135	0.187	0.136
Market-to-Book	11402	3.758	1.751	2.830	4.807	42.481
Book_leverage	11366	0.163	0.055	0.135	0.242	0.138

Panel B: Director-level characteristics

	Non-executive directors				Executive directors			
Variable	N	Mean	p50	SD	N	Mean	p50	SD
equitycomp	96540	237.201	120.000	3030.924	16004	10436.390	5241.500	60358.170
stockpay	96540	173.610	82.000	2794.474	16004	5869.950	1838.000	57726.440
optpay	96540	63.591	0.000	1158.905	16004	4566.440	1393.500	17215.780
slrbns	96540	71.104	60.000	112.128	16004	1304.123	1000.000	1575.935
totcomp	96540	308.305	200.000	3041.318	16004	11740.510	6527.000	60529.100
pubbrdnum_us	96540	0.981	1.000	1.143	16004	0.545	0.000	0.818

Table 2: Impact of EPA enforcement on board compensation

This table examines how the average non-executive director (NED) compensation on a board, changes following a major EPA enforcement under a stacked DiD framework. An EPA enforcement event is classified as a major violation if it meets one of the following criteria: 1) a violation of a law/Act or environmental regulations; 2) illegal disposal of chemicals or discharge without a permit; 3) illegal use of chemicals. For each event year, we construct a cohort of treated and control boards. Treated boards are those overseeing firms that directly experience a major EPA enforcement in a given year. Control boards must meet the following criteria: (1) their firms should not have experienced any EPA enforcement events in any prior cohort, including the current cohort; (2) their firms must be in the same TNIC2 industry as the treated firms; and (3) control boards should not be first-, second-, or third -tier connected to the treated boards in the event year. Both treated and control boards are not required to be in the sample for the entire six-year period surrounding the event year but must have at least one year in the pre-period and one year in the post-period. The independent variable, Treat × Post, is an indicator variable that takes a value of 1 for treated boards in the three years following a major EPA enforcement, and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a board, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus-bonus (column (4)). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm-year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.254**	-0.199*	-0.162	-0.209***	-0.160***
	(0.107)	(0.103)	(0.128)	(0.038)	(0.049)
Constant	4.396***	3.808***	1.199***	4.149***	5.180***
	(0.044)	(0.043)	(0.054)	(0.016)	(0.020)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	3021	3021	3021	3021	3021
R-squared	0.584	0.713	0.584	0.714	0.629
Adj. R-squared	0.478	0.639	0.478	0.641	0.534

Table 3: Impact of product recall on director compensation

This table examines how the average non-executive director (NED) compensation on a board, changes following a major product recall incident under a stacked DiD framework. A product recall incident is classified as a major violation if more than 10 news articles report the event within the seven-day window after the product recall is announced. For each event year, we construct a cohort of treated and control boards. Treated boards are those whose firms experience a major product recall incident in a given year. Control boards are drawn from firms that (1) have not experienced any product incidents in prior cohorts, and (2) operate in the same TNIC2 industry as the firms of the treated boards. Both treated and control boards are not required to be in the sample for the entire six-year period surrounding the event year but must have at least one year in the pre-period and one year in the post-period. The independent variable, Treat × Post, is an indicator variable that takes a value of 1 for treated boards in the three years following a major product recall incident and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a board, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus-bonus (column (4)). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively. Standard errors are clustered at the firm-year level and displayed in parentheses.

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.359*	-0.789***	0.525	-0.197***	-0.147*
	(0.196)	(0.206)	(0.358)	(0.067)	(0.082)
Constant	4.824***	3.182***	2.598***	3.937***	5.424***
	(0.057)	(0.047)	(0.080)	(0.017)	(0.028)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	1119	1119	1119	1119	1119
R-squared	0.428	0.794	0.650	0.801	0.553
Adj. R-squared	0.268	0.736	0.552	0.746	0.429

Table 4: Impact of financial misconduct on director compensation

This table examines how the average non-executive director (NED) compensation changes following a financial misconduct incident under a stacked DiD framework. Panel A reports the firm-level average director compensation, while Panels B and C report director-level compensation changes. Panel B requires that both the treated and control directors are on the auditing or nominating & governance committees, while Panel C covers directors who are not on either committee. For each event year, we construct a cohort of treated and control boards. Treated boards are those whose firms experience a major product recall incident in a given year. Control boards are drawn from firms that (1) have not experienced any product incidents in prior cohorts, and (2) operate in the same TNIC2 industry as the firms of the treated boards. Both treated and control boards are not required to be in the sample for the entire six-year period surrounding the event year but must have at least one year in the pre-period and one year in the post-period. The independent variable, Treat × Post, is an indicator variable that takes a value of 1 for treated boards in the three years following a financial misconduct incident and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a board, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus-bonus (column (4)). Panel A includes cohort × firm fixed effects and cohort × year fixed effects, and standard errors are clustered at the firm-year level and displayed in parentheses. Panels B and C include cohort × firm × director fixed effects and cohort × year fixed effects, and standard errors are clustered at the firm-director-year level and displayed in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively. Standard errors are clustered at the firm-year level and displayed in parentheses.

Panel A: firm-level average director compensation

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.138	0.195	-0.409	-0.343**	-0.068
	(0.240)	(0.228)	(0.341)	(0.160)	(0.159)
Constant	3.770***	1.993***	2.319***	3.457***	4.787***
	(0.033)	(0.026)	(0.037)	(0.014)	(0.016)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	4201	4201	4201	4201	4201
R-squared	0.541	0.709	0.583	0.647	0.586
Adj. R-squared	0.424	0.635	0.476	0.557	0.480

Panel B: directors in the auditing or nominating & governance committees

	(1)	(2)	(3)	(4)	(5)
	lequitycomp	lstockpay	loptpay	lslrbns	ltotcomp
Treat × Post	-0.367***	-0.159	-0.365***	-0.252***	-0.198***
	(0.113)	(0.111)	(0.132)	(0.063)	(0.053)
Constant	3.630***	2.199***	1.921***	3.467***	4.742***
	(0.016)	(0.013)	(0.017)	(0.008)	(0.007)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm ×Director FE	Y	Y	Y	Y	Y
N	16545	16545	16545	16545	16545
R-squared	0.547	0.693	0.597	0.601	0.599
Adj. R-squared	0.421	0.608	0.485	0.491	0.488

Panel C: directors do not in the auditing or nominating & governance committees

	(1)	(2)	(3)	(4)	(5)
	lequitycomp	lstockpay	loptpay	lslrbns	ltotcomp
Treat × Post	0.304	0.087	0.219	-0.630***	0.062
	(0.265)	(0.257)	(0.302)	(0.215)	(0.112)
Constant	3.585***	1.996***	2.019***	3.507***	4.774***
	(0.039)	(0.030)	(0.041)	(0.020)	(0.019)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm × Director FE	Y	Y	Y	Y	Y
N	2809	2809	2809	2809	2809
R-squared	0.591	0.722	0.633	0.583	0.633
Adj. R-squared	0.456	0.629	0.512	0.444	0.511

Table 5: Impact of cyber-attack incidents on board compensation

This table examines how the average non-executive director (NED) compensation on a board changes following a major cyber-attack incident under a stacked DiD framework. A cyber-attack incident is classified as a major one if more than one individual is affected by the incident. For each event year, we construct a cohort of treated and control boards. Treated boards are those whose firms experience a major external cyber-attack incident in a given year. Control boards are drawn from firms that (1) have not experienced any cyber-attack incidents in prior cohorts, and (2) operate in the same TNIC2 industry as the firms of the treated boards. Both treated and control boards are not required to be in the sample for the entire six-year period surrounding the event year but must have at least one year in the pre-period and one year in the post-period. The independent variable, Treat × Post, is an indicator variable that takes a value of 1 for treated boards in the three years following a major cyber-attack incident, and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a board, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus-bonus (column (4)). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively. Standard errors are clustered at the firm-year level and displayed in parentheses.

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	0.080	0.086	-0.002	-0.111**	-0.001
	(0.118)	(0.121)	(0.139)	(0.055)	(0.053)
Constant	4.808***	4.387***	0.966***	4.277***	5.455***
	(0.018)	(0.018)	(0.024)	(0.009)	(0.009)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	6774	6774	6774	6774	6774
R-squared	0.520	0.666	0.610	0.701	0.593
Adj. R-squared	0.410	0.590	0.520	0.632	0.500

Table 6: Impact of EPA enforcement on first-tier connected board compensation

This table examines how the average non-executive director (NED) compensation for a first-tier connected board changes following a major EPA enforcement, under a stacked DiD framework. A first-tier connected board is defined as a board that has not experienced any EPA enforcement in the past six years but shares at least one director with the firm that directly experiences a major EPA enforcement in a given year. For each event year, we construct a cohort of treated and control boards. Treated boards are those first-tier connected boards to the boards of firms that directly experience the enforcement. Control boards must meet the following criteria: (1) their firms should not have experienced any EPA enforcement events in any prior cohort, including the current cohort; (2) their firms must be in the same TNIC2 industry as the treated firms; and (3) control boards should not be first-, second-, or third -tier connected to the treated boards in the event year. The independent variable, Treat × Post, is an indicator variable that takes value of 1 for treated boards in the three years following a major EPA enforcement, and 0 otherwise. The event year itself is excluded. Panel A reports the baseline results of the stacked DiD. Panel B includes an additional interaction term Treat × Post × Same_tnic2, where same_tnic2 is an indicator variable that takes the value of 1 if the first-tier connected board is in the same TNIC2 industry as the boards of the firm that directly experiences the EPA enforcement, and 0 otherwise. Panel C examines the treatment effects across different numbers of shared directors. aff_dirs in Panel C measures the number of shared common directors on the first-tier connected board. Correspondingly, we construct three indicator variables: 1(aff_dirs = 1), 1(aff_dirs = 2), and 1(aff_dirs = 3plus), which equal to 1 if the first-tier connected board shares one, two, or no less than three common directors with the affected boards in a given cohort, respectively; otherwise, the value is 0. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a firm, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus-bonus (column (4)). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm-year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

Panel A: First-tier connected borad

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.233**	-0.343***	0.114	-0.148***	-0.117**
	(0.116)	(0.110)	(0.133)	(0.043)	(0.055)
Constant	4.250***	3.376***	1.418***	3.992***	5.085***
	(0.044)	(0.044)	(0.055)	(0.016)	(0.021)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	3534	3534	3534	3534	3534
R-squared	0.600	0.741	0.593	0.727	0.652
Adj. R-squared	0.499	0.675	0.489	0.658	0.563

Panel B: First-tier connected board, examine the industry effects

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.190	-0.285**	0.123	-0.152***	-0.122**
	(0.117)	(0.111)	(0.136)	(0.044)	(0.056)
Treat × Post × Same_tnic2	-0.663*	-0.911***	-0.127	0.060	0.075
	(0.344)	(0.338)	(0.252)	(0.080)	(0.088)
Constant	4.250***	3.377***	1.418***	3.992***	5.085***
	(0.044)	(0.044)	(0.055)	(0.016)	(0.021)

Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	3534	3534	3534	3534	3534
R-squared	0.601	0.742	0.593	0.727	0.652
Adj. R-squared	0.499	0.676	0.489	0.658	0.563

Panel C: First-tier connected board, the effected of number of shared directors

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post × 1(aff_dirs=1)	-0.192	-0.300***	0.087	-0.117***	-0.079
	(0.122)	(0.112)	(0.143)	(0.045)	(0.057)
Treat × Post × 1(aff_dirs=2)	0.030	-0.290*	0.493***	-0.155**	0.015
	(0.169)	(0.164)	(0.183)	(0.061)	(0.069)
Treat × Post × 1(aff_dirs>=3)	-1.015***	-0.712**	-0.491	-0.327***	-0.615***
	(0.283)	(0.294)	(0.368)	(0.099)	(0.143)
Constant	4.247***	3.375***	1.417***	3.991***	5.083***
	(0.044)	(0.044)	(0.055)	(0.016)	(0.020)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	3534	3534	3534	3534	3534
R-squared	0.603	0.741	0.594	0.728	0.656
Adj. R-squared	0.501	0.675	0.491	0.658	0.568

Table 7: The impact of EPA enforcement on the firm toxic releases

This table examines whether, following the EPA enforcement, the directly affected firms and their first-tier connected firms reduce their toxic emissions. Panel A reports the emission changes for the firms that directly experience the EPA enforcement, and Panel B reports the emission changes for the first-tier connected boards. Column (1) measures the onsite releases, and column (2) measures the total releases, which equals the onsite releases plus offsite releases. The independent variable, Treat × Post, is an indicator variable that takes value of 1 for treated firms in the three years following a major EPA enforcement, and 0 otherwise. The event year itself is excluded. Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm-year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

Panel A: Emission changes of the affected firms		
	(1)	(2)
	Onsite_release	Total_release
Treat × Post	-3.467**	-3.933**
	(1.726)	(1.733)
Constant	12.972***	15.011***
	(0.840)	(0.848)
Cohort × Year FE	Y	Y
Cohort × Firm FE	Y	Y
N	2321	2321
R-squared	0.720	0.744
Adj. R-squared	0.642	0.672
Panel B: Emission changes of the first-tier connected firms		
	(1)	(2)
	Onsite_release	Total_release
Treat × Post	0.042	0.040
	(0.105)	(0.109)
Treat × Post × Same_tnic2	-0.899*	-1.156**
	(0.481)	(0.555)
Constant	0.594***	0.807***
	(0.044)	(0.045)
Cohort × Year FE	Y	Y
Cohort × Firm FE	Y	Y
N	1835	1835
R-squared	0.817	0.867
Adj. R-squared	0.757	0.823

Appendix A: Variable Definition

Variable	Definition
lstockpay	The natural logarithm of one plus the sum of the value of stock grants (Boardex variables valeqaward) and LTIP (Boardex variables ltipvalue)
loptpay	The natural logarithm of one plus the value of option grants (Boardex variable estvaloptaward).
lequitycomp	The natural logarithm of one plus option and stock compensation (i.e., Optipay+Stockpay).
lslrbns	The natural logarithm of one plus the sum of salary (Boardex variable salary) and bonus (Boardex variable bonus).
ltotcomp	The natural logarithm of total compensation. Total compensation equals to the equitycomp plus slrbns.
Size	The natural logarithm of book asset (AT).
lnSale	Natural logarithm of aggregate firm-level sales (SALE)
ROA	Operating income before depreciation (OIBDP) divided by book value of total assets (AT)
Markt-to-Book	Market capitalization is calculated as stock price (PRCC_F) multiplied by the number of shares outstanding (CSHO),devided by total ordinary equity value (CEQ)
Book Leverage	Book leverage equals to long term debt (DLTT) plus debt in current liability (DLC), divided by book asset (AT) minus total equity value (CEQ) plus and plus market capitalization.
Onsite_release	The amount of toxic chemicals released at the facility site where they are produced or used. (in 1,000,000 lbs)
Total_release	Total releases includes both on-site and off-site releases of toxic chemicals. ((in 1,000,000 lbs)
Support_ratio	Number of votes “for” divided by the total number of votes “for,” “against,” “withheld,” and “abstained.”
Pass	A dummy variable which equals 1 if the proposal passes and 0 otherwise.
Director_leave	A dummy variable that takes a value of 1 if the director leaves the firm in year t, and 0 otherwise.
Director_turnover	A dummy variable that takes a value of 1 if the director leaves the firm in year t, and 0 otherwise.
Forced_turnover	A dummy variable that takes a value of 1 if the director receives less than 90% voting support in year t and departs in that year, and 0 otherwise.

Appendix B: Other results

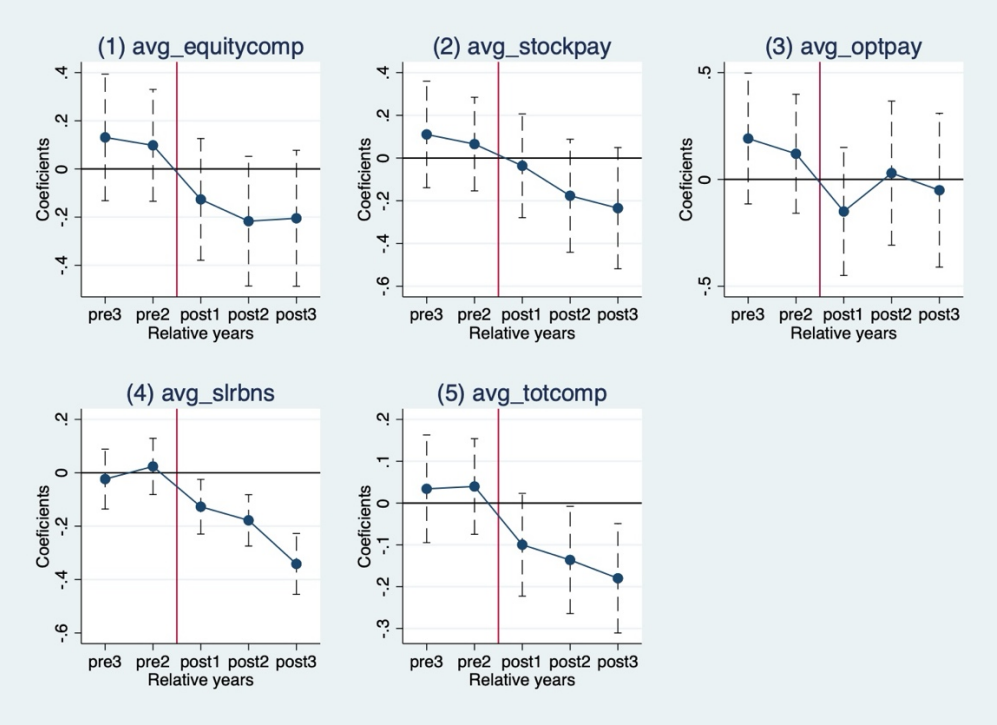

Figure B.1: Pre-trend test for directly affected boards after EPA enforcement

This figure reports the dynamic changes in the average board compensation of firms that directly experience EPA enforcement in the years before and after the enforcement. Specifically, this figure plots the coefficients for the following regression:

$$Y_{ijct} = \beta_0 + \beta_1 pre3 \times treat_{ijct} + \beta_2 pre2 \times treat_{ijct} + \beta_3 post1 \times treat_{ijct} + \beta_4 post2 \times treat_{ijct} + \beta_5 post3 \times treat_{ijct} + \gamma_{ijc} + \omega_{tc} + \epsilon_{ijct}$$

Where $pre3 \times treat_{ijct}$ and $pre2 \times treat_{ijct}$ are dummy variables equal to 1 for the treated boards if the year is three year or two years prior to a major EPA enforcement, respectively. $post1 \times treat_{ijct}$, $post2 \times treat_{ijct}$ and $post3 \times treat_{ijct}$ are dummy variables equal to 1 for treated boards in the year which is one year, two-year or three-year after the EPA enforcement, respectively. Cohort × firm fixed effects and cohort × year fixed effects are also included. Standard errors are clustered at the firm-year level. The five sub-figures depict the firm-level averages for equity-like compensation, stock-based pay, option-based pay, salary-plus-bonus, and total compensation, respectively. Solid dots represent point estimates for the coefficients, and dashed lines denote the 95% confidence intervals.

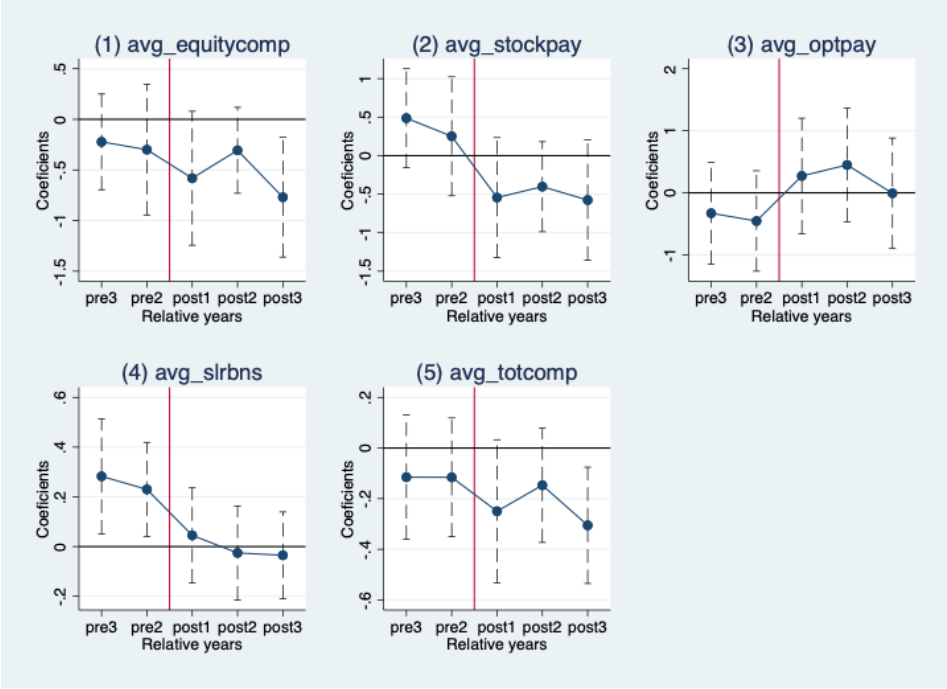

Figure B.2: Pre-trend test for directly affected boards after product recall

This figure reports the dynamic changes in the average board compensation of firms that directly experience product recall in the years before and after the recall. Specifically, this figure plots the coefficients for the following regression:

$$Y_{ijct} = \beta_0 + \beta_1 pre3 \times treat_{ijct} + \beta_2 pre2 \times treat_{ijct} + \beta_3 post1 \times treat_{ijct} + \beta_4 post2 \times treat_{ijct} + \beta_5 post3 \times treat_{ijct} + \gamma_{ijc} + \omega_{tc} + \epsilon_{ijct}$$

Where $pre3 \times treat_{ijct}$ and $pre2 \times treat_{ijct}$ are dummy variables equal to 1 for the treated boards if the year is three year or two years prior to a major product recall, respectively. $post1 \times treat_{ijct}$, $post2 \times treat_{ijct}$ and $post3 \times treat_{ijct}$ are dummy variables equal to 1 for treated boards in the year which is one year, two-year or three-year after the product recall, respectively. Cohort × firm fixed effects and cohort × year fixed effects are also included. Standard errors are clustered at the firm-year level. The five sub-figures depict the firm-level averages for equity-like compensation, stock-based pay, option-based pay, salary-plus-bonus, and total compensation, respectively. Solid dots represent point estimates for the coefficients, and dashed lines denote the 95% confidence intervals.

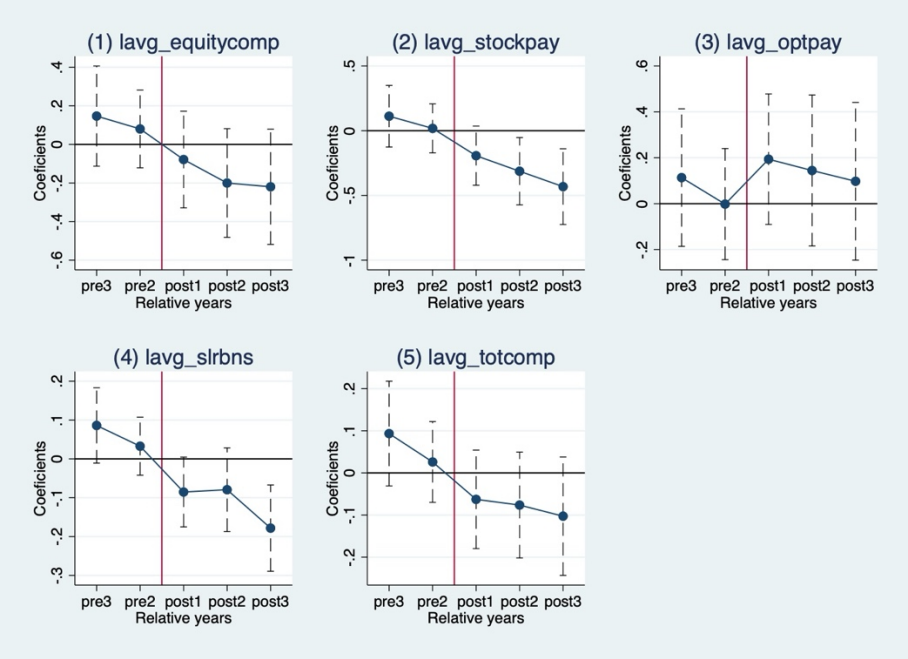

Figure B.3: Pre-trend test for first-tier connected boards after EPA enforcement

This figure reports the dynamic changes in the average board compensation of firms that are connected to those directly experience EPA enforcement in the years before and after the enforcement. Specifically, this figure plots the coefficients for the following regression:

$$Y_{ijct} = \beta_0 + \beta_1 pre3 \times treat_{ijct} + \beta_2 pre2 \times treat_{ijct} + \beta_3 post1 \times treat_{ijct} + \beta_4 post2 \times treat_{ijct} + \beta_5 post3 \times treat_{ijct} + \gamma_{ijc} + \omega_{tc} + \epsilon_{ijct}$$

Where $pre3 \times treat_{ijct}$ and $pre2 \times treat_{ijct}$ are dummy variables equal to 1 for the treated boards if the year is three year or two years prior to a major EPA enforcement, respectively. $post1 \times treat_{ijct}$, $post2 \times treat_{ijct}$ and $post3 \times treat_{ijct}$ are dummy variables equal to 1 for treated boards in the year which is one year, two-year or three-year after the EPA enforcement, respectively. Cohort × firm fixed effects and cohort × year fixed effects are also included. Standard errors are clustered at the firm-year level. The five sub-figures depict the firm-level averages for equity-like compensation, stock-based pay, option-based pay, salary-plus-bonus, and total compensation, respectively. Solid dots represent point estimates for the coefficients, and dashed lines denote the 95% confidence intervals.

Table B.1 The impact of EPA enforcement on director compensation (director level regression)

This table reports how director compensation changes after EPA enforcement using director-level data, rather than board-level average compensation. Panel A reports the compensation changes for directors of firms that directly experience the EPA enforcement, Panel B reports the changes for directors of first-tier connected boards. The independent variable is Treat × Post, which is an indicator variable and takes value of 1 for treated boards three years following a major EPA enforcement, and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a firm, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus-bonus (column (4)). Each specification includes cohort × firm × director fixed effects and cohort x year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm-director-year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

Panel A: Affected directors

	(1)	(2)	(3)	(4)	(5)
	lequitycomp	lstockpay	loptpay	lslrbns	ltotcomp
Treat × Post	-0.124***	-0.142***	-0.128**	-0.316***	-0.109***
	(0.048)	(0.046)	(0.053)	(0.028)	(0.022)
Constant	4.326***	3.822***	1.019***	4.007***	5.183***
	(0.019)	(0.019)	(0.021)	(0.011)	(0.008)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm × Director FE	Y	Y	Y	Y	Y
N	20652	20652	20652	20652	20652
R-squared	0.568	0.677	0.618	0.654	0.643
Adj. R-squared	0.462	0.597	0.524	0.569	0.555

Panel B: First-tier connected directors

	(1)	(2)	(3)	(4)	(5)
	lequitycomp	lstockpay	loptpay	lslrbns	ltotcomp
Treat × Post	-0.227***	-0.378***	0.178**	-0.134***	-0.092**
	(0.080)	(0.080)	(0.079)	(0.046)	(0.037)
Constant	4.190***	3.471***	1.168***	3.898***	5.084***
	(0.023)	(0.024)	(0.023)	(0.013)	(0.011)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm × Director FE	Y	Y	Y	Y	Y
N	22021	22021	22021	22021	22021
R-squared	0.596	0.731	0.628	0.611	0.671
Adj. R-squared	0.479	0.652	0.520	0.498	0.575

Table B.2: Impact of EPA enforcement on second-tier and third-tier connected board compensation

This table examines how the average non-executive director (NED) compensation for a second-tier or third-tier connected board changes following a major EPA enforcement, under a stacked DiD framework. Panel A reports the results for second-tier connected boards, and Panel B reports the results for third-tier connected boards. For each event year, we construct a cohort of treated and control boards. For second (third) tier connected boards, treated boards are those second (third) tier connected boards to the affected boards, and control boards are defined in a similar way as before. The independent variable, Treat × Post, is an indicator variable that takes value of 1 for treated boards in the three years following a major EPA enforcement, and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a firm, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus - bonus (column (4)). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm × year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

Panel A: Second-tier connected board

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.171	-0.307**	0.071	-0.197***	-0.163*
	(0.168)	(0.149)	(0.207)	(0.063)	(0.088)
Constant	4.073***	2.933***	1.763***	3.870***	5.002***
	(0.063)	(0.063)	(0.080)	(0.025)	(0.032)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	2089	2089	2089	2089	2089
R-squared	0.605	0.723	0.564	0.694	0.632
Adj. R-squared	0.494	0.645	0.441	0.608	0.528

Panel B: Third-tier connected board

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.451	0.212	-0.342	-0.236***	-0.306
	(0.442)	(0.417)	(0.411)	(0.085)	(0.239)
Constant	3.905***	2.539***	1.861***	3.743***	4.888***
	(0.069)	(0.065)	(0.064)	(0.013)	(0.037)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	887	887	887	887	887
R-squared	0.639	0.756	0.631	0.756	0.657
Adj. R-squared	0.502	0.663	0.491	0.663	0.526

Table B.3 Impact of Product recall and financial misconduct on first-tier connected board

This table examines how the non-executive director (NED) compensation for the first-tier connected board changes following a major product recall (Panel A) and financial misconduct (Panel B) , under a stacked DiD framework. For each event year, we construct a cohort of treated and control boards. Treated boards are those first-tier connected boards to the affected boards, and control boards are defined in a similar way as before. The independent variable, Treat × Post, is an indicator variable that takes value of 1 for treated boards in the three years following the incident, and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a firm, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus -bonus (column (4)). For Panel A, each specification includes cohort × firm fixed effects and cohort × year fixed effects, and standard errors are clustered at the firm × year level and displayed in parentheses. For Panel B, each specification includes cohort × firm × director fixed effects and cohort × year fixed effects, and standard errors are clustered at the firm ×director ×year level and displayed in parentheses. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Details regarding variable definitions can be found in Appendix A.

Panel A: Product recall

	(1) lavg_equitycomp_ned	(2) lavg_stockpay_ned	(3) lavg_optpay_ned	(4) lavg_slrbns_ned	(5) lavg_totcomp_ned
Treat × Post	-0.155	-0.193	-0.143	-0.005	0.025
	(0.150)	(0.154)	(0.173)	(0.071)	(0.053)
Constant	4.278***	3.086***	1.855***	3.868***	5.102***
	(0.031)	(0.029)	(0.038)	(0.013)	(0.013)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	5086	5086	5086	5086	5086
R-squared	0.527	0.746	0.587	0.712	0.613
Adj. R-squared	0.416	0.686	0.489	0.644	0.521

Panel B: Financial misconduct

	(1) lequitycomp	(2) lstockpay	(3) loptpay	(4) lslrbns	(5) ltotcomp
Treat × Post	0.057	-0.009	-0.047	-0.365***	-0.023
	(0.057)	(0.049)	(0.055)	(0.036)	(0.023)
Constant	3.520***	2.411***	1.521***	3.479***	4.657***
	(0.010)	(0.009)	(0.011)	(0.005)	(0.005)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm × Director FE	Y	Y	Y	Y	Y
N	46147	46147	46147	46147	46147
R-squared	0.562	0.699	0.585	0.619	0.629
Adj. R-squared	0.447	0.620	0.476	0.518	0.531

Table B.4 CEO compensation changes and turnover following EPA enforcement

This table presents how CEO compensation changes after experiencing EPA enforcement. Columns (1) to (5) report results for different components of compensation. Column (6) measures CEO turnover, defined as a dummy variable equal to 1 if the CEO leaves the firm in a given year and 0 otherwise. Column (7) measures CEO forced turnover. We use RavenPack "category" variable to define whether a CEO turnover is forced, following Parrino, Sias, and Starks (2003) and Dasgupta, Li, and Wang (2018). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm × year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	lceo_equitycomp	lceo_stockpay	lceo_optpay	lceo_slrbns	lceo_totcomp	turnover	forced_turnover
Treat × Post	-0.103	-0.407***	-0.258*	-0.032	-0.049	0.007	0.016**
	(0.069)	(0.112)	(0.140)	(0.042)	(0.031)	(0.012)	(0.007)
Constant	8.793***	7.363***	6.281***	7.194***	9.208***	0.070***	0.021***
	(0.029)	(0.044)	(0.056)	(0.011)	(0.012)	(0.002)	(0.001)
Cohort × Year FE	Y	Y	Y	Y	Y	Y	Y
Cohort × Firm ×FE	Y	Y	Y	Y	Y	Y	Y
N	6813	6813	6813	6813	6813	6808	6808
R-squared	0.525	0.685	0.640	0.618	0.681	0.101	0.104
Adj. R-squared	0.432	0.624	0.570	0.543	0.618	0.039	0.042

Table B.5 CEO compensation changes and turnover following financial misconduct

This table presents how CEO compensation changes after experiencing financial misconduct. Columns (1) to (5) report results for different components of compensation. Column (6) measures CEO turnover, defined as a dummy variable equal to 1 if the CEO leaves the firm in a given year and 0 otherwise. Column (7) measures CEO forced turnover. We use RavenPack "category" variable to define whether a CEO turnover is forced, following Parrino, Sias, and Starks (2003) and Dasgupta, Li, and Wang (2018). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm × year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	lceo_equitycomp	lceo_stockpay	lceo_optpay	lceo_slrbns	lceo_totcomp	turnover	forced_turnover
Treat × Post	-0.427	-1.702***	0.737	-0.184**	-0.364**	0.043**	0.050*
	(0.476)	(0.430)	(0.549)	(0.077)	(0.163)	(0.014)	(0.027)
Constant	7.454***	3.934***	6.283***	6.974***	8.564***	0.073***	0.038***
	(0.050)	(0.052)	(0.060)	(0.013)	(0.017)	(0.001)	(0.001)
Cohort × Year FE	Y	Y	Y	Y	Y	Y	Y
Cohort × Firm ×FE	Y	Y	Y	Y	Y	Y	Y
N	4087	4087	4087	4087	4087	4921	4921
R-squared	0.477	0.686	0.469	0.598	0.652	0.074	0.057
Adj. R-squared	0.342	0.605	0.332	0.494	0.563	0.040	0.023

Table B.6 Impact of Reprisk major environmental incidents on board compensation and spillover effects

This table examines how the average non-executive director (NED) compensation for directly affected boards (Panel A), first-tier (Panel B), second-tier (Panel C), or third-tier (Panel D) connected boards changes following a major EPA enforcement, under a stacked DiD framework. For each event year, we construct a cohort of treated and control boards. The construction of the treated and control boards follows the procedure described earlier. The independent variable, Treat × Post, is an indicator variable that takes value of 1 for treated boards in the three years following a major EPA enforcement, and 0 otherwise. The event year itself is excluded. The dependent variables across columns (1) to (5) represent different components of the average NED compensation of a firm, with a log-plus-1 transformation. Column (1) reports the director equity-like compensation, which is the sum of director stock-based pay (column (2)) and option-based pay (column (3)). Column (4) represents salary-plus-bonus, while column (5) reports total compensation, which is the sum of equity-like compensation (column (1)) and salary-plus -bonus (column (4)). Each specification includes cohort × firm fixed effects and cohort × year fixed effects. *, **, and *** denote significance level of 10%, 5% and 1%, respectively. Standard errors are clustered at the firm × year level and displayed in parentheses. Details regarding variable definitions can be found in Appendix A.

Panel A: Directly affected board

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.268*	-0.280*	0.061	0.046	-0.155**
	(0.150)	(0.152)	(0.195)	(0.052)	(0.063)
Constant	4.849***	4.754***	0.507***	4.409***	5.478***
	(0.038)	(0.038)	(0.054)	(0.022)	(0.018)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	1184	1184	1184	1184	1184
R-squared	0.510	0.542	0.563	0.499	0.504
Adj. R-squared	0.381	0.421	0.448	0.367	0.373

Panel B: First-tier connected board

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.021	-0.265***	0.561***	-0.090**	-0.029
	(0.092)	(0.099)	(0.121)	(0.035)	(0.036)
Constant	4.891***	4.514***	0.948***	4.326***	5.502***
	(0.023)	(0.026)	(0.034)	(0.010)	(0.010)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	4071	4071	4071	4071	4071
R-squared	0.514	0.634	0.624	0.677	0.562
Adj. R-squared	0.401	0.550	0.537	0.602	0.460

Panel C: Second-tier connected board

	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp

Treat × Post	-0.195***	-0.329***	0.017	-0.064**	-0.080**
	(0.065)	(0.071)	(0.102)	(0.029)	(0.035)
Constant	4.914***	4.555***	0.988***	4.325***	5.507***
	(0.021)	(0.024)	(0.034)	(0.010)	(0.012)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	5247	5247	5247	5247	5247
R-squared	0.578	0.674	0.625	0.742	0.523
Adj. R-squared	0.477	0.597	0.536	0.680	0.410
Panel D: Third-tier connected board					
	(1)	(2)	(3)	(4)	(5)
	lavg_equitycomp	lavg_stockpay	lavg_optpay	lavg_slrbns	lavg_totcomp
Treat × Post	-0.262***	-0.405***	-0.098	-0.102***	-0.162***
	(0.084)	(0.091)	(0.115)	(0.033)	(0.038)
Constant	4.921***	4.514***	1.115***	4.317***	5.519***
	(0.032)	(0.035)	(0.045)	(0.013)	(0.015)
Cohort × Year FE	Y	Y	Y	Y	Y
Cohort × Firm FE	Y	Y	Y	Y	Y
N	3829	3829	3829	3829	3829
R-squared	0.558	0.672	0.650	0.721	0.577
Adj. R-squared	0.449	0.590	0.563	0.652	0.471

Table B.7: Voting results on director elections

This table reports the director voting results and subsequent turnover changes after EPA enforcement and financial misconduct. Panel A reports the voting results and Panel B reports director turnover. Treat × Post, is an indicator variable that takes a value of 1 for treated boards in the three years following a EPA enforcement or a financial misconduct incident and 0 otherwise. Cmmt is a dummy variable that takes the value 1 if the director serves on at least one of the audit or nominating & governance committees. Support_ratio is constructed following the method of Malenko and Shen (2016), which is the number of votes "for" divided by the "base", as reported on the ISS. Pass, which equals 1 if the proposal passes and 0 otherwise. Director_turnover is a dummy variable equal to 1 if the director leaves the firm in year t, and 0 otherwise. Forced_turnover is a dummy variable equal to 1 if, in year t, the director leaves the board after receiving an election voting support ratio below 90%. Each specification includes cohort × firm × director fixed effects and cohort × year fixed effects. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively. Standard errors are clustered at the firm-director-year level and displayed in parentheses.

Panel A: Voting on director election

	EPA Enforcement		Financial Misconduct	
	(1)	(2)	(3)	(4)
	Support_ratio	Pass	Support_ratio	Pass
Treat × Post	-0.002	0.001	0.005	0.005
	(0.003)	(0.003)	(0.032)	(0.005)
Treat × Post × Cmmt			-0.007	-0.002
			(0.034)	(0.005)
Constant	0.964***	0.997***	0.963***	0.993***
	(0.001)	(0.001)	(0.001)	(0.001)
Cohort × Year FE	Y	Y	Y	Y
Cohort × Firm × Director FE	Y	Y	Y	Y
N	6888	6900	4700	4735
R-squared	0.439	0.405	0.475	0.367
Adj. R-squared	0.259	0.213	0.238	0.081

Panel B: Director turnover

	EPA Enforcement		Financial Misconduct	
	(1)	(2)	(3)	(4)
	Director_turnover	Forced_turnover	Director_turnover	Forced_turnover
Treat × Post	-0.011	0.005	0.085**	-0.009
	(0.008)	(0.003)	(0.040)	(0.007)
Treat × Post × Cmmt			-0.070	0.084**
			(0.044)	(0.041)
Constant	0.064***	0.003**	0.091***	0.006***
	(0.003)	(0.001)	(0.002)	(0.002)
Cohort × Year FE	Y	Y	Y	Y
Cohort × Firm × Director FE	Y	Y	Y	Y
N	19452	6888	32531	4700
R-squared	0.331	0.276	0.301	0.370
Adj. R-squared	0.191	0.043	0.143	0.085

european corporate governance institute

about ECGI

The European Corporate Governance Institute has been established to improve *corporate governance through fostering independent scientific research and related activities.*

The ECGI will produce and disseminate high quality research while remaining close to the concerns and interests of corporate, financial and public policy makers. It will draw on the expertise of scholars from numerous countries and bring together a critical mass of expertise and interest to bear on this important subject.

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