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Is Pollution Value-Maximizing? The DuPont Case

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Abstract

Can companies systematically profit by externalizing major costs on society? The answer to this question depends on the effectiveness of three deterrence mechanisms, namely, litigation, regulation, and reputation. This Article examines the conditions under which all three deterrence mechanisms fail simultaneously, allowing companies to do well financially by doing harm. Using DuPont's decades-long emissions of the toxic chemical PFOA as a case study, we diagnose systemic weaknesses in corporate deterrence and identify targeted policy solutions. For six decades, DuPont emitted PFOA, causing irreparable harm to human health and the environment. To examine how such catastrophic pollution can come from such a respected company, we review thousands of internal company documents that were unearthed during litigation. The documents allow us to reconstruct the costs and benefits of pollution as DuPont executives viewed them in real time. We also conduct content analysis of media coverage of the PFOA debacle to examine whether these DuPont executives suffered hits to their labor-market reputation following the debacle and interview key players involved in the debacle. We then merge the insights from DuPont's case with recent studies of corporate deterrence, to make the following three contributions. First, we demonstrate through financial analysis that pollution can be profitmaximizing for chemical companies, even when it is very harmful to society. Second, we explain why all deterrence mechanisms failed. A large time lag between the executive decision to pollute and the payment of sanctions for the pollution diluted the deterrent effect of tort litigation. Weak statutory design and the revolving doors between regulators and chemical companies rendered regulation ineffective. And the ability of chemical companies to control the information environment and manufacture doubt about the effects of their chemicals watered down the effectiveness of reputational discipline. Finally, we propose concrete policy instruments to improve deterrence, such as introducing an environmental qui tam mechanism, recalibrating the oversight duty doctrine, and redesigning prejudgment interest rules.

Keywords: Pollution, Firm Objectives, Environmental Regulation, Information Suppression

JEL Classifications: K32, Q52, L21

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IS POLLUTION VALUE-MAXIMIZING?

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Can companies systematically profit by externalizing major costs on society? The answer to this question depends on the effectiveness of three deterrence mechanisms, namely, litigation, regulation, and reputation. This Article examines the conditions under which all three deterrence mechanisms fail simultaneously, allowing companies to do well financially by doing harm. Using DuPont's decades-long emissions of the toxic chemical PFOA as a case study, we diagnose systemic weaknesses in corporate deterrence and identify targeted policy solutions.

For six decades, DuPont emitted PFOA, causing irreparable harm to human health and the environment. To examine how such catastrophic pollution can come from such a respected company, we review thousands of internal company documents that were unearthed during litigation. The documents allow us to reconstruct the costs and benefits of pollution as DuPont executives viewed them in real time. We also conduct content analysis of media coverage of the PFOA debacle to examine whether these DuPont executives suffered hits to their labor-market reputation following the debacle and interview key players involved in the debacle. We then merge the insights from DuPont's case with recent studies of corporate deterrence, to make the following three contributions.

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INTRODUCTION

Can companies make money for their shareholders by externalizing large costs on society? Numerous practitioners and scholars are espousing a win-win approach to corporate governance, according to which companies that do good for society will also do well financially. The greener a company is, the better it will be able to attract talent, retain customers, and secure financing, or so the argument goes.[1] Proponents of the win-win approach assume that the inverse is also true: the more a company pollutes, the more it will suffer from heavier legal sanctions and reputational fallouts, and the worse it will do financially.

This Article highlights the conditions under which companies can do well by *doing bad*. It illustrates the limits of the win-win approach by using the unique case study of DuPont, one of the largest and most respected companies in American history.[2] DuPont used an extremely toxic chemical called PFOA in the process of manufacturing Teflon. For over six decades (1951–2013), DuPont emitted PFOA into the air, ground, and drinking water of nearby communities. During that time, DuPont was widely perceived as "a company driven by science" and its CEOs were hailed as environmental visionaries who quite literally wrote the book on corporate sustainability.[3]

To understand how such catastrophic pollution could come from such a respected and reputation-sensitive company, we dissect a trove of internal company documents that litigation against DuPont has unearthed. By analyzing decades of internal communications, we reconstruct the *private* costs and benefits of using PFOA as company insiders viewed them in real time. We then contrast the company's internal perspective with the *social* costs and benefits of PFOA pollution. To assess whether DuPont directors and officers suffered reputational fallouts for their company's behavior, we analyze the content of media coverage of the PFOA debacle. We also interview key players involved in the controversy, from the lawyer who held DuPont accountable to chemical experts who attempted to study PFOA effects but were rebuffed. We then merge the evidence from DuPont's case with recent empirical and theoretical studies of corporate deterrence, to spotlight holes in conventional theories and offer concrete policy levers to deter corporate pollution. In the process, we make the following three contributions.

First, we show that pollution can be profit-maximizing for chemical companies, even when it is very harmful to society. To highlight the divergence between private motives to pollute and the public interest, we focus on a crucial

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[1] *See generally* ALEX EDMANS, GROW THE PIE: HOW GREAT COMPANIES DELIVER BOTH PURPOSE AND PROFIT (2020) (providing a book-length account of the win-win approach).

[2] *Infra* notes 14–15.

[3] *See, e.g.*, Leo E. Strine, Jr., *Corporate Power Is Corporate Purpose I: Evidence from My Hometown*, 33 OXFORD REV. ECON. POL'Y 176, 180 (2017) (former Chief Justice of Delaware Supreme Court, praising DuPont for its "track record of long-term investment and better-than-typical treatment of constituencies other than stockholders"); *infra* notes 181–183.

meeting in DuPont's headquarters in 1984. By then, company insiders already knew that PFOA is toxic, does not break down in the environment, and accumulates in human blood. In 1984, they learned for the first time that this unusually toxic and persistent chemical had entered the water supplies of nearby communities. DuPont executives then called a meeting to decide between three options: (1) ceasing to use PFOA; (2) continuing to use PFOA while investing in abatement measures; or (3) continuing to use PFOA without abatement. DuPont chose option (3). In fact, it doubled production. The fundamental question is why. Why did not the company at least invest in abatement, which was relatively cheap and could have saved the company from ultimately paying billions in legal sanctions and reputational damages (not to mention the catastrophic harm to the environment and nearby communities)?

One possible answer is that DuPont executives greatly underestimated the adverse health effects of PFOA and underestimated the company's exposure to liability. The internal documents allow us to dispel this possibility. In real time, DuPont insiders referred to PFOA as the company's "number one legal issue," indicating that they anticipated a very large legal sanction if caught.

Another possibility is that DuPont executives knew what they were doing: they simply decided that the profits from polluting at present outweighed whatever sanction the company might end up paying down the road. The internal documents support this possibility. We calculate the present value of the three options that were on the table in 1984 and show that even if DuPont had correctly anticipated suffering a *billion*-dollar sanction in the future, the company may have still found it worthwhile to pollute without investing in abatement, as long as the probability of being detected and punished was perceived as less than 19%. While we cannot confirm what probability DuPont executives subjectively assigned to being caught and punished, we demonstrate that only a combination of several unlikely events led DuPont to ultimately being held accountable. Thus, it is hard to imagine that the perceived probability was above 19%. Our conclusion is sobering: polluting may very well have been the shareholder value-maximizing decision in 1984.

In and of itself, the divergence between private and social interests in pollution is not surprising. Some of our readers may take it as an axiom that business companies have incentives to externalize their costs on others. What is surprising about DuPont's case even for these skeptical readers is that the company *got away* with externalizing major costs for such a long period. Every modern economy has institutions that are meant to curb such corporate externalities: ex-ante regulatory interventions, such as dictating that a company cannot use a certain chemical; ex-post impositions of liability, forcing a polluting company to fully compensate the victims of emissions; and reputational fallouts, where a company and its managers lose future business opportunities when the market learns about what they did. Granted, each of these mechanisms suffers from its own flaws. But because the flaws of each

mechanism are not perfectly correlated with the others,[4] experts and laypersons assume that a combination of the three mechanisms work to deter major externalities.[5]

This is where our second contribution comes in: highlighting conditions under which all mechanisms fail *simultaneously*. The threat of tort liability failed to deter pollution primarily because of the large time lag. DuPont started paying significant sanctions for their behavior only thirty-three years after the 1984 decision. We show that a $1 billion sanction in 2017 is equivalent to $100 million in 1984 (adjusting to the time value of money). In other words, even if DuPont anticipated paying huge sanctions down the road, pollution remained value-maximizing as long as these sanctions came *way* down the road.

The threat of regulatory intervention failed to deter pollution because of a poor design of the statutory framework and the ability of large chemical companies to dilute enforcement. The Toxic Substances Control Act (TSCA), which DuPont helped shape, "grandfathered" chemicals like PFOA that were already in use when TSCA went into effect in 1976.[6] Regulation of existing chemicals was built on the premise that chemical companies will self-report damning information about their own chemicals. But when the chemical in question is extremely profitable, such a regulatory regime only incentivizes companies to suppress existing information and not to fund further testing. Even after damning information about PFOA surfaced and reached the regulator, DuPont could pull levers to dilute regulatory enforcement, such as hiring former regulators at the local and national levels.

The DuPont case also illuminates conditions under which reputational discipline (the threat of losing future business opportunities) is ineffective. A large time lag between pollution and detection dilutes the force of labor-market reputational concerns. We show that by the time news about PFOA started surfacing, all relevant players from the 1980s either had died, retired, or emerged unscathed without even being mentioned in media coverage of PFOA. At the organizational level, the internal documents show how giant corporations can actively limit the credibility and diffusion of damning information even after it surfaces. To generalize, reputational deterrence is effective when the harms are immediate, concentrated, and certain. It is ineffective when the harms are delayed, dispersed, and probabilistic.

Our third and final contribution is to identify policy instruments to improve deterrence. The core problem highlighted by the DuPont case is extreme information asymmetries about manmade pollutants. Large chemical companies can maintain an information monopoly for decades. Thus, the policy

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[4] The idea is that even when the regulators are captured, private litigation could hold polluters to account; even if litigation is delayed, reputational fallouts are immediate; and so on.

[5] *See, e.g.*, KENT A. CLARK CTR. FOR GLOB. MKTS., STAKEHOLDER CAPITALISM SURVEY (Sept. 21, 2022), https://www.kentclarkcenter.org/surveys/stakeholder-capitalism-3/ (asking top financial economists whether they believe that profit-maximizing companies can consistently impose significant negative externalities. Out of the top economists, 47% of said no, and only 30% said yes).

[6] *Infra* note 130.

instruments that are effective are those that curb the information asymmetry. For example, the most frequent proposal is to increase the severity of sanctions when companies are caught. But increasing the severity of sanctions will not reduce companies' incentives to suppress information; in fact, it may increase them. Policy proposals that could improve the information flows include introducing an environmental qui tam mechanism (to enhance information flows from inside the company to the outside world), and recalibrating corporate law's oversight duties (to enhance information flows from the bottom of the corporate hierarchy to its top).

Our analysis is closely related to a vast literature on corporate wrongdoing and deterrence. We differ from the extant literature in both focus and methodology. In terms of focus, prior studies typically examine only one of the three deterrence mechanisms in isolation. Some discuss how companies are underdeterred by tort litigation.[7] Others lament that companies get away with violating regulations.[8] Yet others find that companies do not suffer significant reputational fallouts when they pollute.[9] Our analysis underscores the need to think about corporate deterrence holistically: deterrence comes from a combination of the three mechanisms. From a policymaking perspective, our analysis spotlights the most worrisome sets of circumstances, namely, those that lead to the joint failure of all deterrence mechanisms.

Methodologically, our study relies on a rich case study. We do not marshal broad statistical claims about the prevalence of noncompliance with environmental regulation. Instead, we aim at fleshing out the *mechanisms* that enable noncompliance.[10] Getting a rare peek into a giant company's decision-making processes is especially valuable when one considers questions of deterrence. After all, deterrence is shaped by perception: what matters is not the magnitude of sanctions or the likelihood of detection per se, but rather how decision-makers within companies perceive these factors in real time.

Choosing DuPont as the locus of a case study on deterrence follows the recommendation of qualitative methodologists to sample "crucial, least likely

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[7] *See, e.g.*, Don Dewees & Michael Trebilcock, *The Efficacy of the Tort System and Its Alternatives: A Review of Empirical Evidence*, 30 OSGOODE HALL L. REV. 57 (1992) (surveying the literature).

[8] *See, e.g.*, Dennis M. King & Jon G. Sutinen, *Rational Noncompliance and the Liquidation of Northeast Groundfish Resource*, 34 MARINE POL'Y 7 (2009) (providing a specific example).

[9] *See* Jonathan M. Karpoff, *Does Reputation Work to Discipline Corporate Misconduct*?, *in* THE OXFORD HANDBOOK OF CORPORATE REPUTATION 362 (Michael L. Barnett & Timothy G. Pollock, eds., 2014) (surveying the literature).

[10] In that respect, the Article corresponds with a subgenre in the literature on corporate wrongdoing, which is based on postmortem analyses of large debacles. *See, e.g.*, Dennis A. Gioia, *Pinto Fires and Personal Ethics: A Script Analysis of Missed Opportunities*, 11 J. BUS. ETHICS 379 (1992) (on car safety); W. Kip Viscusi, *Pricing Lives for Corporate Risk Decisions*, 68 VAND. L. REV. 1117 (2015) (surveying the literature); Joni Hersch, *Breast Implants: Regulation, Litigation, and Science*, *in* REGULATION THROUGH LITIGATION 142 (Kip Viscusi, ed., 2002) (on cosmetic surgeries). One key difference between our analysis and existing ones is that we quantify the difference between social and private incentives to pollute. Existing analyses either lament the absence of cost-benefit analysis (Viscusi, *id*) or show just the company's side of it (Gioia, *id*).

cases."[11] DuPont is hardly a fly-by-night operator. It has long enjoyed a reputation for thinking long term and taking care of its stakeholders, and possesses the economies of scale to invest in abatement and compliance. According to conventional theories of deterrence, such well-established, reputation-sensitive companies are the ones least likely to engage in serious misconduct. Examining why the PFOA debacle nevertheless occurred allows us to identify holes in conventional theories and practices. It also generates testable hypotheses for further empirical research. Indeed, following the circulation of early drafts of this Article, teams of researchers empirically tested several of our hypotheses, such as whether local news outlets are captured by large companies, or whether large companies can deflect blame by spinning off their polluting units.[12]

The Article proceeds in four parts. Part I provides the factual background, explaining how DuPont began using PFOA, and identifying the pivotal decision point in 1984. Part II calculates the costs and benefits of each option that was on the table in the 1984 meeting, concluding that DuPont's decision to continue emitting PFOA without investing in abatement was probably a shareholder value-maximizing decision ex ante, despite being socially inefficient. Part III examines why the external systems of control – legal liability, regulation, and reputation – all failed to deter this socially harmful pollution. Part IV draws lessons from the DuPont case to reassess widely proposed policy solutions and introduce new solutions. A short Conclusion summarizes our main contributions and identifies questions for future research.

I. WHAT HAPPENED: SIX DECADES OF PFOA EMISSIONS

DuPont is one of the oldest American companies, continually operating since 1802 in Wilmington, Delaware.[13] The company was born when Thomas Jefferson called the attention of its founders to the young nation's need for gunpowder.[14] Throughout the relevant timeframe of our analysis (1984–2017), DuPont was consistently referred as "one of the most distinguished of any U.S. corporation," and scored highly on environmental and corporate governance metrics.[15] Like any other chemical company, DuPont has faced multiple

[11] *See, e.g.*, THE SAGE ENCYCLOPEDIA OF QUALITATIVE RESEARCH 70 (Lisa Given, ed., 2008).
[12] *Infra* notes 156, 190.
[13] After the events relevant to the timeframe of our analysis (1984–2017) transpired, DuPont merged with Dow Chemical and in May 2024 announced plans to split into three companies. Samantha Delouya, *A 220-Year-Old American Corporate Powerhouse is Breaking Up*, CNN (May 22, 2024), https://www.cnn.com/2024/05/22/business/dupont-de-nemours-company-split.
[14] *See generally* Susan Chaplinsky et al., *DuPont Corporation: Sale of Performance Coatings* (Darden Case No. UVA-F-1709, 2014) (a business-school case study detailing the evolution of DuPont).
[15] *See, e.g.*, Bill George, *The DuPont Proxy Battle Is a Battle for the Soul of American Capitalism*, HUFFINGTON POST (May 11, 2015), http://www.huffingtonpost.com/bill-george/the-dupont-proxy-contest_b_7256490.html; ROBERT BILOTT, EXPOSURE: POISONED WATER, CORPORATE GREED, AND ONE LAWYER'S TWENTY-YEAR BATTLE AGAINST DUPONT 77 (2019) (hereinafter "Exposure").

decision points under uncertainty, whereby a chemical that makes better products may also be damaging to the environment and human health. The PFOA story is perhaps the starkest example of such a decision point.

Section A explains why DuPont started using PFOA. Section B summarizes the adverse environmental and health effects of PFOA emissions. Section C introduces the key decision point in our analysis, namely, the 1984 fork-in-the-road meeting. Section D reconstructs what information was available to these DuPont executives back in 1984.

A. Starting to Use PFOA

In the 1930s, a DuPont scientist accidentally created a substance that would later be known as Teflon, when experimenting with refrigerants.[16] Trying to reproduce Teflon on a mass scale proved to be dangerous and ineffective at first.[17] Then, DuPont learned that using a chemical known as PFOA helps to stabilize the reaction needed to produce Teflon.[18] A combination of carbon and fluorine made PFOA very stable to heat and repellent to water, and thus great for production.[19] Yet it also made the chemical potentially very dangerous to the environment and humans, as it does not break down in the environment and accumulates in human blood.[20]

From 1951 to 2000, DuPont received PFOA from a supplier called 3M. DuPont handled the material in their Washington Works plant, located in West Virginia near the Ohio border. By 2003, the Washington Works plant had released more than 1.7 million pounds of PFOA into the nearby environment.[21] PFOA emissions came in three forms: poured from the outflow pipes of the plant into the Ohio River, where it traveled down- and upstream; transferred in trucks and buried in unmarked landfills, where it leached into drinking wells; and pumped through the plant's smokestacks into the air.[22] Throughout all these decades, the affected communities and the relevant regulators knew next to nothing about the chemical or the fact that it was being emitted on such a scale. The outside world started learning about the problem of PFOA emissions only in the early 2000s, following a tort lawsuit.

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[16] *See* Richard D. Lyons, *Roy J. Plunkett is Dead at 83; Created Teflon While at Du Pont*, N.Y. TIMES (May 15, 1994), http://www.nytimes.com/1994/05/15/obituaries/roy-j-plunkett-is-dead-at-83-created-teflon-while-at-du-pont.html.

[17] Exposure, *supra* note 15, at 53–58.

[18] *Id* (explaining that PFOA is a surfactant, meaning that it reduces the tension between two surfaces, thereby smoothing out the process of producing Teflon).

[19] *Id*. at 67.

[20] *See* Linda G. T. Gaines, *Historical and Current Usage of Per- and Polyfluoroalkyl Substances (PFAS): A Literature Review*, 66 AM. J. INDUS. MED. 353, 354 (2022).

[21] *See generally* Dennis J. Paustenbach et al., *A Methodology for Estimating Human Exposure to Perfluorooctanoic Acid (PFOA): A Retrospective Exposure Assessment of a Community (1951–2003)*, 70 J. TOXICOLOGY ENVT'L HEALTH 28 (2007) (detailing the amounts of emissions); Veronica M. Vieira et al., *Perfluorooctanoic Acid Exposure and Cancer Outcomes in a Contaminated Community: A Geographic Analysis*, 121 ENVT'L HEALTH PERSP. 318 (2013) (detailing the geography of emissions).

[22] Paustenbach et al., *id*.

B. Learning about Problems with PFOA

In the mid-1990s, the Tennants – a family of farmers living near DuPont's West Virginia plant – started suspecting the plant's emissions.[23] Their cattle all died after drinking water from a creek that was close to a DuPont landfill.[24] The Tennants voiced their concerns to the company and local regulators.[25] The latter brushed the farmers off, telling them that their cattle were dying because the farmers were not taking good care of them.[26] The Tennants were not aware of PFOA and its effects at the time, but as long-time farmers, they knew that something was wrong, and so they retained a lawyer and sued.[27] Little did they know that their individual lawsuit ("the Tennant Litigation") would end up surfacing a much bigger story. The discovery process in the Tennant litigation and subsequent lawsuits unearthed internal documents containing damning information about PFOA's effects, which were known inside DuPont and 3M in real time but kept away from the public eye.

Following the Tennant Litigation, citizens in nearby communities filed a class action against DuPont for contaminating the area's drinking water ("the Class Action").[28] As part of settling the class action, DuPont agreed in 2004 to facilitate a thorough examination of PFOA's health effects by an independent science panel. In 2012, the panel published its results, finding that DuPont's PFOA emissions are linked to six types of diseases: (1) high cholesterol, (2) ulcerative colitis, (3) thyroid diseases, (4) testicular cancer, (5) kidney cancer, and (6) pregnancy-induced hypertension.[29] Of the 70,000 individuals drinking the contaminated water, 3,500 were diagnosed back then as suffering from the enumerated diseases.[30] In recent years more scientists started studying the long-

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[23] Exposure, *supra* note 15, at 4.

[24] Nathaniel Rich, *The Lawyer who Became DuPont's Worst Nightmare*, N.Y. TIMES (Jan. 6, 2016), http://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html.

[25] *Id*.

[26] *Id*.

[27] *Id*.

[28] *See generally* Elizabeth V. Young, *Outsourcing the Jury: Bartlett v. DuPont and the Role of Alternative Adjudication in Preserving Jury "Fairness" in Complex Scientific Litigation,* 77 OHIO ST. L. J. 15 (2016) (describing the class action proceedings).

[29] C8 SCIENCE PANEL, PROBABLE LINK REPORT (Oct. 29, 2012), http://www.c8sciencepanel.org/prob_link.html.

[30] Each of these individuals was set to litigate his or her own damages claim with DuPont (Young, *supra* note 28). After several bellwether cases were tried in 2015–2016, ordering DuPont to pay damages ranging from $1.6ml to $12.5ml, the company settled all cases for $670ml in February 2017. *DuPont Reaches Global Settlement of Multi-District PFOA Litigation*, DUPONT.COM (Feb. 13, 2017), https://www.dupont.com/news/dupont-reaches-global-settlement-of-multi-district-pfoa-litigation.html.

term health effects of PFOA, and found that it also impairs the immune system,[31] reduces fertility,[32] and causes many more ailments.[33]

By 2013, shortly after the science panel submitted its conclusions, DuPont stopped using PFOA and replaced it with a new chemical from the same family. The new chemical is supposed to be less persistent, but the jury is still out on its long-term health effects.[34]

C. Reaching a Crucial Decision Point in 1984

This Article spotlights DuPont's decisions in real time to keep using PFOA even when faced with alarming information about the pollutant's effects. Specifically, the Article zooms in on a top-level meeting at DuPont's headquarters in May 1984. That meeting was convened after DuPont's medical director sent memos to the company's heads of business units, alerting them to the critical mass of alarming information that had accumulated on PFOA emissions.[35] The nine heads of the business units were joined by the company's chief toxicologist and other legal and scientific staffers, to discuss how to proceed.[36]

Thanks to the discovery process in litigation, we have access to the preparation materials that these executives received, and to a lengthy memo summarizing the options that they considered. Three options were on the table: (1) stopping use of PFOA altogether, (2) continuing use of PFOA while investing in abatement measures, or (3) continuing use of PFOA without investing in abatement. The business executives understood that the medical and legal departments favored option (1): halting production.[37] But the executives were concerned that such a decision would jeopardize the viability of a very profitable business segment.[38]

DuPont ended up choosing option (3): continuing to produce without investing in abatement. In fact, DuPont doubled the production of PFOA.[39]

The question is why. The option of abating PFOA was relatively cheap and could have prevented much of the horrific damage to the community as

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[31] *See* Nadia Gaber et al., *The Devil They Knew: Chemical Documents Analysis of Industry Influence on PFAS Science*, 89 ANNALS GLOB. HEALTH 37, 40 (2023).
[32] Andrea Di Nisio et al., *Endocrine Disruption of Androgenic Activity by Perfluoroalkyl Substance: Clinical and Experimental Evidence*, 104 J. CLIN. ENDOCRINOL METAB 1259, 1266 (2019).
[33] *See, e.g.*, Suzanne E. Fenton et al., *Per- and Polyfluoralkyl Substance Toxicity and Human Health Review: Current State of Knowledge and Strategies for Informing Future Research*, 40 ENV'TL TOXICOLOGY & CHEMISTRY 606, 607–11 (2020) (surveying the literature).
[34] *See, e.g.*, Paul Karoff, *EPA's New Rules on Forever Chemicals Don't Go Far Enough, Study Suggests*, HARV. GAZETTE (May 16, 2023) (detailing the problems with the new family of chemicals: the shorter chain of carbons makes them less bio-accumulative, but also potentially harder to filter and more toxic).
[35] Exposure, *supra* note 15, at 189.
[36] *Id*. at 190.
[37] *Id*. at 191.
[38] *Id*.
[39] *Id*. at 192.

well as whatever legal and reputational sanctions DuPont ended up suffering.[40] Why did DuPont not stop production, or at minimum invest in abatement? To answer this question, we must reconstruct the information environment, to figure out what the 1984 decision-makers knew about PFOA in real time.

D. What They Knew When Deciding to Continue Polluting

The thousands of internal documents exposed during litigation allow us to analyze who inside DuPont knew what about PFOA and when. Most of the relevant documents are now publicly available through a dedicated website (hereinafter: "industry documents" website).[41] We created our own dedicated website where we host nine of the most pertinent documents (hereinafter: "online sources appendix").[42] Going through the documents in chronological order reveals how knowledge about PFOA evolved internally.

DuPont realized very quickly that PFOA is toxic. By the early 1960s, its chief toxicologist found that exposure to PFOA enlarged rat and rabbit livers.[43] In 1970, its scientists explicitly recognized that PFOA is "highly toxic when inhaled and moderately toxic when ingested."[44] In 1978, the company's occupational physician noted "unusually high" liver enzyme elevations in the blood of DuPont workers of the Parkersburg plant.[45] In 1979, DuPont's internal lab reported that PFOA causes "corneal opacity and ulceration in rats, death in dogs."[46]

Importantly, by the end of the 1970s, DuPont became aware that PFOA is not only toxic, but also extremely bio-persistent and bio-accumulative.[47] In lay terms, this means that even brief exposure to the chemical can cause serious damage to the human body over time, as our bodies cannot get rid of it. That also means that whatever damage PFOA causes to humans could remain dormant for decades.[48] Reaching that realization later led DuPont to set a community exposure guidelines for PFOA at 1 part per billion (ppb).[49] The fact that they set the permissible level so low (basically the lowest detectable level)

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[40] Bartlett v. E. I. du Pont de Nemours & Co., No. 2:13-CV0170 (S.D. Ohio Oct. 8, 2015), transcript, Vol. 7, pp. 163–73.
[41] Gaber et al., *supra* note 31.
[42] *See* online source appendix. In other instances, we refer to testimonies based on the full transcripts that we obtained from the two bellwether cases, namely, Bartlett transcripts and Vigneron transcripts. *Supra* note 40.
[43] Exposure, *supra* note 15, at 190.
[44] *Id*.
[45] Industry documents website (Bower et al., 1978).
[46] Industry documents website (Snyder et al., 1979). Note that in 1978, a 3M study on PFOS (a close cousin of PFOA) toxicity in rhesus monkeys was aborted after 20 days when all exposed subjects died. State of Minnesota v. 3M Co., No. 27-CV-10-28862, Exhibit PTX1193 (Minn. Dist. Ct. Dec. 2010), https://www.ag.state.mn.us/Office/Cases/3M/docs/PTX/PTX1193.pdf.
[47] Exposure, *supra* note 15, at 173.
[48] *Id*. at 175.
[49] *Id*. at 71.

tells us just how dangerous the company thought that PFOA can be.[50] For comparison, the safe level of lead is 15ppb and that of arsenic is 10ppb.[51]

As if that was not enough, by 1981 DuPont scientists learned that PFOA may travel from pregnant mothers to their babies and cause birth defects in humans. The realization came after 3M notified DuPont of a study whereby rat fetuses whose mothers were exposed to PFOA developed eye and nostril defects.[52] At that point, DuPont's chief medical officer notified the vice president in charge of the business unit producing Teflon.[53] DuPont scientists reviewed the 3M rat study and found it to be valid.[54] The company then started monitoring the babies of seven female workers who worked with PFOA and were pregnant at the time. They found detectable PFOA levels in the umbilical cord blood, indicating that PFOA can indeed travel through the human placenta. And two of the seven monitored babies were born with birth defects in their eyes and nostrils.[55] DuPont responded by transferring its female workers from the PFOA unit until the company could be sure that there exists a level of exposure that does not pose such potential harm.[56] Yet the company did not alert the regulator or the nearby community to the new findings.[57]

A crucial piece of information came in 1984 when DuPont learned that this extremely toxic and bio-persistent chemical had reached the nearby communities' drinking water. The company sent employees to quietly collect samples of tap water from their own homes, public water fountains, and other watering places around the area.[58] When samples came back with detectable levels of PFOA, DuPont executives called the above-mentioned top-level meeting to discuss how to proceed.[59]

Internal documents from after the May 1984 meeting complete the picture of damning information about PFOA's effects coming to DuPont executives' attention. By 1986, 3M explicitly warned DuPont that PFOA should either be incinerated or dumped in a commercial landfill (DuPont did neither at the time).[60] In 1988, DuPont learned that PFOA is an animal carcinogen and a potential human carcinogen as well.[61] And when the company detected PFOA levels above the abovementioned 1ppb threshold, they

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[50] *Id*. at 72.
[51] *Id*. at 67.
[52] Online Sources Appendix (Karrh Memo).
[53] *Id*.
[54] Online Sources Appendix (Raines Memo).
[55] Online Sources Appendix (Pregnancy Test Results). DuPont's own guidelines for the monitoring of female workers suggested ex ante that a 20% rate would be alarming. A 2-out-of-7 result should therefore have been treated as a red flag.
[56] Online Sources Appendix (Karrh Memo).
[57] Exposure, *supra* note 15, at 177.
[58] *Id*. at 70.
[59] *Id*. at 189–90.
[60] *See* Cara Salvatore, *Exxon Atty Warned DuPont Counsel on Pollution, Jury Told*, LAW 360 (Jun. 2, 2016), https://www.law360.co.uk/articles/803264/exxon-atty-warned-dupont-counsel-on-pollution-jury-told.
[61] Exposure, *supra* note 15, at 65, 178.

continued using PFOA without alerting the outside world.[62] Instead, they worked on revising the threshold.[63]

We want to be careful about what we can or cannot say here. The internal documents do not necessarily support an impression of DuPont's higher-ups making conscious decisions to harm others. The documents rather reflect a lot of epistemic uncertainty in real time regarding the scope and magnitude of PFOA's effects. What the documents do reveal, on the other hand, are decisions to err on the side of continuing to use this profitable yet dangerous chemical, and decisions not to invest in studying it further (in other words, decisions not to reduce the epistemic uncertainty).[64] To reiterate, while there was uncertainty about the exact effects of PFOA in 1984, there was certainty that this toxic chemical is unusually persistent and accumulative. Instead of proceeding with maximum caution given the prospect of creating irreversible harms to human health and the environment, DuPont executives decided to ramp up production. The same pattern of behavior continued decades later: in the early 2000s, after 3M notified DuPont that it would phase out PFOA and stop supplying it, DuPont simply started making the chemical on its own.[65]

Another indication of the executives' awareness of PFOA's effects comes from how they treated their own employees. Following the neonatal birth defects study, DuPont immediately pulled all female employees of child-bearing age from the PFOA unit and monitored the situation closely.[66] Before the 1984 meeting DuPont had already set super-low acceptable exposure levels for employees.[67] In the 1984 meeting, the executives heard assurances that the current levels of exposure were below these guidelines. Yet, nowhere in the 1984 memo do we find discussion of acceptable *community* exposure guidelines, nor do we find assurances that actual community exposure levels were safe. In other words, while DuPont was very proactive and cautious about their employees' exposure, it was very passive and nontransparent about community exposure.[68]

All in all, we can rule out the possibility that the 1984 decision was due to lack of awareness of the potential risks of PFOA. Could it have been a calculated decision to profit by externalizing large costs on society?

II. WHY IT HAPPENED: IS POLLUTION VALUE-MAXIMIZING?

[62] *Id*. at 156–59.
[63] *Id*.
[64] The documents also reveal how damning information existed in silos: the 1984 memo omitted key details about PFOA, allowing its rapporteur to state that "there was a consensus that C8, based on all the information available within the company and from 3M, does not pose a health hazard at low-level chronic exposure."
[65] Exposure, *supra* note 15, at 227.
[66] Bartlett transcripts, Vol. 4, p. 162.
[67] Exposure, *supra* note 15, at 71.
[68] *Id*. at 174, 188.

Under what conditions can companies make money for their shareholders by externalizing large costs on society? Over the past decade, numerous practitioners and scholars have espoused a win-win approach to corporate social responsibility: companies can do well by doing good.[69] Companies that treat the environment better will also do well financially, or so the argument goes.[70] The idea is that employees, customers, and investors prefer doing business with companies that are greener. The other side of coin is that companies that pollute will ultimately suffer from heavier regulatory burdens, larger legal sanctions, and reputational fallouts.

The DuPont case illustrates the limits of the win-win approach. It provides a rare concrete example, with numbers attached, that demonstrates just how consequential the divide between shareholder value maximization and social welfare can be. And it provides a rare peek behind the curtain into factors that drive companies to maximize profits by polluting, thereby facilitating better design of policy measures to deter pollution.

Section A assesses whether using PFOA to produce Teflon without investing in abatement was socially optimal, given what we know about its human health costs. Section B assesses whether such a decision was *privately* optimal for a long-term shareholder of DuPont, given what we know about the sanctions that the company ended up paying.

A. Was Pollution Socially Optimal?

Pollution comes with costs, but the optimal level of pollution is not zero.[71] To identify the optimal level, one needs to consider, among other things, the benefits of using the polluting chemical, such as a better cooking experience with Teflon.[72] To establish whether the decision to keep producing Teflon while using PFOA was socially optimal, we therefore estimate first the social benefits (Subsection 1) and then the social costs (Subsection 2) as of 1984.

1. The Social Benefits of Using PFOA

DuPont managers estimated in 1984 that replacing PFOA with another substance in the production of Teflon would have jeopardized $100–$200

[69] EDMANS, *supra* note 1.
[70] *Id*.
[71] *See* STEVEN SHAVELL, FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW 80–83 (2004).
[72] *Id*. One should also consider the social costs of undertaking efforts to reduce pollution to zero, such as the administrative costs of fighting polluting companies in courts. *Id*. We note, however, one important difference between the social costs in the PFOA case and social costs in other cases, such as the costs of cigarette smoking. With the latter, one line of argument is "informed tradeoffs": cigarette smokers presumably know that smoking is bad for them but engage in it anyhow. With the former, the harmed individuals living nearby DuPont's plant did not know and certainly did not make an informed decision to drink PFOA from their tap.

million annually in profits.[73] We know in retrospect that PFOA production continued up to 2013. Accordingly, under the assumption of perfect foresight, DuPont executives anticipated that this stream of profits would continue for at least twenty-eight years. When calculating how valuable this stream of profits was in their eyes, we need to discount future revenues (namely, all revenues that accrue after 1984) to their 1984 dollar terms. To do so, we use the T-bill rate at the time (9.8%),[74] and add a risk premium of 8% (thus assuming a beta of 1), for a total discount rate of 17.1%.[75] We further assume that DuPont executives anticipated that the profits would grow at the expected rate of inflation (which in 1984 was 4.2%).[76] Under these plausible assumptions, the present value (in 1984 dollar terms) of profits from using PFOA is between $760–$1,500 million (an average of $1.1 billion).

This number represents only the *producer* surplus. To estimate the benefits from using PFOA to produce Teflon one should also add the consumer surplus.[77] Yet, for our purposes here we can conservatively set the social benefits of using PFOA strictly at the level of DuPont's profits from the product (namely, $1.1 billion). This assumption is not far-fetched: Teflon was a trademarked product that was not sold directly to the public, but rather to retailers. We can thus assume that a shrewd producer like DuPont was able to extract a large part of the consumer surplus.[78] While it is unlikely that consumer surplus was zero, we assume that it was so in order to understate our claims. As Subsection 3 will show, this underestimation does not affect our main conclusion.

2. The Social Costs of Using PFOA

To estimate in the most conservative way possible the social costs of using PFOA, we limit ourselves to human health costs while ignoring damages to the

[73] Online source appendix (1984 meeting memo).

[74] "T-bill rate" denotes the return on US Treasury bills. US Treasury bills are short-term government securities that are considered relatively risk-free. Financial economists frequently use the T-bill rate as the baseline for discounting future cash flows, because it represents the time value of money in a risk-free investment. *See* FED. RSRV. BANK OF ST. LOUIS, *Three-Month Treasury Bill Secondary Market Rate, Discount Basis*, https://fred.stlouisfed.org/series/TB3MS/.

[75] "Risk premium" denotes here the additional return that investors require to compensate for taking on uncertainty and risk associated with an investment (here: the investment in PFOA and production of Teflon) beyond the risk-free rate provided by Treasury securities. A "beta of 1" reflects our assumption that the investment's risk level is equal to that of the overall market, in the sense that its returns are expected to move in line with market fluctuations.

[76] Assuming profits grow at the expected rate of inflation is straightforward in finance, reflecting the notion that a company's profits streams typically increase over time as prices overall are rising. In other words, the company's revenues preserve their real (inflation-adjusted) value. *See* FED. RSRV. BANK OF ST. LOUIS, *University of Michigan: Inflation Expectation*, https://fred.stlouisfed.org/series/MICH.

[77] To illustrate, it could be that DuPont is making $1 billion (in present terms) from selling Teflon, but consumers would have been willing to pay twice that price, making the social benefits equal to $2 billion.

[78] *See* PHILIP KOTLER & WALDEMAR PFOERTSCH, INGREDIENT BRANDING 159 (2010) (using Teflon as the paradigmatic example of powerful "ingredient branding," suggesting that DuPont had power to extract much of the surplus).

environment. We further narrow our scope to individuals living near the West Virginia plant, in the six closest water districts. This gives us a group of 70,000 people who lived in the area with the highest exposure to PFOA emissions. When quantifying the human health costs for these 70,000 people, we consider only costs associated with the six specific diseases that were originally enumerated in the science panel report.[79] For these diseases, we focus only on the delta, namely, the uptick in incidence and prevalence rates that can be expected in areas with high levels of exposure to PFOA (relative to areas with low levels of PFOA exposure). To get this number, we rely on calculations done in connection with the PFOA medical monitoring program, based on the unprecedented human health study that the class action led to.[80]

Appendix A describes in detail our calculations for each of the six diseases. To illustrate, for every year of exposure to high levels of PFOA, a 70,000-person community would suffer 1.05 additional cases of testicular cancer, 21 additional cases of kidney cancer, and 0.7 additional cases of ulcerative colitis. We assume that such an uptick in incidences of diseases continued for the entire period PFOA was used and stopped when PFOA was phased out (1984–2013).[81]

To go from these incidence numbers to total social costs we need to put a cost on each added incidence of disease. The latter has three components: the medical costs of treating the disease, the reduction in the quality of life due to the disease, and, in case of deadly diseases, the value of lost life.

We gather medical costs estimates based on the best practices at the time. We ignore the cost imposed by a reduction in the quality of life, for the sake of not overstating our claims. The trickiest part is assigning value to the loss of lives. For that, we use a concept routinely used in cost-benefits analysis of regulatory agencies, namely, the value of statistical life (VSL), which denotes the amount of money people are hypothetically willing to pay to reduce their risk of death by a certain amount. Different regulatory agencies use different estimates of the value of statistical life (VSL) when making regulatory decisions, and for each regulator that number varies greatly over the years.[82] For example, the EPA set VSL in 2009 at $9.1 million,[83] but an earlier meta-analysis of VSL estimates used by US regulatory agencies generates a median

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[79] C8 Panel Report, *supra* note 29.

[80] *Id*. For sources on the incidence and prevalence rates of the enumerated diseases see, e.g., Michael D. Kappelman et al., *Recent Trends in the Prevalence of Crohn's Disease and Ulcerative Colitis in a Commercially Insured US Population*, 57 DIG DIS SCI (2013); Mark P. J. Vanderpump, *The Epidemiology of Thyroid Disease*, 99 BRIT. MED. BULL. (2011).

[81] To be sure, toxic chemicals may continue to cause diseases even after the polluting company ceased releasing them. As with other factors in the equation, we opted here to use the most conservative estimate possible and err on the side of *under*stating our claim.

[82] *See generally* Paul Dolan, *The Measurement of Health-Related Quality of Life for Use in Resource Allocation Decisions in Health Care*, *in* HANDBOOK OF HEALTH ECONOMICS (Anthony J. Culyer & Jospeh P. Newhouse, eds., 2000), at 1723 (describing the difficulties in quantifying the value of life).

[83] *See* Binyamin Appelbaum, *As U.S. Agencies Put More Value on a Life, Businesses Fret,* N.Y. TIMES (Feb. 16, 2011) (reporting on the then-updated numbers).

of around $7 million.[84] We ended up using the arithmetic mean of twenty-six studies that covered the period that we focus on (the 1980s), generating a VSL of $6.2 million.[85] To bring that number to 1984 values, we adjusted for the Consumer Price Index inflation during that period,[86] and arrived at a number of $3.6 million. To ensure that we do not overstate our claims, we subsumed the reduction in the *quality* of life due to diseases such as cancer into the value of lost life.[87]

The last step is to multiply the additional incidences by the value of lost life due to the incidences, and to discount all costs so that they are expressed in 1984 dollars terms.[88] The bottom line of this ultraconservative estimate puts the social costs of using PFOA at $369 million.[89]

3. The Costs of Abating PFOA Pollution

From the 1984 meeting memo we know that there was a third option on the table, namely, continuing to use PFOA while investing in abatement measures that would reduce emissions. That way, the company could supposedly keep the sizeable stream of profits (calculated in Subsection 1) while not causing sizeable societal costs (calculated in Subsection 2).[90] The question was how costly such an investment would be for the company. Luckily for us, the 1984 memo contains a detailed assessment of the cost of building an incineration device: an upfront cost of $1 million (to build the device) and an ongoing cost of $1 million per year (to operate the device).[91] To adjust these numbers to 1984 dollar terms, we assume that the operating costs remain constant in real terms and do not fluctuate with the market, and discount them at the same *real* rate we used for the social cost calculation (5.6%).

Our calculations show that in 1984 present-value terms, the costs of investing in abatement were $18.8 million.[92]

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[84] *See* W. Kip Viscusi & Joseph E. Aldy, *The Value of a Statistical Life: A Critical Review of Market Estimates throughout the World*. 27 J. RISK UNCERTAINTY 5 (2003).
[85] *Id*.
[86] The Consumer Price Index tracks the prices of a standardized basket of goods and services over time.
[87] Several studies suggest that the costs of dying from cancer should reflect a higher value than the VSL attached to dying from industrial accidents, since the former comes with a lengthy, agonizing morbidity period and dread. *See, e.g.*, Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 COLUM. L. REV. 941, 972–74 (1999). In keeping with the theme of estimating conservatively so as not to overstate our results, we chose not to count this debatable morbidity factor. For studies measuring the costs of the other enumerated diseases included in our calculations see Russel D. Cohen et al., *Systematic Review: The Costs of Ulcerative Colitis in Western Countries*, 31 ALIMENTARY PHARMACOLOGY & THERAPEUTICS 693 (2010) (surveying the literature).
[88] Since these costs are expressed in 1984 terms, we discount them at the real rate at the time: 9.8% - 4.2% = 5.6%.
[89] *Infra* Appendix A.
[90] We know from later testimonies by DuPont executives that building an incineration device would have been the best option to limit the social costs of PFOA pollution. Bartlett transcripts, Vol. 7, pp. 163–73.
[91] Online Sources Appendix (1984 meeting memo).
[92] *Infra* Appendix A.

This result is striking, and so is its upshot: it matters less whether we misestimated the value of producing Teflon with PFOA versus halting its production, because the 1984 decision crossroads contained a third avenue that clearly dominates the other two. Producing while investing in abatement was the optimal choice. The costs of the prescribed abatement measures ($18.8 million) are greatly inferior to the costs of production without abatement, according to the most conservative estimate of PFOA pollution possible ($369 million). Even readers who believe that companies should emit toxic substances if these substances net useful products must therefore acknowledge that in our case the decision to ramp up production without investing in abatement was not good for society. But was it good for DuPont?

B. Was Pollution Privately Optimal?

For our purposes, let us assume that the DuPont managers facing the 1984 decision point were strictly interested in maximizing shareholder value in the long run.[93] From the perspective of shareholder value maximization (SVM), what matters is not the social costs of pollution but rather the sanctions that the company expects to pay for polluting. This simplification allows us to model the 1984 decision using the classical economic theory of deterrence.[94] We compare the expected benefit accruing to shareholders from using PFOA with the expected sanction, assuming risk neutrality.[95] The expected sanction is a function of the perceived probability of getting caught and the perceived magnitude of the sanction imposed upon getting caught:

$$B > \pi[L + R]$$

Let B denote the benefits accruing to DuPont. π denotes the probability that DuPont's mishandling of PFOA will be detected. L denotes the legal damages DuPont will have to pay if detected. R denotes the reputational fallouts DuPont will suffer if detected, as in diminished future business opportunities. The idea is that a shareholder value maximizer will continue using PFOA only if the benefits exceed the expected sanctions as she perceives them.

The previous Section gave us the numbers for the left-hand side of the deterrence equation. The benefits of producing Teflon are around $1.1 billion, and the benefits of avoiding investment in abatement are around $19 million. This Section constructs the right-hand side of the equation.

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[93] From DuPont's 1984 proxy filing we learn that all board members, except those belonging to the Compensation Committee, were beneficiaries of an incentive plan. The maximum amount available for the rewards under that plan was a function of the company's earnings. In addition, executives were granted options under a stock option plan. Collectively, executives owned about 1.5 million options at an average strike price of $40.85. Many of the nonexecutive directors were former executives, who probably already owned shares, and were representatives of large shareholders. Thus, it is plausible to assume that DuPont's 1984 board members had a strong incentive to maximize shareholder value.

[94] S*ee generally* Gary S. Becker, *Crime and Punishment: An Economic Approach*, 76 J. POL. ECON. 169 (1968) (providing the classical account).

[95] The risk neutrality assumption is commonplace in such scenarios, because diversified shareholders typically make decisions based on expected value calculations rather than on risk aversion.

1. Magnitude of Sanction

The first difficulty that we encounter is deciphering how DuPont managers *perceived* the expected severity of sanctions in real time. DuPont ended up paying hefty sanctions in the 2010s, but did the managers at the fork-in-the-road meeting in 1984 expect that the company would have to pay such hefty sanctions in the future? The internal documents from the 1980s show DuPont insiders referring to PFOA emissions as the company's "number one legal issue."[96] Thus, they did expect to pay a very large amount if caught. We will therefore assume that DuPont had perfect foresight regarding the legal liability imposed if caught, if only to show that even the expectation of sizeable sanctions would not have deterred DuPont executives from polluting.[97]

We therefore must compile the various sanctions that DuPont paid. The first sanction came in 1997, when the West Virginia regulator slapped DuPont on the wrist with a $200,000 fine.[98] In 2001 DuPont settled the Tennant case, for an undisclosed amount, and in 2005 settled the drinking-water class action, for a reported $107 million.[99] In the class action settlement, DuPont further agreed to finance an epidemiological study and medical monitoring valued at around $350 million.[100] In 2005 the company also settled the enforcement action with the US EPA over failing to disclose information, for $16.5 million.[101] By far the biggest sanction in our timeframe came in 2017, when DuPont settled the multidistrict litigation of 3,500 private lawsuits, for $670 million.[102]

Assuming that the magnitude of legal sanctions is not correlated with the economy,[103] we can discount all these sanctions at the 1984 risk-free rate (9.8%). This puts the 1984 value of future legal sanctions at around $100 million.

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[96] Bartlett transcripts, Vol. 5, p. 243.

[97] The use of lagged actual sanctions as a proxy for perceptions of expected sanctions is also commonplace. *See* Wayne B. Gray & Jay P. Shimshack, *The Effectiveness of Environmental Monitoring and Enforcement: A Review of the Empirical Evidence*, 5 REV. ENVT'L ECON. & POL'Y 3, 12 (2011).

[98] *See In re* E.I. du Pont de Nemours & Co., Consent Agreement & Final Order, EPA Docket No. TSCA-HQ-2005-5022 (Dec. 14, 2005), https://www.epa.gov/sites/default/files/2013-08/documents/eabmemodupontpfoasettlement121405.pdf.

[99] *See* Michael Janofsky, *DuPont to Pay 16.5 Million for Unreported Risks*, N.Y. TIMES (Dec. 15, 2005), https://www.nytimes.com/2005/12/15/politics/dupont-to-pay-165-million-for-unreported-risks.html.

[100] Young, *supra* note 28.

[101] EPA Consent Agreement, *supra* note 98.

[102] The emphasis is on "in our timeframe" (1984–2017). It is hard to say with certainty what the final tally of PFOA liability costs will be. For example, there could be large costs stemming from a future cleanup action. Still, as Part III clarifies, to the extent that additional legal and reputational costs will be imposed in the future, they are not likely to alter our conclusions. Future costs are "diluted" for our purposes not only because of the time lag but also because DuPont has since spun off its PFOA division. *Infra* Part III.

[103] In practice, jurors who assign punitive damages tend to focus on defendants' ability to pay. *Infra* Section IV.A. As a result, the magnitude of legal sanctions may be *positively* correlated with the state of the economy. If we considered this correlation, the discount rate would be even higher and the present value of the sanction smaller, thereby strengthening our conclusions.

2. Probability of Detection

If we temporarily set the reputational sanction to zero, we have an equation with one unknown, namely, the probability of detection. A shareholder value-maximizing manager will choose to invest in abatement ($19 million) to save the company from paying legal fines ($100 million) only if she perceives the probability of detection to be higher than 19%. In other words, 19% is the break-even probability, which makes a DuPont shareholder indifferent between investing in abatement and continuing to produce without abatement.

We therefore need to assess how a DuPont manager in 1984 perceived that probability of detection in real time. One way to do so is by looking at actual, objective enforcement data from around that time. In 1991, the EPA announced a limited "amnesty period" in which chemical companies could retroactively report on risks without incurring full sanctions.[104] 11,000 such reports came from the industry, which was four times more than all the reports submitted in the fifteen years prior to the amnesty period combined.[105] In other words, there was rampant underreporting and underenforcement when the 1984 decision was taken. Indeed, the US Government Accountability Office and the Office of Management and Budget have acknowledged as much, noting that the EPA's ability to monitor chemicals was very limited back then.[106]

Another way to illustrate why the perceived probability of detection was likely below 19% is by looking in retrospect at the rare combination of low-probability events that led to DuPont being detected and having to pay the fines that it did. Consider the following four unlikely events that transpired.

First, the plaintiffs in the PFOA litigation were represented by a top environmental defense lawyer from a big law firm, named Robert Bilott.[107] Bilott's unique background in representing the industry prepared him to find a needle in a haystack: a single passing reference to an obscure chemical buried within tens of thousands of internal company documents.[108] But in real time, it was hard for DuPont's management to anticipate that a lawyer whose specialty was defending chemical companies would go to war with the biggest name in the industry.

Second, the plaintiffs in the PFOA litigation enjoyed rare access to incriminating informal communications simply because of a then-recent technological advancement that DuPont insiders were not prepared for. When

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[104] *See* Cary Coglianese, Richard Zeckhauser, & Edward Parson, *Seeking Truth for Power: Informational Strategy and Regulatory Policymaking*, 89 MINN. L. REV. 277, 310 (2004).
[105] *Id*; THOMAS O. MCGARITY & WENDY E. WAGNER, BENDING SCIENCE: HOW SPECIAL INTERESTS CORRUPT PUBLIC HEALTH RESEARCH 119 (2008).
[106] Gray & Shimshack, *supra* note 97, at 3.
[107] Rich, *supra* note 24. The Tennants were able to land a top environmental lawyer from a big defense firm by pure chance: a family connection (the story was so compelling that it became a focus of the Hollywood movie *Dark Waters*).
[108] Exposure, *supra* note 15, at 51.

DuPont insiders realized just how problematic the PFOA emissions were, they went to great lengths to avoid documenting what they knew about it in order to maintain plausible deniability. They even had an in-house lawyer hold workshops for company employees on how to avoid creating a paper trail regarding PFOA's effects.[109] Normally, such measures prevent or at least delay the ability of outsiders (plaintiffs) to prove the mental state of insiders. But in DuPont's case, plaintiffs got their hands on a trove of emails *from that same lawyer* indicating that top managers were aware of PFOA's effects and had put a lid on the topic. How did such an unanticipated discovery come to pass?

The reason is timing and technology: these emails were transmitted in the first days of handheld devices. Back then, top managers received so-called "blackberries," and used them to communicate in their off-hours with their friends and family. What these insiders did not realize is that all the data transmitted on these new handheld devices was stored on company servers, and so all their communications became searchable during discovery.[110] In other words, for a very short period, even seasoned legal counselors did not fully grasp how personal emails could be discoverable, and were much less guarded in what they wrote.[111] Even the in-house lawyer sent emails about how the PFOA debacle was "about to hit the fan," lamenting that the company would rather "save some money" than do what is right, and so on.[112] These emails were a large part of the reason why the plaintiffs were able to survive motions to dismiss the class action, and why, ultimately, they were awarded *punitive* damages.[113] In other words, this unanticipated discovery changed the equation by ramping up the severity of sanctions.

Third, the plaintiffs also enjoyed perfect timing in terms of the doctrines available to them. The only reason that plaintiffs were able to sustain the class action was that the West Virginia Supreme Court had just then adopted (in a separate case) a new common law tort called "medical monitoring."[114] The medical monitoring doctrine allows plaintiffs who have been exposed to hazardous substances to recover the costs of medical surveillance, even if they cannot show that they suffered actual harm.[115] To qualify for monitoring, plaintiffs simply need to show that the defendant negligently exposed them to an increased risk of future harm. Even today most US states do not recognize the doctrine, and back then it was a rarity. To illustrate how the sudden

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[109] *See* Sharon Lerner, *The Teflon Toxin: DuPont and the Chemistry of Deception*, THE INTERCEPT (AUG. 11, 2015), https://theintercept.com/2015/08/11/dupont-chemistry-deception/).
[110] Exposure, *supra* note 15, at 151.
[111] *Id*.
[112] *Id*.
[113] To qualify for punitive damages, the plaintiffs must show that the polluting company demonstrated conscious disregard to public health of environmental safety. BMW v. Gore, 517 U.S. 559, 575-80 (1996). The internal emails served as indication that even DuPont lawyers believed that the company's executives consciously disregarded the social costs of PFOA pollution.
[114] Exposure, *supra* note 15, at 131 (the lawyer who fought DuPont admitting that "[t]he fact that this unusual and progressive medical-monitoring ruling popped up at all […] was a startling stroke of fortune").
[115] Metro-North Commuter Ry. Co. v. Buckley, 521 U.S. 424, 438 (1997).

introduction of the doctrine in West Virginia changed the prospect of litigation against DuPont, one can simply look at the 3M counterfactual. Litigation against 3M for the same PFOA pollution stalled because it was handled in Minnesota, which had not recognized medical monitoring.[116]

Finally, a fourth low-probability event occurred after the settlement of the medical monitoring class action in the mid-2000s. The standard outcome in such settlements would have been that the plaintiff lawyers use the $70 million award to cut small checks to individual group members, and a hefty check to themselves. In this case, however, Bilott and his team invested the money in further studies of PFOA: they offered $400 to each community member who agreed to take a blood test and be interviewed.[117] This unheard-of strategy led to an unprecedented large-scale (65,000-participant) epidemiological study. The study was then analyzed by an independent science panel, which was able to establish links between low-level exposure to PFOA and six diseases.[118] With the causal links established, plaintiffs were able to extract a much bigger $670 million settlement.

While we cannot determine the precise probability of each one of these events, we can safely say that each one was considered unlikely in 1984, if it was considered at all. And since the events are largely independent of each other, compounding their probability easily leads to an ex-ante probability of detection lower than 19%. To illustrate, the joint occurrence of four events with a probability of 50% each is only 6.25% (0.5*0.5*0.5*0.5).

The upshot is clear and alarming: a monetary calculation of costs and benefits suggests that producing Teflon by using PFOA while not investing in abatement was the rational decision from the company's perspective, even if it was very harmful from a social perspective. The next step is to examine why the institutions that are supposed to deter such large externalities failed.

III. WHY LITIGATION, REGULATION, AND REPUTATION DID NOT STOP DUPONT FROM POLLUTING

In and of itself, the fact that private and social motives to pollute diverge is not surprising. After all, it is an axiom that business companies have incentives to externalize their costs on others. What is surprising in DuPont's case is that the company *got away with* externalizing major costs for an extremely lengthy

[116] When the case against 3M eventually progressed, it was largely because the plaintiffs there could use evidence that was produced in the DuPont litigation.

[117] Mariah Blake, *Welcome to Beautiful Parkersburg, West Virginia: Home to one of the Most Brazen, Deadly Corporate Gambits in U.S. History*, HUFFINGTON POST, https://highline.huffingtonpost.com/articles/en/welcome-to-beautiful-parkersburg/.

[118] C8 Panel Report, *supra* note 29. Several legal scholars have since called to adopt this innovative legal strategy in other cases. *See, e.g.*, Wendy E. Wagner, *Administrative Law, Filter Failure, and Information Capture*, 59 DUKE. L. J. 1322, 1327–28 (2010)). The purported advantage is that an independent science panel can do a better job of determining the health effects of obscure chemicals relative to judges or jurors. The disadvantage is higher administrative costs. We revisit these points when discussing policy implications in Part IV below.

period. Every advanced economy has institutions that are meant to curb such corporate externalities: ex-ante regulatory interventions, such as dictating that a company cannot use a certain chemical or cannot emit over a certain threshold; ex-post impositions of liability, forcing a polluting company to fully compensate the victims of emissions; and reputational fallouts, where a company and its managers lose future business opportunities when the market learns about what they did. This Part examines why all these institutions failed to prevent the catastrophic case of PFOA pollution.

The failure of all deterrence mechanisms is especially egregious given that DuPont's decision-makers *anticipated in real time* the possibility of suffering massive legal and nonlegal sanctions for polluting. One internal memo explicitly warned that PFOA could end up being DuPont's biggest legal problem.[119] Other memos discussed the potential for grave "public liability" and "corporate image" fallouts.[120] The anticipation of massive sanctions down the road apparently did not stop DuPont from doubling down on PFOA production in real time.

What factors caused DuPont's decision-makers to discount the threat of legal and reputational sanctions? Are these factors generalizable to other cases? Section A focuses on how a large time lag can dilute the deterrent power of *litigation*. Section B highlights the levers large chemical companies can pull to capture *regulation*, such as utilizing loopholes in the statutory framework and hiring former regulators to water down public enforcement. And Section C identifies the conditions under which even the threat of losing one's *reputation* is not enough to deter pollution.

A. Litigation

At first sight, the DuPont PFOA case appears as the poster child for successful US-style tort litigation. A plaintiff attorney uses far-reaching discovery tools to extract information, uncovers corporate misconduct, holds the company accountable to the tune of hundreds of millions of dollars, receives a hefty award for his services, and rides off into the sunset (while Hollywood produces a movie about his case). However, a closer look reveals a more somber reality: DuPont insiders anticipated in real time this exact scenario of having to pay sizeable amounts in tort litigation down the road, but that did not stop the company from continuing to pollute. Why?

One factor that can significantly dilute the deterrent power of litigation is a large *time lag* between misbehaving and being punished for it. In 1984, DuPont executives already knew that an extremely toxic, bio-persistent and bio-accumulative chemical was in the drinking water of nearby communities and decided to continue emitting it. But it was only in the early 2000s that a victim

[119] Bartlett transcripts, Vol. 4, p. 90; Vol. 5, p. 243.
[120] *See, e.g.*, online source appendix (Bowman Email).

of PFOA pollution (the Tennants) managed to name, blame, and make a claim against DuPont. And only in 2017 did DuPont start paying truly sizeable sanctions (settling after the bellwether cases). The previous Part focused on the consequences of such a large time lag, showing that it erodes the deterrent power of litigation by a factor of ten.

This Part examines the *causes* of such a large time lag. The immediate cause is extreme information asymmetries. When the pollutant in question is a manmade substance, the company can count on litigation happening much further down the road, if at all. After all, there are close to 100,000 chemicals on the market, and 1,500 new ones are introduced each year.[121] Environmental regulators are stretched too thin to closely monitor all these chemicals. And individual victims are usually unaware that the substance exists, let alone that it is the source of their health problems. The only realistic scenario of someone from outside the company learning about the pollution in real time is if someone from inside the company tells the outside world about it.

Herein lies the rub: polluting companies can go to great lengths to keep damning information from leaking out. To illustrate, when an internal memo about PFOA's effects was sent to DuPont executives in 1994, its copies were numbered, and its recipients had to return the copies for shredding afterward.[122] Recall that DuPont's in-house lawyer was holding workshops inside the company on what *not* to document and share regarding PFOA.[123] Aside from limiting the diffusion of existing damning information, the company also avoided producing new damning information. For example, in 1991 DuPont scientists asked company executives for funding to further study the effects of PFOA exposure, but the executives ultimately refused, deciding to "do the study after we are sued."[124] In other words, DuPont executives proactively suppressed information until after litigation was underway.

Even when one or more victims somehow find out the truth and file lawsuits, the polluting company can cabin the information produced in this specific litigation, effectively keeping other victims in the dark. Indeed, chemical companies have long paid hefty fees to plaintiff attorneys who agree *not* to advance specific lawsuits, and promised higher settlement awards to victims who sign strict confidentiality provisions.[125] In most cases, this strategy succeeds because individual victims and their attorneys do not internalize the benefits of warning the outside world about the toxic pollutant.[126] In other

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[121] *See* Sheldon Krimsky, *The Unsteady State and Inertia of Chemical Regulation under the US Toxic Substance Control Act*, 15 PLOS BIOL. (2017), https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2002404.
[122] Industry documents website (Boone et al., 1994).
[123] Lerner, *supra* note 109.
[124] *Id*.
[125] Exposure, *supra* note 15, at 109.
[126] *See* Steven Shavell, *The Fundamental Divergence between the Private and the Social Motive to Use the Legal System*, 26 J. LEGAL. STUD. 575, 577 (1997).

words, plaintiffs and their attorneys are usually content to exchange secrecy for a bigger personal payment.

In that sense, the DuPont case serves as an exception that proves the rule. When a large company faces a plaintiff attorney-led class action, that attorney typically finances the entire litigation out of retained earnings or debt. As a result, plaintiff attorneys are typically reluctant to litigate hard cases that are likely to be prolonged, such as claims based on probabilistic harm from exposure to unstudied chemicals. In our case, by contrast, the class action was led by a defense lawyer, who fought the company in court for almost twenty years while earning a salaried income from his large firm.[127] Having a defense lawyer was thus crucial both in terms of knowledge (knowing how to find the PFOA information needle in a haystack) and in terms of the business model (having the funding to litigate all the way to the end and uncover more information).[128]

Polluting companies thus do not view the time lag as exogenous but rather proactively exploit holes in the system to delay sanctions. To restore the deterrent power of litigation, policymakers need to plug those holes and punish delay tactics. We return to this theme with concrete proposals in Part IV below.

B. Regulation

On paper, regulation could overcome the abovementioned information and incentives problems that plague private litigation. Regulators are supposedly more public-spirited than plaintiff attorneys and enjoy greater powers to extract information from regulated entities. Ex ante, regulators can set requirements that prevent toxic pollution to begin with. Ex post, regulators can vigorously enforce these requirements and punish companies that violate them. In practice, however, regulatory noncompliance is common.[129] The DuPont case underscores several factors that lead to pervasive noncompliance. Let us consider one example of each stage of regulatory intervention: limits to effectively setting the rules ex ante, and limits to effectively enforcing the rules ex post.

First, the DuPont case illustrates the limits of a regulatory framework that relies on *self-reporting*. The relevant statutory framework for regulating toxic pollutants is the Toxic Substances Control Act (TSCA).[130] When TSCA was originally enacted in 1976, it represented a significant improvement by establishing a comprehensive federal system to assess and regulate the risks that

[127] Exposure, *supra* note 15, at 41, 132.
[128] DuPont constantly tried (to no avail) to prevent Bilott from making the information that he uncovered in litigation available to other victims, such as by asking for gag orders. *Id*. at 91.
[129] *See, e.g*., Joost A. de Gouw et al., *Daily Satellite Observations of Methane from Oil and Gas Production Regions in the United States*, 10 SCI. REP. 1379 (2020) (documenting noncompliance with environmental regulation).
[130] Toxic Substances Control Act, Pub. L. No. 94-469, 90 Stat. 2003 (1976) (codified as amended at 15 U.S.C. §§ 2601–697).

come with introducing new chemicals. However, TSCA had a blind spot: it "grandfathered" all the chemicals that were already in commercial use prior to 1976, including PFOA.[131] The regulator could not require testing or impose restrictions on grandfathered chemicals, unless the regulator had evidence that the chemical poses a substantial risk.[132] In other words, grandfathered chemicals were presumed safe until proven otherwise. Realistically, the only way for damning information about a grandfathered chemical to come out was if the regulated company self-reported it.[133] But as the calculations from Part II demonstrate, when the chemical in question is very profitable, companies face superstrong incentives to err on the side of *under*reporting.

To be sure, not all self-reporting schemes are bound to fail. But for self-reporting to work even in the face of superstrong incentives, the design of the regulatory framework must be impeccable. Here it was far from it. The requirement to report only if a company believes that its substance poses a *substantial* risk provided companies an easy out. After all, it may take decades before enough hard evidence accumulates of the risks that chemicals such as PFOA pose to human health and the environment. Companies could have therefore easily justified to regulators and internally that "sure, we had evidence of some risk, but we were unaware of evidence that the risk is substantial." Another common way of defeating the self-reporting requirement was by reporting nominally. For example, chemical companies fulfilled the requirement to report while omitting the chemical's name and other basic details, under the guise of trade-secret claims.[134]

Indeed, the DuPont case provides many concrete examples of the company defeating the purpose of self-reporting. DuPont used different names in its reporting of PFOA to the regulator (APFO, FC-143, C8, and so on), thereby making it harder to connect the dots.[135] When DuPont testing revealed exposure to PFOA well beyond the safe levels that the company itself set, the company simply moved the guideposts: it replaced the 1ppb guidelines with a 150ppb guideline, thereby granting itself cover for not reporting further.[136] And when the company's own lab found unacceptable levels of PFOA, the company changed the way it measured, by switching to an outside lab whose raw data results showed the levels to be half as high.[137] Further, the company counted on another perceived loophole in the reporting scheme: as long as there existed public information in some form on the substance, the company felt that it was

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[131] *Id*.
[132] *Id*. at §8(e).
[133] U.S. GOV'T ACCOUNTABILITY OFF., PERFORMANCE AND ACCOUNTABILITY REPORT (2000). In 2016, the Lautenberg Act revised the TSCA, such that it now requires the regulator to systematically assess the risks of all chemicals and not just new ones. The criterion for prioritizing regulatory action is not when a chemical was introduced but rather the potential risk stemming from the chemical.
[134] MCGARITY & WAGNER, *supra* note 105.
[135] Exposure, *supra* note 15, at 67.
[136] *Id*. at 156–57.
[137] *Id*. at 159.

relieved of its duty to call the attention of the regulator to substantial risk data.[138]

The regulatory framework was thus full of holes that DuPont exploited. This is perhaps unsurprising, given that DuPont and other large chemical companies lobbied hard and helped shape the version of TSCA that was adopted.[139] Pertinently, the fact that there was such a difference between how the regulatory framework treated new chemicals and how it treated old (grandfathered) chemicals only incentivized chemical companies to further suppress problematic data about the then-unregulated PFOA.[140]

Aside from lobbying to shape the rules that apply to them, large companies also pull levers to dilute enforcement against them for breaking the rules. This is the second theme that DuPont's case illustrates, namely, the problematic aspects of the *revolving doors* between regulators and regulated entities. When information about PFOA emissions started coming out, the matter was initially handled by the West Virginia environmental regulator. The same individual regulator who signed the initial consent agreement with DuPont (which allowed the company to delay litigation and further regulatory probes) subsequently joined the consulting company that was hired by DuPont to implement that same agreement.[141] The door also revolved from industry to public office: three DuPont in-house attorneys who handled PFOA issues for the company subsequently joined the local regulator to monitor enforcement of said consent decree.[142] As more information about the scope and severity of PFOA pollution surfaced, prompting the federal regulator (US EPA) to become involved, DuPont started hiring through the federal revolving door. Notably, the company hired two former US EPA higher-ups to handle its communications with regulators.[143]

To be sure, the revolving door between regulators and industry is not categorically bad.[144] For example, some studies suggest that the prospect of post-regulatory employment makes regulators work harder and enforce more vigorously to signal their high quality to prospective employers.[145] But the DuPont case highlights conditions under which revolving doors are likely to have a negative effect, even without assuming explicit quid pro quos. For expert

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[138] *Id*. at 172.
[139] *Cf*. Nathaniel O. Keohane et al., *The Choice of Regulatory Instruments in Environmental Policy*, 22 HARV. ENVT'L L. REV. 313, 363–64 (1998) (discussing how large incumbent companies shape environmental regulations to receive grandfathering benefits).
[140] *See generally* Angela N. H. Creager, *To Test or Not to Test: Tools, Rules, and Corporate Data in U.S. Chemicals Regulation*, 46 SCI. TECH. & HUM. VALUES 975 (2021) (on the perverse incentives that the regulation creates).
[141] Exposure, *supra* note 15, at 84.
[142] *Id*. at 195.
[143] *See* Sharon Lerner, *The Teflon Toxin: How DuPont Slipped Past the EPA*, THE INTERCEPT (Aug. 20, 2015), https://theintercept.com/2015/08/20/teflon-toxin-dupont-slipped-past-epa/.
[144] *See* Ernesto Dal Bó, *Regulatory Capture: A Review*, 22 OXFORD REV. ECON. POL'Y 203, 214 (2006).
[145] *See, e.g.*, Ed deHaan et al., *The Revolving Door and the SEC's Enforcement Outcomes: Initial Evidence from Civil Litigation*, 60 J. ACCT. ECON. 1 (2015) (providing empirical support for this claim).

chemists working as local regulators at the West Virginia EPA, DuPont may be the only viable option for post-regulatory employment. These local regulators are therefore less likely to enforce regulation aggressively out of fear of antagonizing the de-facto monopsony in their relevant labor market.

Federal regulators at the US EPA, by contrast, have many other post-employment opportunities, but the DuPont case nevertheless illustrates two additional troubling aspects of the revolving doors between regulators and regulated entities. First, DuPont hired higher-ups, rather than mid- and low-level public officials. Generally, studies that find positive effects of revolving doors tend to focus on staffers at enforcement divisions, whereas studies that find negative effects focus on higher-ups who set the regulatory agenda.[146] Second, DuPont hired these higher-ups not to develop and test new chemical products but rather to handle communications with the media and the regulator (i.e., with their former mentees and colleagues). When companies hire former regulators for positions of "regulatory affairs" and "communications," they typically seek to capitalize on the former regulator's connections rather than on her technical expertise.[147]

C. Reputation

While legal scholars have endlessly analyzed the failures of litigation and regulation, they have devoted very little attention to the failures of reputation.[148] All too often, conventional economic analyses assume that reputational concerns will deter corporate misbehavior.[149] In other words, the threat of losing the company's goodwill among its customers, workers, and investors will incentivize managers (whose compensation is tied to company performance) to refrain from misbehaving. Further, managers who care about their individual labor-market reputation will not want to jeopardize their future employability by being associated with corporate illegalities and scandals, or so the argument goes.[150]

In practice, however, reputational disciplining is hardly automatic, especially when it comes to corporate pollution. For reputational concerns to deter pollution, at least four nontrivial conditions must hold, namely, revelation, diffusion, certification, and motivation.[151] First, someone must have access to information about pollution (revelation). Second, that someone must have the ability and incentives to disseminate the damning information widely

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[146] *See* James D. Cox & Randall S. Thomas, *Revolving Elites: The Unexplored Risk of Capturing the SEC*, 107 GEO. L. J. 845, 869, 887 (2019).
[147] *See* Wentong Zheng, *The Revolving Door,* 90 NOTRE DAME L. REV. 1265, 1280 (2015).
[148] *See* CASS R. SUNSTEIN, ON RUMORS 22 (2011) (arguing that the legal literature suffers from "indefensible optimism about the operation of actual information markets").
[149] *See, e.g.*, Eugene F. Fama, *Agency Problems and the Theory of the Firm*, 88 J. POL. ECON. 288, 289 (1980).
[150] *Id*.
[151] ROY SHAPIRA, LAW AND REPUTATION 13-35 (2020).

(diffusion). Third, the company's stakeholders must perceive the damning information as credible (certification). Finally, a critical mass of the company's stakeholders must be willing to act on the information (motivation). That is, stakeholders must find it in their best interests (or be morally compelled) to stop doing business with the polluter going forward. The DuPont case illustrates the circumstances that make these conditions unlikely to occur. Importantly, the case illustrates how polluting companies do not take reputational sanctions as given but rather fight back to dilute the prospective fallout.

Subsection 1 illustrates why it is so hard for someone from outside the polluting company to unearth and disseminate damning information. Subsection 2 explains why even when such information is out, company executives do not necessarily face a hit to their labor-market reputations. Subsection 3 focuses on the organizational level, showing how companies can evade reputational fallout even after damning information about them is out.

1. Revealing, Disseminating, and Certifying Damning Information

We have focused thus far on how chemical companies can keep damning information about pollutants away from regulators. But regulators are the not the only source of information on toxic pollutants. Victims of pollution, investigative journalists, and academic experts may possess the ability and incentives to reveal, certify, and diffuse information on pollution. The DuPont case highlights the conditions under which *none* of these actors is likely to break the information monopoly.

Victims. Victims are a good source of information when the harms that they suffer are immediate and concentrated. But victims are a weak source of information when harms are latent, probabilistic, and dispersed. It took more than fifty years of PFOA pollution until one resident of a nearby community started suspecting that his tap water was contaminated with a mysterious toxic chemical.[152] The Tennants were only able to suspect DuPont's emissions because DuPont dumped massive quantities of PFOA in a landfill adjacent to their property, and all their animals suddenly died. Had DuPont merely dumped smaller quantities or lined the landfill, there is a chance that we all would still be unaware of PFOA and its irreversible damages.

Even when victims gain access to information about a toxic pollutant that hurts them, they may not have the incentive to widely spread that damning information. The DuPont case illustrates the significant social costs for spreading damning information about large corporations that are the biggest employer in town.[153] For instance, the Tennants had to change their church more than once, and people would walk out of a restaurant when they

[152] Exposure, *supra* note 15, at 125.

[153] Kevin Williams, *In Ohio's "Chemical Vallet": A Debate over Good Jobs and Bad Health*, WASH. POST (Dec. 12, 2015) ("Tension between the broader populace and those who say their health has been compromised by C8 is palpable in bingo halls, diners, and beauty parlors throughout the valley").

entered.[154] And the teacher behind the drinking-water class action testified that "a guy called my wife and asked, 'If I lose my job are you going to pay for my wife and kids?'"[155]

Media. The media was apparently too slow to hold DuPont accountable for PFOA pollution. To understand the causes of this failure, we must separate between local media and national media. On the one hand, local media outlets are closer to information sources and have stronger incentives to rectify wrongdoing that hurts the community that they are a part of. On the other hand, local media outlets are more dependent on corporate insiders for sourcing and revenues, due to the size and concentration of their relevant markets. Indeed, for the local Parkersburg (WV) media, DuPont was basically the only game in town in terms of advertisement dollars. And any outlet that scrutinized the biggest employer in town drew the ire of their Parkersburg readers. Tellingly, the few victims who came forward reported that when they tried to enlist the help of local journalists, no journalist wanted to touch the issue.[156] On the contrary, the local media ran hit pieces on the plaintiffs and their lawyers.[157]

National media outlets, by contrast, are less dependent on a single company for information and advertising revenues.[158] However, national media outlets typically deem local problems less newsworthy. In other words, national media outlets are less likely to be captured, but also less likely to be interested in reporting the facts. To generalize, national media is more interested in problems that are visual and dramatic, and problems that affect the entire population. Famines receive more media coverage than structural hunger cases, because the former can be visualized better than the latter.[159] And the depletion of the ozone layer receives more media coverage than potential pollution that affects a couple of communities on the West Virginia–Ohio border.

The DuPont case illuminates the exceptions to these rules, namely, conditions that attract the national media's attention. There were two short periods of intense media scrutiny of DuPont: the early 2000s and the mid-2010s. In both periods, media coverage came on the heels of discovery in litigation, which produced credible, libel-proof quotes and documents about PFOA and its effects.[160] In other words, litigation provided national reporters

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[154] Blake, *supra* note 117.
[155] *Id*.
[156] *See* Nathaniel Rich, *The Story behind the E.P.A.'s Contaminated Water Revelation*, N.Y. TIMES (May 27, 2016), https://www.nytimes.com/2016/05/27/magazine/the-story-behind-the-epas-contaminated-water-revelation.html. After the first draft of this Paper was circulated, several research teams empirically tested and corroborated our hypotheses about local media and corporate misbehavior. *See, e.g.*, Jonas Hesse, Gerardo Perez-Cavazos & Casper David Peter, *When the Local Newspaper Leaves Town: The Effects of Local Newspaper Closures on Corporate Misconduct,* 145 J. FIN. ECON. 445, 446 (2022); Pengjie Gao, Chang Lee, & Dermot Murphy, *Financing Dies in Darkness? The Impact of Newspaper Closures on Public Finance,* 135 J. FIN. ECON. 445, 447 (2020).
[157] Exposure, *supra* note 15, at 210.
[158] *See* Alexander Dyck et al., *Media versus Special Interests*, 56 J. L. ECON. 521, 549 (2013).
[159] *See* Amartya Sen, *Poor, Relatively Speaking*, 35 OXFORD ECON. P. 153, 157 (1983).
[160] Exposure, *supra* note 15, at 206–07.

with information subsidies, thereby reducing the costs of reporting. Further, in both periods of media attention there was a strong campaign by civic society organizations, which convinced the media that the PFOA story had widespread implications for their readers.[161] Overall, it seems that national media is effective at spotlighting an already existing smoking gun, but less effective at revealing hidden guns or sticking with a story over the long term.

Academia. In theory, academic experts can study, diffuse, and lend credibility to damning information about toxic substances. In practice, many of the same factors that lead to regulatory capture also prevent academics from holding large companies accountable.[162] The DuPont case illustrates several of these factors, such as lack of access to information.[163] Throughout the first decades of PFOA pollution, academic experts had little to no information about the substance.[164] The chemistry experts who had access to information were the ones working for DuPont and 3M. These in-house experts had little incentive to publicize research that jeopardized the bottom line of their employers.[165]

When information about PFOA started becoming public thanks to litigation, academics who wanted to study the chemical's effects faced multiple hurdles. To illustrate, in 2004 Dr. James Dahlgren and a group of coauthors attempted to publish a paper on the adverse effects of PFOA on community members.[166] Dahlgren's paper was accepted for publication by the *Archives of Environmental Health*, having gone through a peer-review screening and back-and-forth implementations of reviewers' comments. But then the already accepted paper was yanked.

To figure out what exactly happened, we reached out to Dahlgren and the editors. From Dahlgren's vantage point, he had received notice that the presiding editor of the journal who accepted his paper had been fired, and that the new editor had decided to retract Dahlgren's paper.[167] We were not able to corroborate an alleged link between DuPont's pressures and the retraction decision, as the editor who was fired had since died, while the editor who replaced him was adamant that the retraction had nothing to do with DuPont. What we were able to discern is just how much the retraction decision mattered: DuPont has since consistently emphasized, inside and outside the courtroom,

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[161] *Id* (explaining how the campaign of one environmental NGO managed to turn the PFOA story from a local to a national one). *See generally* Wendy Wagner et al., *Rulemaking in the Shade: An Empirical Study of EPA's Air Toxic Emission Standards*, 63 ADMINISTRATIVE L. REV. 99 (2011) (documenting the link between public interest groups' activity and media attention to environmental issues).

[162] *See* Luigi Zingales, *Preventing Economists' Capture*, *in* PREVENTING REGULATORY CAPTURE 124 (Daniel Carpenter & David A. Moss, eds., 2014) (highlighting the parallels).

[163] *See* Lauren Richter, Alissa Cordner, & Phil Brown, *Producing Ignorance through Regulatory Structure: The Case of Per- and Polyfluoroalkyl Substances (PFAS)*, 64 SOC. PERSP. 631, 642 (2021).

[164] Exposure, *supra* note 15, at 59.

[165] *Id*.

[166] It should be noted that Dahlgren was retained by the class action plaintiffs.

[167] In an interview with us, Dahlgren maintains that when he presented a draft of his findings in a Society of Environmental Toxicology and Chemistry (SETAC) conference in Prague, a DuPont representative reached out to him, telling him that he was surprised that Dahlgren's presentation was not excluded from SETAC.

that Dahlgren's paper ended up not being published, presumably in a bid to reduce the credibility of his findings.[168] Other stories of scientists who faced hurdles trying to publish damning information about industrial pollutants abound.[169]

Another strong indication of chemical companies' ability to quash academic inquiry into their chemicals comes from the Weinberg Memo, which was unearthed in litigation.[170] When news about PFOA started coming out in the early 2000s, a PR firm called the Weinberg Group sent a memo to DuPont detailing its proposed strategy to reduce the reputational fallout. A key part of their plan was "to facilitate the publication of papers and articles dispelling the alleged nexus between PFOA and teratogenicity," and "to begin to identify and retain leading scientists to consult on the range of issues involving PFOA so as to develop a premium expert panel and concurrently conflict out experts from consulting with plaintiffs."[171] In other words, the plan was to use the profits from emissions to buy academic experts and have them manufacture doubt about those emissions.[172] All in all, it seems that research that serves the industry's interests is easily manufactured, whereas research that goes against the industry's interests is harder to produce.[173]

2. Individual Reputational Concerns

Classic corporate governance accounts assume that managers are disciplined by the threat of damage to their labor-market reputation.[174] The logic is intuitive: market participants take bad news about a company as a signal that the quality of the company's managers is low. News about corporate misconduct could therefore reduce the earning potential of managers, or so the argument goes.[175] The DuPont case provides an opportunity to test this conventional wisdom. We know who led the company and took the relevant decisions when the PFOA debacle transpired, and we can examine in retrospect how these decision-

[168] Bartlett transcripts, Vol. 5, p. 125; MCGARITY & WAGNER, *supra* note 105, at 140.
[169] For example, Eileen Murphy headed New Jersey's Water Quality Institute and was conducting research on safety standards for PFOA in drinking water. Murphy relays that when she wanted to publish her team's findings, she received a call from her overseer, asking her to halt the publication. When Murphy went ahead and published anyhow, she was subsequently reassigned and effectively shown the door. Lerner, *supra* note 143.
[170] *See* online source appendix (Weinberg Memo).
[171] *Id*.
[172] For a book-length account of various doubt-manufacturing tactics see NAOMI ORESKES & ERIK M. CONWAY, MERCHANTS OF DOUBT (2011).
[173] To be sure, it is unlikely that a company can capture the entire academic publication process. Still, large companies can affect the research incentives at the margin. They can facilitate pro-industry research by granting access to data and funding. And they can also mount obstacles to research that goes against industry interests, such as by working their connections with journal editors or by threatening them with libel or intellectual property claims. For more on these dynamics *see generally* Zingales, *supra* note 162.
[174] Fama, *supra* note 149.
[175] *Id*.

makers were covered by the media or how they fared in the labor market post their DuPont employment.

To do that, we (1) identified all the top executives who sent or received the internal documents reviewed here. Then, we (2) searched the Lexis News and ProQuest databases for articles published during the relevant timeframe of our analysis (1984–2015) that mention the names of said executives along with terms associated with the PFOA debacle, such as "PFOA," "C8," "carcinogenic," "Washington Works," and "Teflon."

We did not find any indication of the executives' names getting dragged through the mud (see Appendix B).[176] That finding should come as no surprise, since almost two decades had passed between the decision that we are reviewing here and the time that mainstream media started paying close attention to the issue. By that time, the media reached out to and mentioned by name only the DuPont executives who were currently running the company rather than the executives who made the pivotal decision twenty years earlier.

We then ran the same search with the names of all of DuPont's *directors* in 1984. To be sure, the internal documents that we reviewed do not reflect direct involvement by DuPont's board in the PFOA decision. Still, corporate governance scholars tend to focus on directors as the locus of reputational discipline when bad things happen to companies.[177] The idea is that a good board of directors could have and should have been involved in such a decision, and so when a debacle like the PFOA debacle happens the market will assume that the directors are not very good at their jobs (regardless of what the market knows about the board's actual involvement). To test whether this theory holds in our case, we extracted the names of the twenty-nine individuals who served on the board from the company's 1984 proxy statement and then searched for details on their post-DuPont careers (see Appendix B).

We found a striking pattern: by the time serious media attention was first directed at the PFOA debacle (2003),[178] nineteen of the twenty-nine original directors had already died or retired from professional activity. Labor-market reputation had thus stopped being a concern for most of the board. Even the ten directors who were still somewhat engaged in professional activity in 2003 were unlikely to suffer reputational fallouts, since media coverage had not associated them with the PFOA debacle.

The takeaway point from our content analysis of media coverage of the PFOA debacle is therefore that a large time lag severs the link between corporate misconduct and individual labor-market reputation.

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[176] There was one exception: Bruce Karrh, who was DuPont's chief medical officer in the relevant timeframe and was later deposed in trial, did appear several times in some media coverage. Remember, however, that the decision we are examining is one in which business executives overruled the scientific department's consideration. Unlike Karrh, those business executives were not mentioned by the press.

[177] *See, e.g.*, Yaron Nili, *Board Gatekeepers*, 72 EMORY L.J. 91, 93 (2022).

[178] Exposure, *supra* note 15, at 207 (noting that media attention first turned to PFOA in 2003).

Another factor that dilutes the effectiveness of reputational deterrence is the type of misconduct in question. A strand of empirical studies in the finance and accounting literatures shows that companies and their managers do not suffer significant reputational fallouts when they misbehave toward third parties, as opposed to misbehaving toward contractual claimants.[179] In other words, when companies pollute the environment or bribe officials, they externalize costs on society, but their shareholders may be fine with such behavior as long as net corporate profits are up. A cursory look at the labor-market consequences for DuPont CEOs during the relevant timeframe corroborates these findings.

Ricard Heckert – CEO between 1986 and 1989 – was remembered in a Wall Street Journal obituary as an environmental visionary who "shut down the chemical giant's production of chemicals suspected of destroying the ozone layer, and ended its work on nuclear weapons."[180] Chad Holliday – CEO for the better part of the 2000s – was hailed in real time as a leader in corporate sustainability, and authored a well-received book titled *Walking the Talk: The Business Case for Sustainable Development*.[181] After he left DuPont in 2009, Holliday was appointed chairman of the board at blue chip companies such as Bank of America and Shell.[182] These companies specifically cited Holliday's commitment to "green conscience" when explaining why they chose him.[183]

All in all, top managers who were interested only in their monetary payoff would have rationally chosen to pollute even if they had perfect foresight of their future reputational costs. For these managers, discontinuing use of PFOA or investing in abatement would have come with immediate, clear costs in terms of reduced income. Incurring such costs to safeguard against future reputational fallouts probably did not make sense for them, given the time lag and the difficulties of attributing such corporate misbehavior to specific individuals.

3. Organizational Reputational Concerns

Unlike individual reputational concerns, corporate reputational concerns are supposedly perpetual. As a result, a large time lag (between polluting and being exposed as a polluter) should not dilute the prospect of reputational deterrence. Still, the DuPont case illustrates other levers that chemical companies can pull to limit the reputational fallout once they are caught polluting. We have already discussed the various information-suppression tactics that companies use to

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[179] Karpoff, *supra* note 9 (summarizing that literature).
[180] *See* Stephen Miller, *Former DuPont CEO Aided Safety Efforts*, WALL ST. J. (Jan. 21, 2010), https://www.wsj.com/articles/SB10001424052748704320104575015522736060774.
[181] Exposure, *supra* note 15, at 211, 226.
[182] *See Royal Dutch Shell Appoints Charles Holliday as Chairman*, BBC NEWS (Oct. 30, 2014), http://www.bbc.com/news/business-29829332.
[183] *Id*.

prevent production and limit the circulation of damning information.[184] We have also explained that the specific type of corporate misbehavior in question – namely, environmental pollution – is not one that typically generates large reputational fallouts.[185] Now let us highlight two additional factors.

First, large companies such as DuPont can *invest in a do-gooder, "green" image as a buffer* against future reputational fallouts. Stakeholders are less likely to attribute bad intentions to a perceivably nice or high-status company, chalking up the bad news to a one-off past mistake rather than a deep-seated flaw.[186] Indeed, DuPont has always heavily invested in its corporate social responsibility image, and has apparently ramped up its efforts since the PFOA bad news broke.[187]

Second, large companies can dilute reputational fallouts by *spinning off blame*. Just before DuPont lost its first bellwether case and faced an onslaught of negative publicity (including a New York Times exposé and a Hollywood movie), the company spun off its Performance Chemicals Unit that dealt with PFOA to a new company called Chemours.[188] The judge presiding over the litigation made it clear at the outset that the spin-off would not necessarily shield DuPont from its legal liabilities.[189] But we are interested here in the possibility that spin-offs can minimize *reputational* liabilities. A cursory look at DuPont's media strategy since the spin-off seems to lend support to this thesis. DuPont is constantly referring any media inquiry on the trial issue to Chemours, refusing to comment further, while pointing out that it is not DuPont's business. Other postmortem analyses of corporate debacles, such as Union Carbide's Bhopal disaster, follow similar dynamics of spinning off to deflect blame in the court of public opinion.[190]

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[184] *Supra* Section III.A.

[185] *Supra* Section III.C.2.

[186] Enron, for example, was considered the poster child for CSR before its collapse. Several scholars suggested that the accolades showered upon Enron for its CSR image contributed to the slow detection and reaction to Enron's misbehavior. Roy Shapira, *Corporate Philanthropy as Signaling and Co-optation,* 80 FORDHAM L. REV. 1889, 1939 (2012); Henrich R. Greve et al., *Organizations Gone Wild: The Causes, Processes, and Consequences of Organizational Misconduct*, 4 ACAD. MGMT. ANNALS 53, 87 (2010).

[187] *See, e.g.*, Brandon Ran, *The Green Hypocrisy: America's Corporate "Environment Champions" Pollute the World 24/7*, RAINFOREST ACTION NETWORK BLOG (May 14, 2009), https://www.ran.org/the-understory/the_green_hypocrisy_america_s_corporate_environment_champions_pollute_the_world_24_7_wall_street/ (reporting that in 2008, just three years after it paid the EPA $16.5 million for failures to report what it knew about PFOA, DuPont opened a PR campaign titled "Open Science").

[188] To emphasize: we do not claim that the main impetus for DuPont's reorganization was the PFOA litigation. Our claim is simply that such reorganization carries with it understudied reputational consequences.

[189] *See* Sharon Lerner, *DuPont May Dodge Toxic Lawsuits by Pulling a Disappearing Act*, THE INTERCEPT (Jun. 15, 2016), https://theintercept.com/2016/06/15/dupont-may-dodge-toxic-lawsuits-by-pulling-a-disappearing-act/.

[190] *See Ex-Union Carbide Officials Sentenced over Bhopal Leak*, REUTERS (Jun. 7, 2010), https://www.reuters.com/article/us-india-bhopal-verdict/ex-union-carbide-officials-sentenced-over-bhopal-leak-idUKTRE6562B420100607. After the first draft of this Paper circulated, a Stanford research team elaborated on our hypotheses regarding the consequences of spin-offs following corporate debacles. Andrew C. Baker, David F. Larcker, & Brian Tayan, *Environmental Spinoffs: The Attempt to Dump Liability Through Spin and Bankruptcy*, Stan. Closer Look Series (Nov. 1, 2020),

IV. POLICY IMPLICATIONS

The DuPont PFOA case is unique in the academic sense of having rare access to internal decision-making processes in large corporations. But the case is not unique in the real-world consequences sense: in many other cases large corporations emitted harmful substances while suppressing information.[191] While the specifics of each case vary, it seems that in most cases of this ilk the various deterrence mechanisms – litigation, regulation, and reputation – have jointly failed. One key driver of the joint failure of deterrence mechanisms is extreme information asymmetries regarding the pollutant in question. To mitigate this recurring problem, let us now use the lessons from the DuPont case to evaluate the desirability of existing proposals to improve deterrence and to come up with creative proposals of our own.

Section A evaluates the most common proposal, namely, to increase the severity of sanctions, and finds it wanting. Increasing the severity of sanctions will not solve the information suppression problem; in fact, it may aggravate it. Section B examines ways to increase the probability of detection. By redesigning whistleblowing regimes and corporate law's oversight duty doctrine, policymakers can improve the flow of information inside the company (bottom-up) and from the company to the regulator (inside-out). Section C proposes ways to reduce the time lag between polluting and paying for it, such as by recalibrating prejudgment interest rules. Section D revisits two endless debates: in environmental law about the proper regulatory default (should we assume that chemicals are innocent until proven guilty or vice versa?), and in corporate law about the proper purpose of corporations (should we assume that shareholders maximize value or welfare?). Section E spotlights the need to think about different policy measures holistically, so that the advantages of one measure counterbalance the others' flaws.

A. Increasing the Severity of Sanctions

If a low probability of detection dilutes legal deterrence, why can't policymakers simply raise the magnitude of the sanction for polluting? For example, policymakers could subject misbehaving companies to aggressive punitive damages. Or they could insist on criminally prosecuting individual decision-makers. In these scenarios, even if decision-makers anticipate a low probability of detection (because the company enjoys a monopoly on relevant

https://www.gsb.stanford.edu/faculty-research/publications/environmental-spinoffs-attempt-dump-liability-through-spin-bankruptcy.

[191] *See, e.g.*, Jenny White & Lisa A. Bero, *Corporate Manipulation of Research: Strategies Are Similar across Five Industries*, 21 STAN. L. POL'Y REV. 105, 132 (2010) (finding similar information-suppression techniques being used across various industries); Matthew H. Keiser et al., *A Review of the Talc Industry's Influence on Federal Regulation and Scientific Research: Lessons Learned*, 19 INT'L J. ENVT'L RES. & PUB. HEALTH 826 (2021) (detailing the case of Johnson & Johnson hiding information about asbestos in its talc).

information about the chemical), they would still perceive the expected sanction as severe enough to deter them from polluting, or so the argument goes. There exists a rich literature challenging the assumption that raising the severity of sanctions would be a good way to improve deterrence.[192] From a black-letter law perspective, such an assumption runs counter to settled concepts in criminal law: proving criminal intent in these settings is difficult given the fragmentation of knowledge inside large chemical companies.[193] Beyond these familiar problems, the DuPont case spotlights three additional limitations.

First, increasing the sanction ex post also raises companies' ex-ante incentives to avoid detection.[194] To illustrate, once DuPont realized (in the early 1990s) that PFOA may end up being the company's "number one legal issue," they did not follow through by stopping pollution and coming out clean. Instead, they had a company lawyer conduct workshops on what *not* to document, and company executives decided not to conduct further studies until the company was sued.[195]

Second, the DuPont case illustrates how in practice judges and jurors rarely assign punitive damages according to optimal deterrence theory.[196] Instead, judges and jurors focus on less relevant factors, and often hesitate to impose disproportionate penalties.[197] Indeed, the transcripts of the PFOA bellwether trials reveal that after DuPont was held liable and it was time to argue for the size of the sanction, the plaintiffs marshaled just one expert witness, who focused in his testimony on how much money DuPont makes per minute.[198]

Finally, the ability to improve corporate deterrence by increasing the sanction is bounded by the value of the company in question.[199] After all, a company cannot pay penalties exceeding its total assets and its ability to

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[192] *See, e.g.*, George J. Stigler, *The Optimum Enforcement of Laws*, 78 J. POL. ECON. 526 (1970) (introducing cross-offenses considerations); A. Mitchell Polinsky & Steven Shavell, *The Optimal Tradeoff Between the Probability and Magnitude of Fines*, 69 AM. ECON. REV. 880 (1979) (introducing risk-aversion considerations); Lucian A. Bebchuk & Louis Kaplow, *Optimal Sanctions When Individuals Are Imperfectly Informed about the Probability of Apprehension*, 21 J. LEGAL STUD. 365 (1992) (introducing the costs of errors in judging probability of detection). Our analysis here also implicates a rich literature on corporate liability regimes and their nuanced ramifications. *See, e.g.*, Jennifer Arlen & Reinier Kraakman, *Controlling Corporate Misconduct: An Analysis of Corporate Liability Regimes,* 72 N.Y.U. L. REV. 687 (1997).

[193] Indeed, even the lawyer who fought DuPont admitted that "[t]here was no one person, event, or decision responsible for the presence of PFOA in the community's water and blood." Exposure, *supra* note 15, at 168.

[194] *See* Arun S. Malik, *Avoidance, Screening and Optimum Enforcement*, 21 RAND J. ECON. 341, 342 (1990) (providing the definitive analysis of why raising sanctions to combat detection avoidance can be counterproductive).

[195] *See* Sharon Lerner, *The Teflon Toxin: DuPont and the Chemistry of Deception*, THE INTERCEPT (Aug. 11, 2015), https://theintercebpt.com/2015/08/11/dupont-chemistry-deception/.

[196] *See* A. Mitchell Polinsky & Steven Shavell, *Punitive Damages*. *in* ENCYCLOPEDIA OF LAW AND ECONOMICS 764, 775–76 (Gerrit De Geets, ed., 2000).

[197] *Id*.

[198] Vigneron transcripts, Vol. 25, p. 36.

[199] *See generally* Steven Shavell, *The Judgment Proof Problem*, 6 INT'L REV. L. & ECON. 45, 45 (1986).

generate revenues.[200] Pertinently, as with the first limitation of avoidance tactics, the misbehaving company can proactively dilute deterrence, such as by delaying the realization of the liability while paying out large dividends in the meantime. Accordingly, any discussion of effective deterrence should address the ability of companies to delay the sanction. Section C below addresses this problem.

B. Increasing the Probability of Detection

The clearest problem to emerge from DuPont's case is the extreme information asymmetry regarding man-made chemicals. This Section explores three types of solutions to the information problem. Subsection 1 focuses on improving the flow of information about toxic substances from inside chemical companies to the outside world (regulators and affected communities), such as through incentivizing whistleblowing. Subsection 2 focuses on improving the flow of information inside chemical companies, such as through recalibrating corporate law's oversight duty doctrine. Subsection 3 focuses on ensuring that suppressing information does not pay, such as through embracing "knowledge remedies" and vigorously sanctioning spoliation.

1. Introducing an Environmental Qui Tam

One method to break the information monopoly of chemical companies is to incentivize whistleblowing. The divergence between social and private incentives to divulge information is not unique to pollution, but rather common to all types of fraud. To deter fraud against the government, Congress introduced in 1986 the False Claims Act, which empowers individuals to sue fraudsters in the name of the government ("qui tam" suits).[201] If the qui tam suit succeeds, the individual who brought it is entitled to fifteen percent of the sanction imposed on the fraudsters.[202] In other areas of law, such as tax fraud and securities markets fraud, policymakers allow whistleblowers to reap hefty rewards when the tips that they provide to regulators lead to successful public enforcement actions.[203] The accumulated experience with these whistleblowing programs suggests that they can be effective.[204] Indeed, in August 2024 the DOJ launched a new pilot program that extends whistleblowing rewards to other

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[200] *See, e.g.*, STEPHEN J. CARROLL ET AL., ASBESTOS LITIGATION (2005) (detailing how the asbestos litigation bankrupted two large companies).
[201] False Claims Amendments Act of 1986, Pub. L. No. 99-562.
[202] *Id*. at §3.
[203] Tax Relief and Health Care Act of 2006, Pub. L. No. 109-432, § 406, 120 Stat. 2922 (codified as amended at 26 U.S.C. § 7623 (2007)); Dodd–Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, §§ 922-24, 124 Stat. 1376, 1841-50 (codified as amended at 15 U.S.C. § 78u-6 (2010)).
[204] *See* Alexander Dyck et al., *Who Blows the Whistle on Corporate Fraud?*, 65 J. FIN. 2213, 2214 (2010).

areas of corporate misconduct not covered by the previous fragmented programs.[205] However, that new pilot program does not cover pollution.[206]

The DuPont case tips the scale in favor of extending whistleblowing mechanisms to cover corporate pollution. The internal documents detailed in Part I reveal that scores of scientists, lawyers, and businesspersons inside the company knew about PFOA's effects in real time. Granted, some of these employees voiced their concerns *internally*, but that apparently was not enough to stop the company from continuing to emit PFOA.[207]

There is a broader point in play here. Internal whistleblowing can be effective when the company will lose money by not solving the underlying problem (say, internal theft). But internal whistleblowing is less effective when the company will *gain* a lot of money by not solving underlying problem (say, polluting rather than halting production). In the latter case, only external whistleblowing (going to the regulator) can help.

Indeed, we have focused thus far on the story of how one outsider (Bilott) unearthed DuPont's pollution, but the prequel to our story involves whistleblowing by an insider. The only reason that Bilott became aware of PFOA pollution is because 3M issued a press release alerting the world to PFOA's existence and announcing that 3M would phase it out.[208] And the only reason that 3M issued that press release is because one of their employees reported concerns about the chemical's disastrous potential to the regulator.[209]

The 3M whistleblower is the exception that proves the rule. After all, none of the DuPont insiders did the same. This is not surprising, as whistleblowers typically face enormous personal costs.[210] In fact, the DuPont case illustrates one set of circumstances where the personal costs for whistleblowing are even more pronounced, namely, when the organization enjoys market power. When a giant corporation is one of the only viable employers in town, the threat of retaliation becomes bigger. In other words, the more concentrated the labor market is, the less likely insiders are to burn bridges with their current companies by blowing the whistle. For example, one DuPont insider admitted in retrospect that "I wasn't about to go against the paycheck that supported my family. So I shut my mouth."[211]

One way to override these personal costs is to promise sizeable personal benefits for whistleblowers. We conjecture that if DuPont insiders knew that they could gain tens of millions by blowing the whistle on PFOA, one of them

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[205] DEPARTMENT OF JUSTICE CORPORATE WHISTLEBLOWER AWARDS PILOT PROGRAM (Aug. 1, 2024), https://www.justice.gov/criminal/media/1362321/dl?inline.
[206] *Id*.
[207] Exposure, *supra* note 15, at 177, 235.
[208] *Id*. at 52–54. Bilott then connected the dots and figured that the same chemical must be used by DuPont as well, and that it was the mysterious chemical that killed the animals at Tennant's farm. *Id*.
[209] Tim Bartley & Malcolm Fairbrother, *Tackling Toxins: Case Studies of Industrial Pollutants and Implications for Climate Policy*, REG. & GOV. (2024), preprint version at 9.
[210] Dyck et al, *supra* note 204, at 2245.
[211] Blake, *supra* note 117.

would have done so. In this counterfactual scenario, nearby communities (and the entire world, as dramatic as it sounds) would have been better off, free of some of the irreparable damage to human health and the environment that accumulated decades of PFOA pollution brought about.

The DuPont case highlights not only the importance of introducing a whistleblowing mechanism for pollution, but also key considerations for how to design such a mechanism. An important design choice is whether to entrust the enforcement of whistleblower tips to the relevant regulator (as in the Dodd–Frank model, where the SEC acts on tips) or allow the insider herself to pursue legal action directly (as in the false claims/qui tam model). This choice should depend on the likelihood that the relevant regulator is captured by the industry. In DuPont's case, the chemical safety regulators were slow to act, even though victims and their attorneys gave the regulators information and actively sought their intervention. To the extent that legislators view this type of regulator as susceptible to regulatory capture, they should opt for the false claims model, which is less dependent on swift reaction by regulators.

2. Recalibrating Director Oversight Duties

Any attempt to solve deterrence problems of the kind that we observed in DuPont's case must address the perverse incentives of directors and officers to remain ignorant.[212] Knowledge in general is inherently fragmented inside large organizations.[213] Knowledge of unethical behavior in particular tends to be pushed down the organizational ladder, while credit for success is claimed up the latter.[214] These dynamics create plausible deniability for those at the top of the corporate hierarchy, allowing them to escape accountability and criminal prosecution.

Indeed, while many of the internal documents we had access to were signed and addressed by the top scientists, engineers, and lawyers inside DuPont, none of these documents contained indications of active involvement of the company's directors or CEOs. Even the lawyer who fought DuPont confessed after deposing the CEO that the latter seemingly did not know in real time about the damning aspects of PFOA pollution.[215] In other words, the problem was not so much that the CEO and directors lied about the effects of PFOA, but rather that they were kept in the dark about it. What can be done to

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[212] *Cf.* Jennifer Arlen, *Evolution of Director Oversight Duties and Liability under Caremark: Using Enhanced Information-Acquisition Duties in the Public Interest*, *in* Research Handbook on Corporate Liability 194, 203–04 (Martin Petrin & Christian Witting, eds., 2023) ("By themselves, corporate and individual criminal liability are not enough to induce companies to adopt effective measures to deter and detect corporate crime. […] [D]irectors must be subject to oversight duties that place precise effective requirements on them to deter, detect, investigate and terminate corporate misconduct that risks substantial harm to the firm and society").

[213] Diane Vaughan, *The Dark Side of Organizations: Mistake, Misconduct, and Disaster*, 25 ANN. REV. SOCIO. 271, 277 (1999).

[214] ROBERT JACKALL, MORAL MAZES: THE WORLD OF CORPORATE MANAGERS 20 (1988).

[215] Exposure, *supra* note 15, at 229.

reverse these willful-blindness dynamics and ensure greater involvement of directors and officers in risk oversight?

The answer could come from recent developments in corporate law's oversight duty doctrine. The so-called "*Caremark* doctrine" (named after Delaware's leading precedent) imposes on directors and officers the duty to be proactive about their firm's compliance.[216] Directors and officers must install a system that monitors compliance issues and reports them back, and they must react to red flags that such a monitoring system generates.[217] Historically, that doctrine did little to reverse the incentives of directors and officers to remain ignorant, because its impossible procedural stance ensured that virtually no lawsuit could survive the motion to dismiss.[218] But in recent years the doctrine has been revamped.[219] Corporate law courts are now increasingly willing to scrutinize oversight efforts, and increasingly willing to provide outside shareholders with access to internal company documents in order to investigate potential failures of oversight.[220] Following the Boeing-737 Max debacle, for example, shareholders gained access to 44,000 internal documents related to how the company handled air safety issues.[221]

What would happen if the PFOA debacle were to happen today, under the revamped version of the oversight duty doctrine? It is virtually a certainty that once news got out about how DuPont has been handling PFOA emissions (say, through an EPA press release announcing that DuPont violated reporting rules and is subject to fines), some pension-fund shareholders and their attorneys would request to inspect DuPont's internal documents.[222] The shareholders would then file a derivative action against DuPont's directors and officers for not doing enough to prevent the debacle. To be sure, it is not a certainty that such a lawsuit would succeed on the merits. DuPont's directors and officers would probably claim in their defense that they had no way of knowing about the potential effects of PFOA, and that directors of a giant chemical company cannot be held personally liable whenever something bad happens in one area of the company. However, the revamped version of the oversight duty doctrine has developed tools to assess such claims. Consider the following two.

First, the DuPont case illustrates the importance of identifying circumstances where lack of documentation could serve as an indication of breach of oversight duties. One could argue that the prospect of facing extensive

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[216] *In re* Caremark Int'l Inc. Derivative Litig., 698 A.2d 959 (Del. Ch. 1996).
[217] Stone v. Ritter, 911 A.2d 362, 370 (Del. Ch. 2006).
[218] *See, e.g.*, Elizabeth Pollman, *Corporate Oversight and Disobedience*, 72 VAND. L. REV. 2013 (2019) (providing a comprehensive overview of *Caremark* cases up until 2019).
[219] Roy Shapira, *Max Oversight Duties: How* Boeing *Signifies a Shift in Corporate Law*, 48 J. CORP. L. 119, 121 (2022).
[220] *Id*.
[221] *In re* Boeing Co. Derivative Litig., 2021 WL 4059934 (Del. Ch. Sep. 7, 2021), at n. 1.
[222] Roy Shapira, *Conceptualizing* Caremark, 100 IND. L.J. (forthcoming), https://ssrn.com/abstract=4778827, manuscript at 1 (noting that virtually all corporate debacles these days are followed by an oversight duty suit).

discovery of the kind we saw in Boeing would only aggravate companies' incentives not to document of the kind we saw in the DuPont case. Yet, corporate law courts have recently clarified that any document *not* produced could be used as pleading-stage evidence against the defendant directors.[223] When it comes to "mission critical" risks (those germane to the company's business model), directors can no longer point to a lack of documentation as evidence that they were not aware of the problem and so should be let off the hook.[224]

Going back to our counterfactual scenario, toxic pollution on the scale of the PFOA emissions would be a mission-critical risk for a chemical company like DuPont. Indeed, chemical executives already in the 1980s used the exact term "mission critical" to describe just how important per- and polyfluoroalkyl substances (PFAS) are to the industry.[225] DuPont's directors and officers would therefore have a hard time using the "I didn't know" excuse: the court would scrutinize their lack of proactive monitoring of the potential risks at the company's various plants. The court would also use lack of documentation as an indication of a lack of needed follow-up actions on the part of the board to remedy potential oversight issues that were flagged by the regulator.[226]

More importantly than what happens in a specific case after the fact is the behavior-shaping effects of the revamped oversight duty doctrine before the fact. The string of new rulings has led to a flurry of law firm memos advising corporate clients to put risk oversight squarely on the board agenda, and to document internal discussions of potential problems meticulously.[227] This newfound emphasis on creating paper trails could carry prophylactic value. Going forward, directors and their legal advisors will attempt to create a proper record of their efforts to monitor and address safety issues. This, in turn, will force directors to ask others in the organization to prepare written materials for them, thereby bringing thorny issues to the fore.

A second aspect of the oversight duty doctrine that the DuPont case illustrates is the application of the duty to giant corporations. The Blue Bell case that ushered in the new *Caremark* era did so in the context of smaller companies that sell only one product.[228] It is intuitive to argue that if directors of a company that sells only ice cream never discussed issues of food safety, they were not trying hard enough to meet their oversight duties. It is less intuitive to fault directors of giant corporations with multiple divisions (such as DuPont) for not discussing one chemical among numerous others under their

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[223] Teamsters Local 443 Health Servs. & Ins. Plan v. Chou, No. 2019-0816-SG, 2020 WL 5028065 (Del. Ch. Aug. 24, 2020), at *57.
[224] Marchand v. Barnhill, 212 A.3d 805, 824 (Del. Ch. 2019).
[225] Exposure, *supra* note 15, at 96.
[226] *See* Ann M. Lipton, *VC Laster Goes to War*, BUS. L. PROF. BLOG (Apr. 28, 2023), https://lawprofessors.typepad.com/business_law/2023/04/vc-laster-goes-to-war.html.
[227] Shapira, *supra* note 222, at 14–16.
[228] Marchand v. Barnhill, 212 A.3d 824; *In re* Clovis Oncology, Inc. Deriv. Litig., 2019 WL 4850188 (Del. Ch. Oct. 1, 2019), at *12–13.

remit. But as our discussion throughout has demonstrated, the fragmentation of knowledge and plausible ignorance problems are more pronounced inside giant chemical organizations. Carefully applying the oversight duty doctrine to our context can therefore add much value. And indeed, in recent years corporate law courts have shown willingness to scrutinize oversight efforts even in giant corporations, such as Boeing, AmerisourceBergen, and Walmart.[229]

3. Embracing "Knowledge Remedies" and Sanctioning Spoliation

Part II explained why the legal fight against PFOA pollution would not have proceeded past the individual Tennant case if it was not for the medical monitoring doctrine, which had just been introduced in West Virginia back then. But there is a broader point at play in adopting this common law tort, namely, that courts need to be proactive in tackling corporate behavior that is meant to reduce victims' ability to establish their case. This Section spotlights two (nonexclusive) routes that courts could choose between to reduce the information problem: embracing novel "knowledge remedies" and sanctioning spoliation vigorously.

Let us consider "knowledge remedies" first. Legal scholars have recently called for more states to move beyond remedies that order defendants to compensate plaintiffs and to adopt remedies that order defendants to produce information about risks they create.[230] Medical monitoring is one such knowledge remedy. Other proposals include ordering companies to fund independent research into the risks associated with their products, or finance public education campaigns about said risks.[231]

Our analysis here lends credence to these calls, and sheds light on how to design such remedies. The internal documents that we reviewed illustrate how the shadow of tort law only incentivized DuPont to avoid further testing ("wait until we get sued" is how the business executives rebuffed the scientists who sought funding for testing), and to avoid reporting what they already knew. In other words, DuPont executives did not want to produce and disseminate information that would increase the expected legal sanction. Knowledge remedies that focus not necessarily on compensating harms but rather on funding future research could reverse these willful-blindness dynamics.[232]

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[229] Teamsters Loc. 443 v. Chou, 2020 WL 5028065, at *5; Ontario Provincial Council of Carpenters' Pension Trust. v. Walton, 2003 Del. Ch. LEXIS 92 (Del Ch. Apr. 26, 2023); Boeing, 2021 WL 4059934.

[230] *See, e.g.*, Alexandra D. Lahav, *The Knowledge Remedy*, 98 TEX. L. REV. 1361, 1365 (2020); Wendy Wagner, *When a Corporation's Deliberate Ignorance Causes Harm: Charting a New Role for Tort Law*, 72 DEPAUL L. REV. 413, 440 (2022) (proposing a "deliberate ignorance" claim).

[231] Lahav, *id*.

[232] *Cf.* Roy Baharad, Stuart M. Benjamin, & Ehud Guttel, *Anti-Patents*, 91 U. CHI. L. REV. 239 (2024) (proposing to reward a company that invents new safety measures by exempting that company from implementing the measures it invented).

The anti-patents proposal builds off our analysis in earlier drafts of

Granted, introducing knowledge remedies would come with its own set of costs, such as increasing the administrative burden on courts. But the merits of introducing such doctrines for toxic torts is especially pronounced in a country like the US, without universal health insurance and with very strong protection of the privacy of patients. The combination of these two elements makes it very difficult to identify the long-term health effects of pollution. By contrast, in Scandinavian countries, with universal health insurance and fewer privacy concerns, such studies can be done at no extra costs for polluting companies.[233]

Next consider spoliation. We have focused thus far on how to curb companies' tactics to suppress information ex ante, before the outside world learns about their toxic pollution. But the DuPont case underscores the need to also tackle companies' tactics ex post, after the world learns about their pollution but before the victims manage to establish their case. To illustrate, after the first victims suspected their PFOA pollution, DuPont stalled the litigation by jointly appointing with the regulator a team to investigate the matter. That team ended up changing the acceptable exposure levels from 1ppb to 150ppb, thereby turning PFOA pollution overnight from a grave problem to ostensibly not a problem at all.[234] After Bilott deposed the team members in courts we learned that the head of the team had destroyed all the notes she has taken, and that DuPont's leading PFOA toxicologist had done the same.[235]

Such spoliation (namely, the intentional or negligent withholding or destroying of evidence) is unfortunately not uncommon.[236] The costs of spoliation loom even larger these days than they did when the DuPont case transpired, due to the nature of electronic evidence.[237] Evidence that is electronically stored can be more conveniently destroyed.[238] The question for our purposes is what tools can effectively curb spoliation.

The tool that many courts adopt is ordering fee-shifting (that is, ordering the spoliating party to pay the other party's legal expenses).[239] The DuPont case illustrates why fighting spoliation with such monetary remedies is not enough in cases of industrial pollution. For one, spoliation in cases of industrial pollution imposes costs not just on the other disputant but also on society at large, by withholding information that is critical for protecting countless nonlitigants.

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[233] *See* Steffen Andersen et al., Measuring the Long-Term Impact of Environmental Externalities (2023) (unpublished manuscript) (on file with authors).
[234] Exposure, *supra* note 15, at 162–64.
[235] *Id*.
[236] Goldstein v. Denner, 310 A.3d 548, 567 (Del. Ch. 2024).
[237] Thomas J. Joyce, *Finding Prejudice from Lost ESI: An Analysis of Courts' Standards under Amended Federal Rule of Civil Procedure 37(e)*, 71 OKLA L. REV. 979, 980 (2019) (noting the effect of electronic evidence on spoliation).
[238] Terramar v. Marion, 2018 Del. Ch. LEXIS 552, at *26–27.
[239] *See, e.g.*, Infab Co. Inc. v. Cusick, 2024 Del. Ch. LEXIS 14, *10.

A better (nonexclusive) way to curb spoliation in such cases is to directly attack the information suppression, such as by ordering further discovery and depositions or by drawing all inferences against the spoliating company.[240] Here again the DuPont case is illuminating. The judge presiding over the case ordered a search of the computers of the scientist who headed the team, and the recovery of all her deleted files.[241] This is how it was learned that the head of the team herself originally thought that the acceptable exposure level should be 1ppb.[242] And to address the issue of DuPont's leading PFOA toxicologist destroying his evidence, the judge not only ordered DuPont to pay the plaintiff lawyer's fees, but also, more importantly, ruled that the jury would be instructed to draw inferences against DuPont at trial. In other words, litigation proceeded on the assumption that whatever documents had been destroyed held information that was unfavorable to DuPont.[243] These ostensibly procedural decisions in the early stages of the process shaped how the case ultimately ended, and played a big role in the ability to hold DuPont accountable.

C. Reducing the Time Lag

Instead of focusing on the size of the sanction that will be imposed, policymakers may be better off focusing on reducing the time lag between detection and enforcement. Perhaps the starkest takeaway point from our case study is just how much the time lag matters: if you pay the price for polluting thirty-three years after you decided to pollute, a $1 billion sanction counts for only $100 million in deterrence value. Now let us consider a counterfactual. What if the delay was reduced by ten years, from thirty-three to twenty-three years? In that case, the present value of future legal liabilities would jump from $100 million to $255 million. Under such a scenario, the probability of detection under which it pays to pollute would have to be below 7.4%. To continue with counterfactuals, if the delay was reduced by twenty years ("only" thirteen years from action to consequences), the present value of future legal liabilities would jump to $746 million, and the probability of detection would have to be below 2.5% for polluting to be optimal.

The upshot could not be clearer: a reduction in the time lag between detection and enforcement is a very effective mechanism to deter corporate misconduct.

The question then becomes *how* to meaningfully reduce the time lag. Here the DuPont case elucidates the need to address two different time lag

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[240] *See, e.g.*, Equitable Trust Co. v. Gallagher, 102 A.2d 538, 541 (Del. 1954) (drawing unfavorable inferences); Treppel v. Biovail Corp., 249 F.R.D. 111, 123–24 (S.D.N.Y. 2008) (ordering additional discovery, including a forensic search of the spoliating party's computer).

[241] Exposure*, supra* note 15, at 164.

[242] *Id*.

[243] *Id*. at 203.

problems. The first problem is a large time lag between misconduct and detection. From the 1950s to early 2000s, the company had a monopoly on information about PFOA pollution. The previous Section tackled that problem.

The current Section focuses on the second problem, namely, a large time lag between detection and enforcement. Even after information about PFOA started coming out in the early 2000s, it took roughly sixteen more years before DuPont ultimately paid the heavy price for the detected rule violations. Some of the delays between detection and enforcement in such cases stem from enshrined procedural safeguards, such as due process and the ability to appeal. But too often the delays stem from defendants' delay tactics that have little to do with fairness in adjudication.[244] The DuPont case illustrates the array of such tactics: from asking plaintiffs and courts to wait while the company investigates internally, to colluding with local regulators to stall litigation, to using countless (including meritless) motions and appeals.[245]

On paper, there exists a ready-made solution for defendants' delay tactics, namely, awarding plaintiffs prejudgment interest.[246] Prejudgment interest compensates the victims for losing the time value of money between the moment their claims accrued and the moment final judgment was rendered. If prejudgment interest is calibrated correctly, it could reduce companies' incentives to delay.

In practice, however, prejudgment interest is rarely calibrated optimally, due to doctrinal hurdles and the perverse incentives of litigants. Consider the doctrinal hurdles first. Most state legislatures cap the interest by statute, and most state courts are reluctant to use their discretion to award interest as a tool to achieve optimal deterrence.[247] To illustrate with one concrete doctrine, the relevant state law in DuPont's case required plaintiffs to show that they were the ones who wanted to settle all along while the defendants never entertained the thought.[248] This is a virtually insuperable hurdle, as defendants can always claim that they entertained settling. Next consider the economic incentives of litigants. Plaintiff attorneys rarely focus on fighting the uphill battle of meeting the conditions for prejudgment interest.[249] Instead, attorneys focus on establishing liability and propping up damages, to secure a hefty settlement.[250] Potential prejudgment interest is thus often relegated to a contingent hypothetical afterthought.

To improve the deterrent effect of prejudgment interest, we propose two straightforward changes. First, policymakers should relax the conditions for

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[244] Recent exposés suggest that this is a pervasive problem: defense firms employ aggressive delay tactics with immense costs to society. DAVID ENRICH, SERVANTS OF THE DAMNED (2022).
[245] Exposure, *supra* note 15, at 139, 142, 213, 224.
[246] *See generally* Michael S. Knoll, *A Primer on Prejudgment Interest*, 75 TEX. L. REV. 294 (1996) (explaining the rationales and outlining the law).
[247] *See* Brainard v. Trinity Universal Ins. Co., 216 S.W.3d 809 (Tex. 2006) (providing a real-world example).
[248] *See* Ohio Rev. Code 1343.03(C); Kalain v. Smith, 25 Ohio St. 3d 157, 159, 495 N.E.2d 572, 574 (1986).
[249] *The Long Form*, The Chancery Daily (Apr. 11, 2023).
[250] *Id*.

aggressively awarding prejudgment. Second, once the conditions for prejudgment interest are met, judges should rethink what interest they assign. Currently, most courts award basic interest.[251] But sophisticated commercial parties neither borrow nor lend at simple interest rates. As the DuPont case painfully illustrates, some compounding is needed to replicate economic reality and achieve better deterrence. Courts should also keep in mind that whenever companies delay payments, they are effectively transferring some business risk onto the tort victims. After all, tort victims will see their award trimmed in case of a decline in the market value of the defendant, as our previous discussion of financial capacity to pay illustrated. Courts should therefore consider computing prejudgment interest at a company's cost of debt.[252]

D. Changing the Regulatory Default or Corporate Objective

We have focused thus far on ways to increase the sanction that polluters expect to pay ex post. But we would be remiss if we did not discuss two options to regulate companies' decisions to pollute ex ante. Subsection 1 revisits the hotly debated issue in corporate law of what the purpose of the company should be. Subsection 2 revisits the hotly debated issue in environmental law of how to set the regulatory default for introducing chemicals into commercial use.

1. Changing the Corporate Objective?

One could claim that the main problem in the DuPont PFOA case was not one of corporate governance *processes* but rather one of corporate *objectives*. Under this reading, DuPont was working like a well-oiled machine toward achieving a certain objective, namely, maximizing shareholder value. The only way to reduce pollution that undermines overall welfare is to change the objective that well-run companies seek, or so the argument goes.

To assess this argument, let us relax our assumption from Part II that DuPont managers sought to maximize shareholder value. What if DuPont managers sought instead to maximize shareholder welfare, where welfare denotes other, prosocial preferences? One could argue that many shareholders would *prefer* that their company not profit from toxic pollution.[253] Shareholders are consumers, and workers, and people too, and they have social and ethical

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[251] Williams v. Energy Transfer, C.A. No. 12168-VCG, 2020 WL 3581095 (Del. Ch. July 2, 2020).

[252] One could even argue that the prejudgment interest should exceed the cost of the company's debt, because creditors are able to impose dividend covenants, while tort claimants are not. Without these restrictions, a defendant would have strong incentives to pay high dividends and delay the day of reckoning. As an alternative to higher prejudgment interest, trial judges should impose dividend (and stock repurchase) restrictions on defense firms before any liability is established.

[253] *See, e.g.*, Oliver Hart & Luigi Zingales, *Companies Should Maximize Shareholder Welfare Not Market Value*, 2 J. L. ACCT. FIN. 247, 249–51 (2017) (providing a formal model); Scott Hirst, Kobi Kastiel, & Tamar Kricheli-Katz, *How Much Do Investors Care about Social Responsibility?*, 2023 WIS. L. REV. 977, 1007–22 (2023) (providing empirical evidence).

concerns.[254] As a result, maximizing shareholder *welfare* does not necessarily mean maximizing corporate profits at all costs. Shareholders would like to earn good returns, but they may not like to earn good returns by emitting toxic chemicals.

Could it be, then, that a simple solution to problems such as PFOA pollution is to let shareholders decide? What if DuPont put its fork-in-the-road decision in 1984 to a shareholder vote? In this case, putting the PFOA decision to a shareholder vote would probably not have solved the problem, if only for the following two reasons. First, in 1984 DuPont had a large shareholder who would have stood to lose so much in monetary terms from curbing pollution as to overcome any prosocial preferences he might have had.[255] Second, shareholder votes could improve the situation only if shareholders are informed about what is at stake. But given everything that we know in retrospect about how damning information was kept secret, it is doubtful that DuPont executives would have shared all relevant information with the public ahead of the shareholder meeting.

2. Changing the Regulatory Default?

One way to curb pollution is for legislatures to change the regulatory default to "guilty until proven innocent": chemical companies would not be able to use a certain chemical until they provided the regulator with evidence that said chemical is safe.[256]

The fault lines in the debate over what the regulatory default should be are well demarcated. On the one hand, requiring that chemical companies study the long-term effects of each chemical before commercializing it will likely chill innovation. On the other hand, allowing chemical companies to emit tons of toxic substances such as PFOA into the environment without understanding the long-term effects of these substances does not seem optimal, either.

The DuPont PFOA case adds to this debate by emphasizing the distinction between bio-persistent and bio-degradable substances. Damage created by the latter is temporary, whereas damage created by the former is irreversible. In the trade-off between chilling innovation and protecting from harm, one should therefore err on the side of caution when it comes to bio-persistent substances.[257] One way to translate this basic insight into policy design is to adopt a two-sided default: degradable substances should be subject to a flexible "innocent until proven guilty" regime, whereas persistent substances should be subject to a precautionary "guilty until proven innocent"

[254] Hart & Zingales, *id*.
[255] Eleonora Broccaredo et al., *Exit versus Voice*, 130 J. POL. ECON. 3101, 3117 (2022).
[256] Think for example about the process that pharmaceutical companies must undergo before marketing new drugs.
[257] In corporate finance parlance, the idea is to preserve the "option value," namely, the price that society should be willing to pay to maintain flexibility in an uncertain future. Emitting tons of chemicals that never break down in the environment does not allow society to reverse course in the future.

regime. And if a company learns midstream (that is, after it has introduced the chemical to the market) that a substance is persistent, it should halt production until that chemical's effects have been fully studied.

However, the accumulated experience with regulating PFAS in Europe suggests that our proposal belongs in the "easier said than done" category. European regulators have generally adopted a more precautionary approach than their American counterparts.[258] And they have specifically listed PFOA in 2017 as a "persistent pollutant," thereby subjecting it to heavier regulation.[259] Nevertheless, environmental law academics have pointed out that Europe's precautionary approach has not yet translated into effective regulation of "forever chemicals." Even when the regulatory default is strict, several factors stand in the way of solving PFOA-like problems. For one, there still needs to be a substantial amount of evidence to classify a chemical as very persistent and accumulative.[260] And proposals to restrict the production and sale of commonly used chemicals tend to falter due to strong lobbying by industry groups.[261]

Ultimately, the European experience suggests that no single legal tool can eradicate problems like PFOA pollution. It takes a village to deter pollution, namely, a combination of several mechanisms. This is what we turn to next.

E. Enhancing the Interactions between Systems: Taxing Secret Settlements

The DuPont case illustrates not just what went wrong but also what went right. Granted, each of the institutions – litigation, regulation, and reputation – suffers from its own limitations in dealing with pollution from man-made chemicals. Yet even if each institution is deeply flawed, the combination of all three could meaningfully check corporate pollution, as long as each institution's flaws are imperfectly correlated with the others' flaws. We have focused thus far on how the extreme information asymmetries regarding PFOA rendered *all* institutions ineffective at first. Let us now shift focus to the reason that DuPont is now nevertheless being held accountable, namely, the interactions between institutions.

Private litigation was the institution that initially broke the information monopoly on PFOA. But Bilott did not stop there: he went to great lengths to ensure that the internal documents he extracted became publicly available, and

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[258] The US amended TSCA in 2016, to empower the regulator to require more information before allowing companies to use chemicals. Still, even in its revamped form TSCA remains less precautionary than the EU REACH framework (short for Registration, Evaluation, and Authorization of Chemicals). *See generally* Agnes Botos et al., *Industrial Chemical Regulation in the EU and the US: A Comparison of REACH and the Amended TSCA*, 22 J. RISK RES. 1187 (2019) (comparing the two frameworks).

[259] Bartley & Fairbrother, *supra* note 209, at 9.

[260] *See* Ian T. Cousins et al., *The Precautionary Principle and Chemicals Management: The Example of Perfluoroalkyl Acids in Groundwater*, 94 ENVT'L INT'L 331, 337 (2016).

[261] *See, e.g.*, Riham Alkousaa, *No EU Vote on Restricting "Forever Chemicals" before 2025, EU Official Says*, Reuters (May 26, 2023), https://www.reuters.com/business/environment/no-eu-vote-restricting-forever-chemicals-before-2025-eu-official-says-2023-05-26/.

to alert the regulator to what the internal documents revealed.[262] The public information from litigation ended up igniting media scrutiny of DuPont. And the media scrutiny, in turn, attracted the attention of the US EPA, thereby facilitating regulatory scrutiny of PFOA.[263] More regulatory scrutiny breeds more media scrutiny, which gets more victims of pollution to come forward and file lawsuits, and the cycle continues.[264]

This seems to be a recurring pattern: as one of us showed elsewhere, most prizewinning investigative journalism projects rely heavily on "legal sources" (such as documents exchanged in discovery, judicial opinions, and regulatory investigation reports).[265] When journalists use documents produced in law enforcement actions, package them into a compelling story, and diffuse the story widely, they thereby increase the probability of reputational sanctions and regulatory interventions. The information that comes out in litigation is thus a positive externality, helping third parties who did not pay for litigation.

This also means that the disputants do not fully internalize the benefits of public dispute resolution. The DuPont case is the exception that proves the rule in this regard. It took Sisyphean efforts by Bilott, first in sifting through more than 690,000 internal documents,[266] and then in sending letters processing and highlighting the relevant information for regulators.[267] In most other cases, plaintiffs usually use defendants' willingness to pay for secrecy to extract higher settlement awards for themselves, not caring whether relevant information leaks out and warns others.[268]

From a policymaking perspective, the main lesson here is the need to rethink the secrecy versus openness debate in litigation. If information from litigation is a public good, secret settlements and confidentiality provisions are a public bad. One straightforward way to minimize the negative externalities of confidential settlements is to impose a sort of a tax on such settlements. The idea is to impose a percentage-based levy on settlement amounts when the agreement includes nondisclosure clauses, allowing for exemptions or lower rates for settlements that serve legitimate privacy interests. If a confidential settlement tax is not politically palatable, another method for reducing failures to warn is by requiring not just defendants but also plaintiffs to share damning information that they extracted with the backing of the legal system.

To be sure, the case against confidential settlements is not clear-cut. For example, some scholars have argued that the higher awards obtained in

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[262] Exposure, *supra* note 15, at 79, 159.
[263] *Id*. at 209.
[264] *Id*. at 233 (noting that the biggest impact of EPA enforcement actions in our case was not so much in increasing the legal sanction as in attracting negative media coverage).
[265] Roy Shapira, *Law as Source: How the Legal System Facilitates Investigative Journalism*, 37 YALE L. POL'Y REV. 153, 180–91 (2018) (conducting content analysis of impactful investigative journalism).
[266] Exposure, *supra* note 15, at 194.
[267] *Id*. at 205–06.
[268] Shavell, *supra* note 126.

confidential settlements could help deterrence.[269] A shrewd plaintiff can capitalize on the defendant's willingness to pay for secrecy and extract the full value of all future liabilities (including reputational fallouts), or so the argument goes.[270] In such a scenario, confidential settlements retain their deterrent effect (because they make polluters pay in full), while reducing litigation's administrative costs (because they obviate lengthy trials).

The DuPont case illustrates the limits of such arguments. The optimal deterrence argument assumes symmetric information. That is, plaintiffs need to be able to appreciate the extent of future liabilities the defendant would face, for the former to be able to understand what the latter's willingness to pay is. This assumption is patently unrealistic when the harms are opaque, widely dispersed, and latent, as is often the case with man-made chemicals such as PFOA.

More importantly, the optimal deterrence argument implicitly assumes zero spillovers. But in the context of industrial pollution, information revealed in litigation against one polluting company can lead to lawsuits and media scrutiny of other companies using similar pollutants. Indeed, information coming from the Tennant litigation has spawned not just thousands of additional lawsuits against DuPont for the same misbehavior (emitting PFOA while producing Teflon in West Virginia); it also spawned lawsuits against 3M and other PFOA polluters around the globe, as well as lawsuits against companies using other chemicals in the same PFAS family (there are currently 12,034 known chemicals in the PFAS family[271]).

To generalize, the case against confidential settlements becomes stronger in situations of chemical pollution or harmful drugs, where information about one product can shed light on the lack of safety precautions for an entire family of products.

The broader point is that policymakers should focus on identifying the ways in which regulation, litigation, and reputation interact, attempting to facilitate positive interactions and minimize negative ones. For example, beyond rethinking confidential settlements, our analysis here puts a thumb on the scale against mandatory arbitration. Large companies can use their market power to force consumers and employees to sign mandatory arbitration and class action waivers.[272] By doing so, big companies can not only dilute the expected legal sanction, but also neutralize the abovementioned positive spillovers of litigation. In the context of hazardous chemicals, mandatory

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[269] Saul Levmore & Frank Fagan, *Semi-confidential Settlements in Civil, Criminal, and Sexual Assault Cases*, 103 CORNELL L. REV. 311, 313 (2013).
[270] *Id*.
[271] Gaber et al., *supra* note 31.
[272] *See, e.g.*, ALEXANDER J.S. COLVIN, ECON. POLICY INST., THE GROWING USE OF MANDATORY ARBITRATION (2017), http://www.epi.org/publication/the-growing-use-ofmandatory-arbitration (showing that over eighty percent of the one hundred biggest companies use mandatory arbitration provisions in their employment contracts).

arbitration provisions therefore generate sizeable social costs, which should be weighed against their purported cost-saving advantages.

CONCLUSION

Capitalist economies can only function properly if they have effective institutions to deter business companies from externalizing their costs on others. This Article delved deeply into a case of a company externalizing significant costs on society for six decades, to understand how and why institutions of deterrence malfunction. The deep dive highlighted one set of circumstances where all three major institutions of corporate deterrence – namely, litigation, regulation, and reputation – are susceptible to joint failure. When toxic substances generate latent, long-term health effects, there exist extreme asymmetries in information, rendering all deterrence institutions ineffective. Recent empirical evidence on when it pays to pollute seems to corroborate our analysis.[273] And our calculations based on internal company documents illustrated just how much is at stake, by quantifying the divide between the private benefits and the social costs of polluting.

The Article then examined various ways to address this shortcoming in our institutions of deterrence. A pollution-related form of whistleblower rewards could improve information flows from inside the company to the outside world, thereby reducing the time lag from pollution to detection. A recalibration of directors' oversight duties could ensure that crucial information reaches the top of an organization, negating directors' incentives to remain ignorant. A change in the regulatory default for approving bio-persistent substances could reverse companies' incentives to delay research into these substances. A more aggressive application of prejudgment interest could reverse companies' incentives to delay litigation once damning information about their substances surfaces. And judicial willingness to adopt innovative "knowledge remedies" such as medical monitoring could facilitate all of the above.

While DuPont has phased out PFOA, the problem of "forever chemicals" is far from over. This toxic chemical is in the blood of most Americans and in our environment.[274] In fact, PFOA pollution is a *global* problem: it happened not just in DuPont's West Virginia plant but also in plants around the world, from the Netherlands to Japan.[275] As of this writing, regulators around the world are wrestling with ways to address the PFOA catastrophe. For example, the EPA is pushing a new rule that will lower the maximum acceptable exposure of PFOA to 4 parts per *trillion* and intends to classify PFOA as a hazardous substance under the Comprehensive

[273] *See, e.g.*, Nathan Atkinson, *Profiting from Pollution*, 41 YALE J. REGUL. BULL. 1 (2023) (testing our hypothesis).
[274] Exposure, *supra* note 15, at 76.
[275] *Id*. at 190.

Environmental Response, Compensation, and Liability Act, thereby opening a conduit for cleanup environmental lawsuits.[276]

What this Article focused on is understanding how to prevent such nightmare problems from occurring in the first place. Understanding how large chemical companies can dilute the different deterrent institutions is key to minimizing the problem of corporate pollution.

[276] 42 U.S.C. §§ 9601–9675.

APPENDIX A: CALCULATING THE COSTS OF POLLUTION

1. Incidence and Prevalence of Diseases Linked to PFOA Pollution

We base our calculations on the findings of the PFOA medical monitoring program screening tests, as published on their website ("The Panel").[277] The panel estimates the increase in new cases of the six enumerated diseases for a community of a given size (70,000 individuals), for a given level of increased exposure to PFOA.

The panel details the ranges of incidences of various diseases associated with the PFOA exposure that the nearest communities to the Washington Works plant suffered. Since not all 70,000 individuals were exposed to the same level of PFOA (some lived closer to DuPont's plant than others) and no detailed map of population-weighted exposure is available, we always chose the lower bound of the scientists' forecasts (to understate our results).

Testicular Cancer: The largest exposure to PFOA in the relevant community increases the risk of males to develop testicular cancer by 3 to 6 times. This led the panel to estimate that in a community of 200,000 individuals, PFOA exposure would cause from 6 to 15 additional cases each year. Because we relied on the lower-bound exposure in a sample of 70,000, we assume 1.05 additional cases of testicular cancer a year.

Kidney Cancer: The panel estimates that exposure to PFOA doubles the risk of developing kidney cancer. Since the baseline rate of incidence of this type of cancer is 3 per 10,000 individuals, the panel estimates 21 additional cases per year in the affected community.

Thyroid Disease: The panel found that exposure to PFOA yields between 20 and 40 new cases of thyroid disease per 10,000 individuals each year. Thus, the lower bound of this estimate implies 140 additional cases per year in our sample.

Ulcerative Colitis: About 200 people in a city of 100,000 people have ulcerative colitis (UC) and 1 to 20 new cases develop each year. The panel found that exposure to PFOA doubles the risk of developing UC. For our sample, this means that the number of new UC cases would be between 0.7 and 14 cases per year. To keep our estimates as conservative as possible, we assume 0.7 additional cases.

High Cholesterol: For high cholesterol the panel provided data only on prevalence and not on incidence. The Panel research showed that in a community with high exposure to PFOA about 2,100 out of 10,000 individuals would have high cholesterol. In an average community that number is 1,500 out of 10,000. In our sample, that translates to 4,200 additional individuals with high cholesterol.

Pregnancy-Induced Hypertension: The panel estimated that exposure to PFOA increases the risk of women getting high blood pressure and preeclampsia by 20% to 30%. Thus, 750 pregnant women (instead of the average number of 600) out of 10,000 would experience high blood pressure, and 500 pregnant women (instead of the average 400) out of 10,000 would experience preeclampsia. Since our sample is 70,000, and since at any time 4% of the women are pregnant, we calculate the additional incidences at 35.

[277] C8 Panel Report, *supra* note 29.

2. Loss Estimates

For each disease we consider both the medical cost of treating it and the probability of dying. For the cost of treating it, we use estimates provided by the website http://www.costhelper.com/, which we then adjust to 1984 dollars using the CPI price index. For the cost in terms of life loss, we take the probabilities of survival from the American Cancer Association.[278] We take an average between the best and the worst survival rate for the disease. We then multiply this probability by the value of statistical life expressed in 1984 dollars (as detailed in Part II above). Because we use 2010s' survival rates, our estimates likely underestimate the number of lives lost (in keeping with our decision to err on the side of understating conclusions).

3. Discount Rate

Since we have all the figures in 1984 dollars, we use a real discount rate. The 10-year T-bill in May 22, 1984 (when the meeting took place) was 13.5%. At the same time, the University of Michigan Inflation Expectation was 4.2% (https://fred.stlouisfed.org/series/MICH).

Table 1 below summarizes our calculations.

[278] NATIONAL CANCER INSTITUTE, SEER CANCER STATISTICS REVIEW, 1975–2013, http://seer.cancer.gov/csr/1975_2013/.

Table 1: Calculating the Social Costs of Pollution

In '000		Source
1. Testicular Cancer		
Incidence per year	2.1	6 additional cases per 200,000
Medical cost per unit	1.09	21.8 Million Medical Expenditure Panel Survey (2014)
Total medical costs	2.28	8,700 new cases https://seer.cancer.gov/statfacts/html/testis.html
Prob of dying	0.14	http://www.cancer.org/cancer/testicularcancer/detailedguide/testicular-cancer-survival-rates
Expected Life loss	1,058	
Total per year	**1,061**	medical cost + expected life cost
2. Thyroid Cancer		
Incidence per year	140	20 per 10,000
Medical cost per unit	0.49	The total cost ($9bn) from the 2014 Medical Expenditure Panel is divided by the total number of cases (20 M).
Total per year	**68**	Only 0.4 of the are cured http://www.thyroid.org/media-main/about-hypothyroidism/
3. Kydney Cancer		
Incidence per year	21	3 per thousand people
Medical cost per unit first year	19.95	46 : https://academic.oup.com/jnci/article/103/2/117/2568866/Pro
Next 4 years	7.92	6.255 for every continuing year
Total medical costs	585	https://academic.oup.com/jnci/article/103/2/117/2568866/Projections-of-the-Cost-of-Cancer-Care-in-the
Prob of dying	0.27	http://www.cancer.net/cancer-types/kidney-cancer/statistics
Expected Life loss	20,412	
Total per year	**20,997**	medical cost + expected life cost
4. Ulceritative colitis		
Incidence per year	0.7	1 per 100,000
Medical cost per unit	2.82	Cohen et al (2010) 6
Total medical cost per year	**2**	
5. Pregnancy-induced hypertension		
High blood pressure	21	extra 150 case per 10,000 pregnant women. 4% of 35,000 pregnant women
Preeclampsia	14	extra 100 case per 10,000 pregnant women. 4% of 35,000 pregnant women
Total incidence per year	35	
Medical cost per unit	70	Pourat et al (2013).
Total medical cost per year	**2,450**	
6. High cholesterol	4200	600 per 10,0000
Medical cost per unit	0.45	We obtain a 2014 estimate of 1.04 per person based on the fact that the Medical Expenditure Panel Survey (2014)
Total medical cost per year	**1,886**	reports an expenditure of 36.25bn for 35 million people with high cholesterol
		https://www.cdc.gov/cholesterol/cholesterol_education_month.htm. Translated into 1984 dollars, this yields 0,45
Total cost per year	**26,465**	sum of the total costs for the 6 diseases
Discount Rate	5.63	real rate = T-bill - inflation expectation
Value of Statistical Life	3,600	Viscusi (1992) in 1984 dollars
2014 dollars deflated by 1984	0.43	
Period	28	
Annuity factor	13.93	
Total	**368,647**	Total cost per year multiplied by annuity factor

APPENDIX B: CONTENT ANALYSIS OF MEDIA COVERAGE

The following table lists all of DuPont's directors in 1984. In addition to their names and roles, we detail whether the director was an insider or not; the length of his/her tenure; when s/he stepped down from DuPont's board; approximately when s/he "stepped down" from the labor market more generally (retired or died); and whether his/her name was mentioned in articles regarding PFOA once the bad news broke.

Insider	Name	Role	Committee	Director since	Stepped down	Left labor market	Mentions
1	**Edward G. Jefferson**	Chief executive officer and chairman of the board	Executive committee, finance committee	1973	1992	Pre-2003 (Around 2002. Stepped down as CEO in 1986, upon reaching retirement age. Died 2006)	-
1	**Ralph E. Bailey**	Vice chairman of the board	Executive committee, finance committee	1981	1987	post-2003	-
1	**Richard E. Heckert**	Vice chairman of the board	Executive committee, finance committee	1973	1994 (retired)	Pre-2003 (in 1994)	(only relati to helpi desig TSC
1	**David K. Barnes**	Executive vice president	Executive committee	1981	1988	Died 1990	-
0	**Andrew F. Brimmer**	President of Brimmer & Company (economic and financial consulting)	Audit committee	1974	1998	Remained a consultant post-2003. Died 2012	-

0	**Charles R. Bronfman**	Deputy chairman of the board at Seagram	Finance committee	1981	Before 2003	Post-2003	-
0	**Edgar M. Bronfman (Sr.)**	Chief executive officer and chairman of the board at Seagram	Compensation committee	1981	Before 2003	Post-2003	-
0	**Charles L. Brown**	Chief executive officer and chairman of the board at American Telephone and Telegraph (AT&T)	Finance committee, compensation committee	1976	1992	Died 2003	-
0	**Norman A. Copeland**	DuPont family member		1972	1984	Pre-2003	-
R	**Joseph A. Dallas**	-	-	1968	1987	Retired pre-2003	-
0	**Louisa C. Duemling**	DuPont family member	Audit committee	1982	2006		-
0	**Edward B. DuPont**	DuPont family member	Audit committee	1977	2005	Post-2003	-
0	**Irénée DuPont, Jr.**	DuPont family member	Finance committee	1959	1988	Pre-2003	-

0	**George P. Edmonds**	Director of the Wilmington Trust Company	Finance committee, compensation committee	1966	1987	Pre-2003	-
0	**Harold Fieldsteel**	Consultant at Seagram	Audit committee	1982	1985	Died 1995	-
1	**Robert C. Forney**	Executive vice president, DuPont	Executive committee	1979	1989	Pre-2003	-
0	**Crawford H. Greene-walt**	-	Finance committee	1942	1988	Died 1993	-
1	**Howard W. Johnson**	MIT/ Honorary chairman of DuPont	Compensation committee, finance committee	1972	1994	Pre-2003	-
R	**Gilbert E. Jones**	-	Audit committee	1977	1987	Pre-2003	-
R	**Edward R. Kane**	-	-	1969	1989	Pre-2003	-
0	**Margaret P. Mackimm**	Vice president of corporate affairs at Dart & Kraft Inc.	Audit committee	1979	1995	Pre-2003	-
R	**Charles B. McCoy**		Finance committee	1961	1987	Died 1995	-
0	**Dean R. McKay**	Consultant at IBM	Audit committee	1981	1992	Died 2005	-
1	**Constantine S. Nicandros**	Executive vice president, Du Pont	Executive committee	1983	1995	Died 1999	-

1	**Wilfred P. Schmoe**	Executive vice president of DuPont	Executive committee	1983	1987	Pre-2003	-
R	**Edward Shapiro**		-	1981	1987	Pre-2003	-
R	**Irving S. Shapiro**	Partner at Skadden, Arps, Slate, Meagher & Flom law firm	Finance committee, compensation committee	1970	1988	Died 2001	-
1	**H. Rodney Sharp III**	DuPont family member and manager of computer systems and finance departments of DuPont	-	1981	2006	2006	
1	**William G. Simeral**	Executive vice president of DuPont	Executive committee	1977	1987	Pre-2003 (Retired 1987; died 2009)	-
1	**Edgar S. Woolard Jr.**	Executive vice president of Du Pont	Executive committee	1982	2000 (was CEO till 1995)	Pre-2003 (Retired 2000)	-

APPENDIX C: LIST OF INTERVIEWS

To shed light on the fuzzy dynamics of how companies affect and are affected by the various deterrence mechanisms, and to make sense of several aspects of the internal documents that we were unclear about, we conducted in-depth open conversational interviews with key actors in the PFOA case. In this type of interview, the researcher introduces a topic in broad strokes, the interviewee talks freely about the interviewee's experience and insights into the topic, and the researcher further probes specific experiences with follow-up questions.[279]

The interview method is of course subject to biases. For example, interviewees may tell their interviewers what they think that the latter want to hear or distort their responses to boost their image. The factor that alleviates such concerns in this Article is that our analysis is based on triangulation with other methods. In other words, interviews are not the primary source of data in this Article but rather serve the purpose of adding richness and context to other methods (such as scouring the internal documents, conducting financial analysis, and analyzing the content of media coverage).

The following list represents those interviews that had the most impact on our analysis here.

[*redacted at the editing stage*]

[279] THE SAGE ENCYCLOPEDIA OF QUALITATIVE RESEARCH 127 (Lisa Given, ed., 2008).

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