

Addressing Environmental Justice through In-Kind Court Settlements

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Abstract

Cash penalties in US environmental court cases can be mitigated if a defendant volunteers to undertake an in-kind project in the location of their violation, for example, by creating an education program or building a public park. A stated goal of the policy is to address environmental justice concerns for low-income and minority populations. However, the historical record shows in-kind settlements most likely occur in the cases involving high-income, majority-white communities. The welfare implications of this inequality are not straightforward. We find evidence that punishment in kind is more lenient than in cash: firms volunteering in-kind projects receive positive reactions by the public and the stock market. More leniency could have implications for future environmental violations. Taking intertemporal environmental quality into account, we estimate a dynamic social welfare function and find that in-kind settlements are nonetheless beneficial. Counterfactuals with a representative social planner would result in more in-kind settlements than under the current institutional setup.

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Introduction

Court cases for corporate wrongdoing often result in a defendant undertaking an in-kind punishment in lieu of a cash penalty, for example, by creating a training session or a public park. In the US, in-kind settlements have long been used in violations of environmental regulations, with a stated goal of addressing environmental justice (EJ) concerns in communities with low incomes and a high share of minorities. While the OECD encourages more countries to adopt the US model (OECD, 2009), recent changes in the US have restricted the use of in-kind settlements (US Department of Justice, 2020). The implications of in-kind settlements are not straightforward yet policies on their use are being made in the absence of any quantitative analysis.

In-kind court settlements have advantages and disadvantages raising questions such as: Is punishment in-kind more lenient than cash? What are the consequences for future environmental quality? What is the public's perception of this policy? In which communities are cases most likely to settle with in-kind projects? What is the optimal use of in-kind settlements and how far is the current distribution from optimal? Our paper provides insights into these questions, offering guidance to the now changing policies on in-kind punishment, and contributing to the general discussions on targeting goods, environmental justice, corporate environmental stewardship, and the efficacy of environmental enforcement actions.

In this paper we use the history of US federal environmental case settlements to estimate implications of in-kind punishment for firms and communities. Every year around 5,000 cases are brought against defendants for violating federal environmental statutes, such as the Clean Air Act and Clean Water Act. In the settlement of these cases, the Environmental Protection Agency (EPA) gives defendants the opportunity to reduce the assessed cash penalty by volunteering environmentally beneficial projects in the location of the violation, under the Supplemental Environmental Projects Policy. The projects are supplemental in that they have to go above and beyond what would be legally required of the defendant. They span a wide array of interventions including, for example, lead abatement, retrofitting school buses, emergency equipment for the

local fire department, as well as upgrades at the violating facility.

In-kind settlements have the advantage of being able to target goods to a particular group, similar to in-kind benefit transfers, such as food stamps or housing assistance (Nichols and Zeckhauser, 1982; Blackorby and Donaldson, 1988; Currie and Gahvari, 2008; Lieber and Lockwood, 2018). In the case of social assistance programs, targeting is achieved when the cost of receiving an in-kind benefit is such that the less deserving self-select out. In the context of in-kind settlements in US environmental enforcement cases, targeting is even more direct: under US federal law, the Miscellaneous Receipts Act requires cash penalties to be paid to the US Treasury.¹ Thus, in the confines of the Miscellaneous Receipts Act, the question of in-kind versus cash involves weighing the value of targeting resources to a policy goal and geographic area versus adding to the public fund, where the allocation of resources is decided based on a number of policy objectives as well as electoral incentives and lobbying.

Targeting is further pronounced in the case of Supplemental Environmental Projects through the EPA naming environmental justice as a critical factor to evaluate in-kind settlements.² The correlation of pollution and socioeconomics has been well documented (for reviews, see Mohai et al., 2009, Banzhaf et al., 2018 and Banzhaf et al., 2019), but policies to combat environmental justice directly, including the EPA's Supplemental Environmental Projects, have been little studied.³ On one hand, by the EPA encouraging in-kind settlements in EJ communities, one might expect a higher share of such settlements resulting from cases that involve EJ communities. On the other hand, the EPA does not have the statutory authority to require an in-kind settlement, but can only accept or reject those that are proposed by a defendant; the negotiations between firms and the

¹Congress has the exclusive power over federal government spending, the so-called "power of the purse." Therefore, according to the Miscellaneous Receipts Act (33 U.S.C. §3302(b)), all penalties must be paid by the government official receiving the monies to the US Treasury.

²The EPA's in-kind policy states that "...because promoting environmental justice through a variety of projects is an overarching goal, EJ is one of the six critical factors on which SEP proposals are evaluated... SEPs that benefit communities with EJ concerns are actively sought and encouraged." (U.S. Environmental Protection Agency, 2015).

³Broadly speaking, policies can indirectly address environmental justice if, by uniformly lifting environmental quality, disadvantaged groups obtain larger marginal benefits, or can directly address environmental justice by delivering more environmental goods to disadvantaged groups. Policies to combat environmental justice directly have been little studied. The legal aspects of Supplemental Environmental Projects have been discussed in the law literature (see for example, Dana, 1998 or Ganguly, 1998).

regulator, with input from the community, might result in non-EJ communities being more likely to settle with in-kind projects.⁴ As intended by the policy, we see a large share of cases settling with in-kind settlements in the decile with the highest share minorities and lowest incomes, larger than most other deciles, but contrary to the intention of the policy, the largest share occurs in the cases involving the richest and whitest communities.⁵ Our findings shed light into the working of the EPA’s effort to address EJ concerns through environmental enforcement actions, suggesting that the EPA’s attempt to target in EJ communities is less effective than systemic factors that determine settlement decisions.

Other advantages of in-kind settlements can be gleaned from the literature studying different redistributive policies. The closest parallel is discussed by [Burtraw \(1991\)](#), provides reasons to prefer in-kind over cash when compensating those disproportionately affected by market-based environmental policies (in what he terms “linked-compensation”). Advantages include monetary valuation of environmental harm being difficult, and even if a cash amount is calculated, it may be hard to swallow by those affected; cash compensation could be viewed as “extortion” and raises political concerns of how to distribute ([Pacca et al., 2020](#)); cash compensation is more likely to lead to moral hazard; and in-kind compensation might be favored for paternalistic reasons. In-kind settlements as used in US environmental enforcement cases are also similar to the case of earmarking policies. Earmarking comes with the disadvantage of constraining optimal spending ([McCleary, 1991](#)), but has advantages of targeting spending to the most affected parties ([Pirttilä et al., 1998](#)) and preventing politicians from discretionary spending ([Brett and Keen, 2000](#)) or time-inconsistent policymaking ([Marsiliani and Renstrom, 2000](#)). The economic implications of targeting resources to specific geographic areas have been discussed in the context of place-based policies, whose benefits include the merits of providing public goods, generating agglomeration advantages, and reducing labor market frictions and other market imperfections ([Kline and Moretti, 2014](#); [Neumark and Simpson, 2015](#)). In our paper we focus on the benefits of targeting environ-

⁴The SEP guidelines state that “the EPA should encourage input on project proposals from the local community that may have been adversely impacted by the violations.” ([U.S. Environmental Protection Agency, 2015](#))

⁵To investigate where in-kind settlements are more likely to occur, we categorize census block groups using the EPA’s proxy for susceptibility to pollutants, specifically a demographic index based on income and race in the location of the violation.

mental improvements and abstract from broader general equilibrium and political benefits.

However, in-kind settlements have a dynamic feature that makes them unique from redistribution and earmarking policies. One goal of penalties is to be punitive, in order to deter future violations. In-kind settlements, by providing some benefits to the firm in the form of improved reputation, may ultimately result in diminished deterrence.^{6,7} On the other hand, in-kind settlements could result in increased deterrence and environmental quality for a number of reasons. First, firm goodwill could incentivize firms to undertake more environmental stewardship. Second, local communities might become more likely to monitor and report violations.⁸ And third, an additional benefit to the firm arising from Supplemental Environmental Projects is that the in-kind settlement can include the purchase of equipment for environmental improvements. New equipment can help the firm remain in compliance or even go above and beyond regulatory compliance.

To test for leniency of in-kind settlements, we conducted a randomized survey on a representative sample of nearly 2,500 US residents. We find evidence that in-kind punishment has a positive impact on the public perception of a violating firm. In the survey, we randomly assigned respondents to read a description of a hypothetical settlement, involving either a cash payment to the US Treasury or an in-kind project to the violated community, and then asked respondents to express their perception of the violating company (e.g., how good of an investment the company would make or their overall feeling toward the company). Survey respondents that were given the in-kind treatment had a much more favorable view of the company, even though the company was guilty of the same violation. These findings support the emerging view that corporate social

⁶As [Aguzzoni et al. \(2013\)](#) put it in their analysis of antitrust enforcement actions, “only if the penalties that firms incur when found guilty of antitrust infringement are large enough, will the firms be deterred from engaging in anti-competitive behavior.” Their argument can naturally be extended to penalties associated to enforcement actions in other areas, including environmental enforcement actions.

⁷In the case of Supplemental Environmental Projects (SEPs), the EPA guidelines acknowledge that there might be benefits to firms: “While in some cases a SEP may provide the alleged violator with certain benefits, there must be no doubt that the project primarily benefits public health and/or the environment” ([U.S. Environmental Protection Agency, 2015](#)). Similarly, the OECD observes that “in several OECD countries such as the US, the regulated community has been very receptive to this practice [in-kind settlements], as it helps an offender repair its public image tarnished by the violation” ([OECD, 2009](#)).

⁸The public procurement literature suggests that a public administration is more likely to report a breach of contractual terms if part of the monetary fine goes to the administration (see [Dimitri et al., 2006](#)). A similar argument can be extended to communities that would benefit from in-kind settlements.

responsibility (CSR) might be an optimal strategy for firms, given the preferences of shareholders, consumers, employees, activists, and regulators (Kitzmueller and Shimshack, 2012).⁹

Survey results also show more generally that the public has a strong preference for targeted in-kind projects over cash to the US Treasury. In a choice experiment, we allowed survey respondents to choose their preferred settlement: either a cash penalty to the US Treasury or an in-kind project targeted to the area of the violation, randomly varying the price tag associated with the in-kind settlement, as well as whether respondents were told that the violation occurred in an environmental justice area.¹⁰ We find that survey respondents prefer the targeted in-kind option and the EJ treatment results in a statistically significant increase (6 p.p.) in preference for in-kind, which is in line with the literature’s finding of a public preference for redistribution to individuals living in distressed areas (Gaubert et al., 2020). In our analysis, the extent to which respondents would forgo cash to the Treasury for a targeted in-kind project is striking: over 85% respondents were willing to forgo two thirds of the cash penalty (i.e., respondents preferred \$100,000 in in-kind to the afflicted community rather than \$300,000 cash to the Treasury).

Does the positive view of in-kind settlements have tangible consequences for the firms involved? To investigate this question, we use data on US environmental cases occurring between 1997 and 2017 and measure whether the announcement of a firm volunteering an in-kind settlement is associated to a different stock-market response from the announcement of a firm paying a cash penalty. For various reasons investors may view settlement type differently: the ultimate cost associated with in-kind settlements is uncertain, and the in-kind settlement might improve the firm’s reputation, as suggested by the survey. Recent papers have examined the stock-market impact of environmental enforcement actions (Karpoff et al., 2005; Armour et al., 2019; Brady et al., 2019), but so far no attention has been paid to the difference between cash and in-kind

⁹While part of an enforcement action, in-kind projects resemble CSR in that they commit firms to provide environmental benefits above and beyond legal requirements, and might therefore be part of a firm strategy to respond to stakeholders pressures.

¹⁰This choice set was chosen because it is the only choice set allowed under the Miscellaneous Receipts Act.

settlements.¹¹ Our stock-market findings are in line with the survey findings. While there is no significant difference in abnormal stock-market returns by settlement type before the settlement announcement, the stock-market response to the announcement is asymmetric: cash settlements are associated with a negative stock-market reaction, whereas the response to in-kind settlements is positive. We consider several case- and defendant-level characteristics by settlement type and find no evidence of other significant differences. We also restrict the analysis to in-kind settlements only and study the response to in-kind amount: the larger the in-kind settlement, the more positive the stock-market reaction. All in all, the stock market analysis and survey experiments strongly suggest that, even though in-kind settlements arise out of wrongdoing as much as cash-settlements, they provide relatively more benefits to violating firms. The findings more generally support the emerging view that in the face of an environmental violation a company's dedication to environmental stewardship (real or disguised) may mitigate the negative reputational effect associated with the violation (Barrage et al., 2020).

The potential implications on future environmental quality, as well as the largest likelihood of in-kind settlements occurring in non-EJ areas, beg the question of whether we can do better than the current allocation of in-kind versus cash settlements. To answer this question we consider the decision problem as if it belonged to a social planner.¹² The decision is a dynamic one, involving two different tradeoffs: (i) the current-period payoff of a local environmental improvement in one community versus the corresponding cash amount going to the US Treasury; and (ii) a future-period tradeoff that depends on how the settlement type chosen changes environmental quality in the future. To capture both the current and future implications, we construct a dynamic discrete choice model, in which a hypothetical decision maker chooses the optimal settlement: constrained within the confines of the Miscellaneous Receipts Act, the choice is cash to the US Treasury versus an in-kind project in location of the violation. The decision varies by community, depending on social welfare weights placed on each community. In our context of environmental enforcement

¹¹For example, Earnhart and Segerson (2012) and Brady et al. (2019) examine the implications of sanctions on firms for environmental violations, and Supplemental Environmental Projects are summed with other penalty amounts.

¹²The framework that we develop is normative, because the actual allocation is not made by a social planner but rather by negotiations between firm and regulator, with input from communities.

actions, the social welfare weights depend on the degree to which a community faces EJ concerns. Then armed with data on the location of cases and their resulting settlement type, as well as on how environmental quality changed in response to settlement type, we estimate the model using Rust (1987)'s Nested Fixed Point Algorithm. Specifically, we estimate the implicit social welfare weights that reconcile the historical choices of settlement type.

Previous literature has provided estimates of social welfare weights via two approaches. In a stated-preference approach, papers have elicited preferences for redistribution using online surveys (e.g., Saez and Stantcheva, 2016 and Kuziemko et al., 2015). And in a revealed-preference approach, papers have backed out the social planner's welfare weights, given the observed tax and transfer system (e.g., Christiansen and Jansen, 1978, Blundell et al., 2009, Bourguignon and Spadaro, 2012, Jacobs et al., 2017, and Bastani and Lundberg, 2017).¹³ We present a different revealed-preference approach that uses the record of the historical discrete choices to estimate the social welfare weights placed on different communities. Our approach, of using a dynamic discrete choice model to explicitly infer social welfare weights, could be applied to other settings in which decisions impacting future welfare are made for different groups of people over time.

With the estimated social welfare function in hand, we can then run counterfactual experiments that can be used to infer the value of in-kind settlements. As noted above, the impact of Supplemental Environmental Projects on deterrence is ambiguous; survey and stock market results suggest in-kind is more lenient than cash, but at the same time, one of the goals of Supplemental Environmental Projects is to reduce the risk of future violations. Our investigation into future violations shows that differences in future environmental outcomes are small, yet overall in-kind settlements lead to more environmental improvement than degradation. With a counterfactual scenario we see that the future environmental improvement gives impetus for choosing in-kind settlements over cash. We also examine how far the current allocation of in-kind settlements is from

¹³Other literature has estimated the preferences of regulators more broadly and is therefore also related to this paper. For example, Timmins (2002) uses the pricing decisions of managers of municipal water utilities to estimate parameters in their objective functions, which are used to estimate the deadweight loss from pricing below marginal costs. Kang and Silveira (2018) use data on the size of penalties issued to wastewater treatment plants violating the Clean Water Act to reveal regulator preference for counties with high incomes and low voter turnouts.

the optimal allocation under counterfactual representative social welfare functions. A counterfactual experiment in which the social welfare function has utilitarian welfare weights would lead to overall more in-kind settlements, which are more evenly allocated than the current allocation. A Rawlsian welfare function would lead to all settlements in the worst-off communities to be settled in-kind, a large departure from the current 5%-in-kind settlement rate. Recent policy changes underscore the need to understand the political and economic implications of in-kind settlements. Specifically, in March 2020 the US Department of Justice deemed the EPA’s Supplemental Environmental Projects a violation of the Miscellaneous Receipts Act, and suspended their use in cases involving the Department of Justice (US Department of Justice, 2020).¹⁴ Our counterfactual experiments suggest that in-kind settlements are worthwhile.

The rest of the paper is structured as follows. Section 1 describes environmental enforcement actions and the resulting settlements. In Section 2 we present results from an online survey of the public’s preferences. In Section 3 we estimate the stock-market response to settlement announcements. Section 4 presents the current allocation of in-kind settlements across communities. Section 5 develops and estimates a dynamic structural model of in-kind allocation, and studies the welfare implications of counterfactual allocations. Section 6 concludes.

1 Institutional context

When an individual, firm, or local government is found violating U.S. federal environmental laws, enforcement actions can be brought against the violator and usually start with a Notice of Violation, intended to encourage the violator to return to compliance as quickly as possible. The EPA may then start a civil administrative action or a civil judicial action. Civil administrative and civil judicial actions are similar, with the main difference being that judicial actions are brought on behalf of the EPA to courts by the Department of Justice (DOJ) or, in the case of the state-led

¹⁴The possibility to continue their use in administrative cases remains open; administrative cases are smaller but make up the vast majority (95%) of cases.

cases, to state courts by State Attorneys General.¹⁵ The EPA chooses between an administrative or judicial action depending on factors such as, for example, how long it might take to get into compliance or how much penalty will be sought. The penalty is determined according to various factors, such as the magnitude of environmental harm (“gravity”), the firm’s economic gain from violating, the violation history, and the ability to pay. Apart from the penalty, settlements also often record the costs required to get back into compliance (“compliance action costs”).

One goal of penalties is to deter violations in the future.¹⁶ During the settlement negotiation, the EPA allows firms to propose in-kind Supplemental Environmental Projects as a way to mitigate the assessed cash penalty. Supplemental Environmental Projects are voluntary and are negotiated solely between the EPA and the violator, even though the EPA strongly encourages the violator to reach out to the community affected for ideas. The EPA has total discretion on whether to accept or reject a Supplemental Environmental Project.¹⁷ The guidelines on Supplemental Environmental Projects caution consideration when mitigating penalties: “Penalties help maintain a national level playing field by ensuring that violators do not obtain an unfair economic advantage over their competitors who made the necessary expenditures to comply on time. Thus, any mitigation of penalties must be carefully considered” (U.S. Environmental Protection Agency, 2015). The entire penalty cannot be mitigated and one dollar spent in a Supplemental Environmental Project can offset at most 80 cents of the penalty. We note that in the legal interpretation of the policy, Supplemental Environmental Projects are not penalties; the EPA clearly states that “SEPs are not penalties, nor are they accepted in lieu of a penalty” (U.S. Environmental Protection Agency, 2015). This is a necessary qualification such that the policy does not violate the Miscellaneous

¹⁵Criminal cases, citizen suits, and private-party suits are three other categories of enforcement actions but are not included in our study because they are not included in our dataset and also do not allow the option of in-kind Supplemental Environmental Projects. Cases are deemed criminal when they result in significant environmental harm and when there is proof of deliberate misconduct. Private citizens can bring suits to enforce federal laws, which can result in settlements of civil penalties, attorney’s fees, and costs to the plaintiffs. Private-party suits are designed to recover monetary compensation for harm to the plaintiff.

¹⁶“Penalties promote environmental compliance and help protect public health by deterring future violations by the same violator and other members of the regulated community” (U.S. Environmental Protection Agency, 2015).

¹⁷Unfortunately there is no record of whether a Supplemental Environmental Project was proposed and turned down.

Receipts Act (33 U.S.C. §3302(b)), in which penalties cannot be diverted from the US Treasury.¹⁸ Nonetheless, in March 2020 Supplemental Environmental Projects resulting from judicial cases have been deemed illegal (US Department of Justice, 2020). In this paper, we use data from 1997 to 2017 to explore the degree to which Supplemental Environmental Projects are punitive, by examining the impact of Supplemental Environmental Projects on firm reputation and share prices as well as on the impacts on future violations.

Supplemental Environmental Projects are only allowed if they have sufficient “nexus” with the violation. The nexus between the violation and the proposed project is defined by medium and geography. The project must relate to the violation by reducing future violations, adverse impacts, or risk to public health or the environment affected by the violation. The project should also “generally be in the area within a 50-mile radius of the site on which the violations occurred” (U.S. Environmental Protection Agency, 2015). Supplemental Environmental Projects should also not be an action that the violator is legally required to take, they should reach environmental benefits “beyond compliance.” The EPA then evaluates each proposed project based on six critical factors, namely the extent to which it: benefits public health and the environment, addresses EJ concerns, gets input from the affected community, furthers innovation that is environmentally beneficial, reduces pollution across more than one medium, and prevents pollution. Examples of Supplemental Environmental Projects can be found in Appendix Section A1, Tables A1 and A2.

Data on settlements. The EPA keeps a record of all the enforcement cases for violations of federal environmental statutes and makes the information available in the Federal Enforcement

¹⁸While not defined as penalties, Supplemental Environmental Projects are directly intertwined with penalties: the EPA acknowledges that “a primary incentive for a defendant to propose a SEP is the potential mitigation of its civil penalty” (U.S. Environmental Protection Agency, 2015).

and Compliance (FE&C) database (U.S. Environmental Protection Agency, 2017).^{19,20} These data track all formal administrative and judicial enforcement actions taken by the EPA and by some states.^{21,22} We start the sample in 1997 because the EPA took an effort to improve reporting and tracking in 1996 and the data dictionary warns that cases entered prior to 1996 may not provide much settlement detail.²³ For each enforcement case, we use data describing the enforcement action from initiation to its conclusion. A single case may result in: no case conclusion (e.g., where a case is withdrawn and as such does not appear in our dataset), a single case conclusion, or multiple case conclusions. The most common occurrence is a single conclusion (nearly 92% of the cases); when there are multiple conclusions, the sum of their dollar values is assigned to the respective case. We convert all dollar amounts to their 2019 equivalent, using the Consumer Price Index from the Bureau of Labor Statistics (2019).

In more than half of the cases (57%), the defendant pays some form of penalty (cash or a combination of in-kind and cash). Summary statistics for cases that have some form of penalty are reported in the left panel of Table 1 below.²⁴ Supplemental Environmental Projects are not common (occurring in 4.1% of the cases) but when present, their value is larger than cash penalties: the average in-kind settlement amount is around \$300,000, whereas the average cash settlement is roughly \$44,000.²⁵ In general, the large standard deviation for the dollar amounts documents that the size of the settlements is highly variable. In nearly one third of the cases (32%), *Other*

¹⁹Federal environmental statutes include the Clean Air Act (CAA), the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313, the Toxic Substances Control Act (TSCA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), the Safe Drinking Water Act (SDWA), and the Marine Protection, Research, and Sanctuaries Act (MPRSA).

²⁰The FE&C data are available from the Enforcement and Compliance History Online (ECHO) system (<https://echo.epa.gov/>). ECHO incorporates data from the Integrated Compliance Information System (ICIS), used to track federal enforcement cases. For a detailed description of ICIS see <https://echo.epa.gov/tools/data-downloads/icis-fec-download-summary>

²¹These are the states that use the ICIS-National Pollutant Discharge Elimination System.

²²Informal enforcement actions or notices of violations often precede a formal administrative or judicial enforcement action and are also tracked in ICIS, but they are not included in our dataset.

²³See <https://echo.epa.gov/tools/data-downloads/icis-fec-download-summary>.

²⁴The condition that the case has some form of penalty implies that it certainly includes a cash penalty, because the occurrence of a Supplemental Environmental Project is conditioned to the assessment of a cash penalty; the project can mitigate the penalty but never completely cancel it.

²⁵One reason why Supplemental Environmental Projects are not common is that in many administrative cases the assessed fine is minor, so project proposals of a comparable amount are unlikely to be of any interest for all the parties involved.

expenditures are included, namely compliance action cost²⁶ and recovery costs.²⁷ The bulk of the dollars paid by violating entities (around \$1.5 million on average) goes into compliance action and recovery costs.

Table 1: Summary statistics of environmental enforcement actions

	Full sample		Cases in stock-market analysis	
	Mean	(Std. Dev.)	Mean	(Std. Dev.)
I(In-kind settlement)	.041	(.199)	.093	(.291)
I(Other \$ amount)	.323	(.468)	.509	(.500)
Cash \$ amount	44,588	(721,176)	251,673	(1,168,026)
In-kind \$ amount, when present	304,794	(1,357,949)	352,717	(1,179,404)
Other \$ amount, when present	1,441,890	(50,984,757)	12,556,564	(153,547,757)
Observations	56,631		678	

Notes: Summary statistics of enforcement cases with some form of penalty, 1997-2017. The left panel includes any case with some penalty in the FE&C dataset. The right panel includes information for cases that we use in the stock-market analysis; see Section 3 for a description of how we selected these cases.

2 What is the public’s perception?

Before turning to the real world outcomes associated with in-kind settlements, it is useful to investigate how the EPA’s Supplemental Environmental Projects are viewed by the public. Using a choice experiment and a randomized survey we answer two intertwined questions: (1) does the public prefer in-kind local projects or cash paid to the Treasury as punishment for environmental violations, and (2) does the type of punishment change the public’s views about a company? The answers to these questions provide the first ever insights into public views around an instrument that has been so far used, recommended, and modified in the absence of discussion in the economics literature.²⁸

In what follows we first describe the study design and then present the results.

²⁶Compliance action cost includes the cost of the physical and nonphysical actions an entity must undertake to achieve and maintain compliance, including installing new pollution control devices to reduce emissions, preventing emissions of a pollutant etc.

²⁷Recovery costs are costs to reimburse expenditures made by the EPA, usually to stabilize or clean up Superfund sites.

²⁸In similar spirit, [Liscow and Pershing \(2020\)](#) survey a sample of US residents about their preferences on in-kind versus cash transfers; they notice that while a large portion of US income redistribution happens through in-kind transfers, we know little about whether the US public prefers in-kind redistribution, how strong this preference may be, and why preference for in-kind redistribution might be prevalent.

2.1 Survey design

Both our choice experiment and randomized survey were administered online through a survey firm (Prolific). The study ran on October 14th, 2020, and returned a sample of 2,361 respondents.²⁹ After informing participants that they were contributing to a research project, respondents had two sections of a survey to answer.³⁰

Part A: Choice experiment and an attention question. The goal of the choice experiment was to assess whether and under what conditions the public prefers penalties as cash to the US Treasury versus in-kind projects targeted to the violated community. To this end, we described a fictitious situation, phrased to resemble as much as possible a typical environmental enforcement case in the US, where the EPA was negotiating a settlement with a company for an environmental violation, namely exceeding regulatory limits on air emissions. We also informed roughly half of the respondents, selected randomly, that the company’s facility is located in a community vulnerable to environmental justice concerns.³¹ Next we asked the respondents to choose their preferred settlement between a cash penalty of \$300,000 to the US Treasury and an environmental project in the community.³² Across roughly equally sized groups of respondents, we varied randomly the size of the cost of the in-kind project, presenting them with costs both larger and smaller than the cash option (specifically \$100,000, \$200,000, \$300,000, and \$400,000).

The attention question at the end of Part A checked that the respondent could recollect the violation described in the previous question.³³

²⁹The initial sample of subjects who started the questionnaire was slightly larger; we record a 2.5% attrition rate of respondents not completing the survey. See Appendix Section A2 for more details about causes of attrition.

³⁰We randomized the order of appearance of Part A and Part B, to address the concern that the content of the first part of the study would affect responses to the second. The flow of the survey is outlined in Appendix Figure A1.

³¹We explained what is a typical definition of environmental justice. See Figure A3 for the exact text that we used.

³²We provided examples of environmental projects, see Figure A3.

³³For text used, see Appendix Figure A4.

Part B: Randomized survey. The goal of the randomized survey was to learn whether the public’s perception of a firm that violates an environmental regulation is influenced by the type of punishment. First we informed the respondents that the EPA had concluded a settlement for environmental violations. Then we randomly allocated roughly half of them to read that the settlement consists of a cash penalty of \$300,000, and the other half to read that the settlement consists of both a cash penalty of \$150,000 and a \$225,000 in-kind project (retrofitting local school buses).³⁴ Once given the information treatment, we asked respondents to indicate where their opinion about the company fell within five pairs of opposing statements describing overall perception of the company, as well as one’s beliefs about the future company’s relationship with some of its relevant stakeholders (investors, community, regulators).³⁵

2.2 Survey Results

Sample description. The sample is broadly representative of the US population on a number of relevant characteristics, based on a comparison with the most recent estimates from the US Census Bureau.³⁶ There are some relatively small differences in terms of median age (42 against population median age of 38 in 2018) and percentage of foreign born (7% versus population percentage of 13.5% in 2019). For other characteristics, the representativeness is higher: 52% of the respondents are women (compared to the population share of 51%), 65% of those in working age are employed (compared to the OECD’s estimate of the population employment rate in the third quarter of 2020 being 66%), and the percentage of White, Black and Asians is respectively

³⁴This choice of dollar amounts was to keep the amounts as similar as possible to what one might see in EPA Supplemental Environmental Projects; the settlement cannot be completely mitigated by in-kind, and a dollar in-kind can only mitigate at most 80 cents.

³⁵We randomized the order in which the respondent reads the statements. The five opposing statements read as follows: I feel negatively toward the company/I feel positively toward the company; The company will have a hard time hiring workers/The company will have an easy time hiring workers; An investment in the company would be a bad investment/An investment in the company would be a good investment; The company will have hard time getting community approval to expand operations in the area/The company will have an easy time getting community approval to expand operations in the area; The company is unlikely to comply with environmental regulation in the future/The company is likely to comply with environmental regulations in the future. Figure A3 depicts how the respondents saw the question and how they could express their position with respect to each of these pairs of statements.

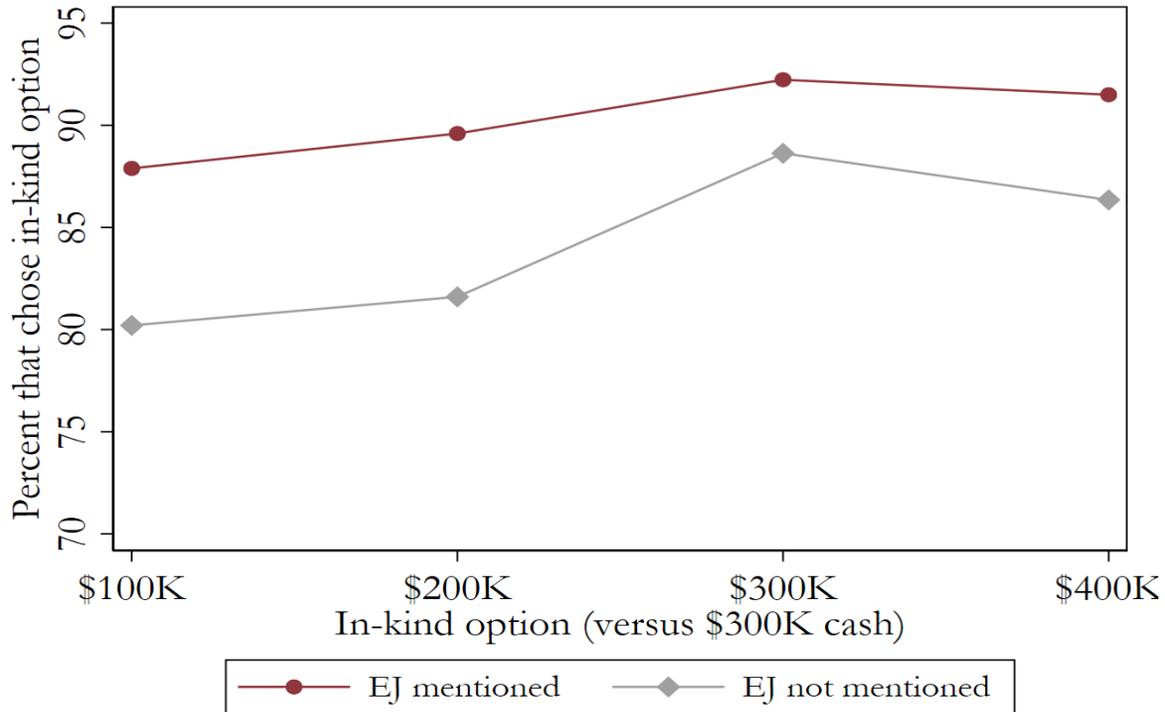
³⁶See <https://www.census.gov/quickfacts/fact/table/US/PST045219>.

78%, 11% and 6 % (compared to 76%, 13% and 6% in the population.)

Part A: Choice-experiment of preference for settlement type. We summarize the results of the choice experiment in Figure 1 and Table 2. An overwhelming majority of respondents (87%) prefer in-kind punishment over cash, even when the size (in dollar amount) is smaller; in other words, most respondents are willing to forgo cash in order to choose an in-kind punishment. The preference for in-kind punishment is also 6 p.p. larger when the settlement description mentions environmental justice concerns. Importantly, under the EJ treatment the size of the proposed in-kind project does not significantly impact the choice; instead, absent the EJ treatment the propensity to choose the in-kind project is significantly larger if the project size is equal to or larger than the cash punishment. Put differently, respondents are more willing to forgo money to choose an in-kind project when the violation occurred in a community subject to EJ concerns. Overall, the choice experiment suggests that (a) the public has a strong preference for in-kind punishment following an environmental violation and (b) the public sees in-kind punishment even more favourably when the violation and the project take place in a community subject to EJ concerns.³⁷ We are further assured of the strong preference for in-kind punishment by the high rate of attention: out of 2,361 respondents only 59 (2.5%) provided the wrong answer to our attention question.

³⁷Notice that, given the options proposed to the respondents, we can only conclude that they prefer in-kind punishment targeted to affected communities to funding for the US Treasury, and the preference for targeting is larger when EJ concerns are involved. While this limits our ability to answer another interesting question, namely whether the public prefers in-kind to cash punishment targeted to the same community, arguably in the context of the US the question that we pose is the most relevant one, since the transfer of cash to the Treasury is the only available alternative to in-kind local projects.

Figure 1: Choice experiment: Support for in-kind over cash to Treasury



Note: Each marker indicates a group of participants randomized into eight different treatments (an information treatment indicating the in-kind project would occur in an environmental justice area and a treatment that varies by cost of the in-kind option). We depict 95% CIs around each treatment; while most confidence intervals overlap, after pooling the data, the EJ treatment is statistically significantly different from the non-EJ treatment (see Table 2).

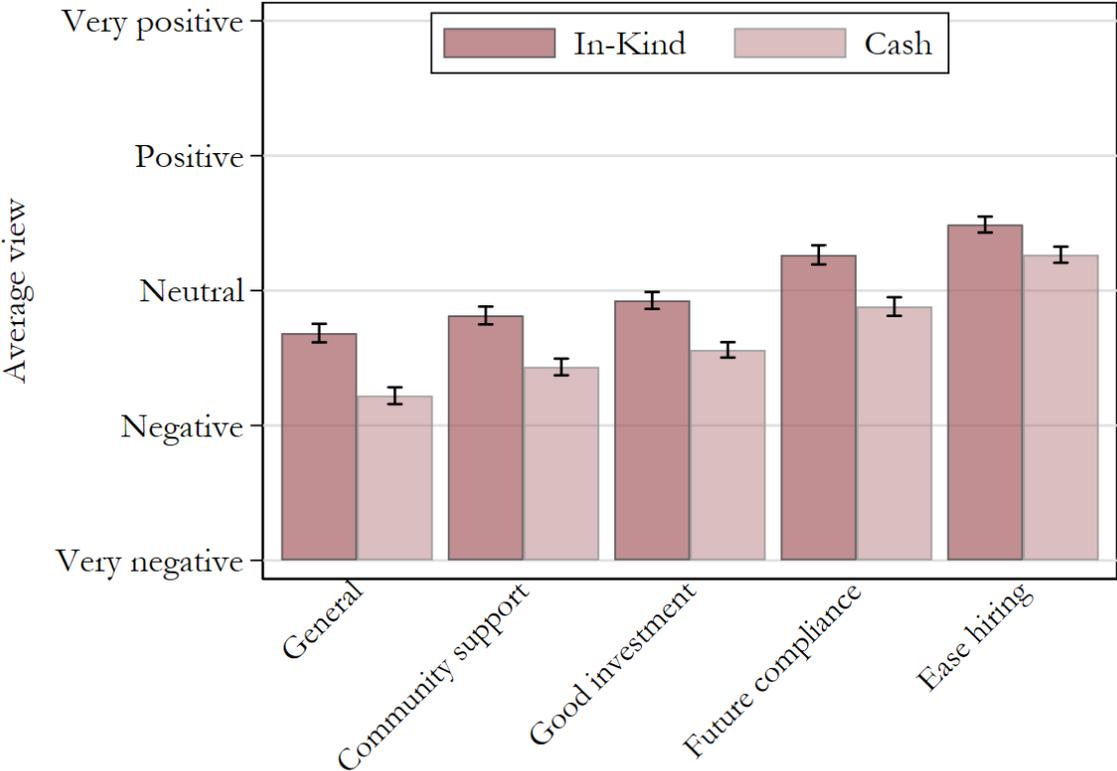
Table 2: Choice experiment: Support for in-kind punishment

	(1) Full sample I(Chooses in-kind)	(2) Non-EJ-info sample I(Chooses in-kind)	(3) EJ-info sample I(Chooses in-kind)
I(\$200K in-kind)	0.02 (0.02)	0.01 (0.03)	0.02 (0.03)
I(\$300K in-kind)	0.06*** (0.02)	0.08** (0.03)	0.04 (0.02)
I(\$400K in-kind)	0.05* (0.02)	0.06* (0.03)	0.04 (0.03)
I(EJ mentioned)	0.06*** (0.01)		
Constant	0.81*** (0.02)	0.80*** (0.02)	0.88*** (0.02)
Observations	2,361	1,184	1,177

Note: This Table presents regression results from the choice experiment. The dependent variable in each column is an indicator for whether an individual chooses the in-kind option. Independent variables are indicators for the treatment the individual received (i.e., indicators for the size of the proposed in-kind punishment, with \$100K as the omitted category, and an indicator for exposure to the EJ treatment). Column (1) pools all observations, column (2) includes only respondents who were not exposed to the EJ treatment, and column (3) includes only respondents who were exposed to the EJ treatment. Heteroskedasticity-robust standard errors in parenthesis, **1%, *5%.

Part B: Survey findings on perception of firms by settlement type. The responses to the survey experiment reveal that the public holds a more positive view of firms that are subject to in-kind rather than cash punishment. To get an average of how respondents viewed companies, we created a scale representing where respondents views fell between the opposing statements, with evenly spaced increments. We depict the averages of the responses in Figure 2, and find that across all questions, respondents have a statistically significant more negative view of the company when the punishment was in cash.

Figure 2: Randomized survey: perception of firm by settlement type



Note: Participants were given information about a company violating the Clean Air Act and randomized into two groups, based on whether the violation resulted in an in-kind or a cash settlement. After reading the violation and settlement type, participants were asked to indicate where their opinion about the company fell between two opposing statements. To depict their responses on the same figure, we categorized their responses to fall on a scale between very negative and very positive. The error bars indicate 95% confidence intervals.

3 How do firms' share prices respond?

Survey evidence suggests that in-kind settlements shed firms in more favorable light than cash settlements, and in the case of respondent's expectations for future compliance, mark the difference between overall positive and overall negative expectations. Here we examine whether in-kind settlements are also associated to different responses from investors. Recent literature has studied the effects of financial payments ordered to firms within settlements of environmental litigations, by considering the stock-market response to news of these settlements (Karpoff et al., 2005; Brady et al., 2019; Armour et al., 2017). Share prices have the advantage of revealing an immediate response that can capture both short and long-term implications.

Share prices might decrease after a settlement because the market prices-in the financial penalty ordered. Additionally, as observed in Brady et al. (2019), investors may revise their expectations of long-term profitability if they foresee changes to future interactions of the firm with some of its stakeholders, such as customers, suppliers, regulators, or neighbouring communities. The most recent literature tends to agree that financial penalties for environmental violations cause a drop in defendants' market valuation, largely reflecting the size of the financial penalty (Karpoff et al., 2005; Brady et al., 2019). However, so far no attention has been paid to the use of in-kind penalties, which might vary how investors react. For example, the cost of an in-kind settlement is only estimated, and so if investors are risk averse, the impact of the settlement on the company's valuation might be larger than the in-kind settlement's dollar amount; or the impact might be lower if the investors anticipate the firm to be able to save on the cost of delivering the in-kind project. Some in-kind settlements also involve a capital upgrade for the defendant, which may be perceived as an improvement in the company's bottom line. Another important aspect is the difference between settlements in terms of reputational effects. Investors might have a more positive view of companies that undertake Supplemental Environmental Projects, either because some investors are environmentally minded and see the projects as commitment to environmental stewardship, or because they anticipate better economic performance due to improved relations between the company and the community targeted by the project, the regulator, and other relevant

stakeholders, such as consumers (Konar and Cohen, 2001).^{38, 39} In the face of an environmental violation a company’s dedication to environmental stewardship (real or disguised) may mitigate the negative reputational effect associated with the violation. Barrage et al. (2020), for instance, find that the negative impact on sales and prices of the BP 2010 Deepwater Horizon Oil Spill was attenuated in areas where BP had previously spent more in its “Beyond Petroleum” advertising campaign.

Stock market data. The EPA enforcement data provide the names of the defendants in each case. To identify the defendants that are publicly traded companies, we used a commercial web interface for searching company names, called Orbis from Bureau van Dijk Electronic Publishing (Bureau van Dijk Electronic Publishing, 2017).⁴⁰ Using a company identifier from Orbis we matched defendants’ daily stock market prices from the CRSP U.S. Stock database provided by Wharton Research Data Services (Wharton Research Data Services, 2019).⁴¹ We match stock-market information for nearly 3,400 cases. Of these, around 2,300 result in no monetary penalty, 910 result in a cash penalty only, and 108 result also in an in-kind penalty. Our goal is to compare cash versus in-kind decisions, and so we restrict the sample to 1,018 cases with some financial penalty. Then we focus on the date when information about the case settlement is announced. The date an in-kind or cash settlement is announced is the day when the final order is lodged if the case is judicial (which is the date when the settlement document is given to the Clerk of the Court for lodging in the District Court), and the date when the final order is issued if the case

³⁸Local communities’ goodwill is potentially material to the firm because citizens can start enforcement actions by initiating lawsuits or by triggering inspections; public agencies may also intervene to preempt citizens’ actions (see Shimshack, 2014). Consumers’ goodwill in general is likely important for firms that produce consumer goods; Campa (2018), for instance, finds that these firms reduce toxic emissions after news-media print stories featuring them as major polluters, and they are especially likely to respond to the media coverage if they produce local goods.

³⁹The media coverage of the settlement may also influence its impact on reputation, since discussion of the in-kind project itself might crowd out discussion of the violation; for example, the following headlines highlight the in-kind project, not the violation leading to the project: Natsu, Jennifer, “Seafood giant agrees to \$23M in upgrades to reduce coolant leaks, EPA says,” *Environment+Energy Leader*, February 20, 2019; or Heath, Michelle, “Valero proposes vegetable garden near Port Arthur refinery,” *Beaumont Enterprise*, April 6, 2015. This aspect makes our analysis also relevant to studies of the phenomenon of “green washing” (Wu et al., 2020).

⁴⁰Orbis uses an approximate string matching algorithm, which in a test sample of 1,000 cases resulted in a better match of defendant names than Stata’s fuzzy match algorithm.

⁴¹The company identifier from Orbis is the ISIN number, which we converted to the identifier in the CRSP dataset—the CUSIP number—by removing the first two characters and the last digit.

is administrative.⁴² We manually checked the 1,018 cases to see if information about the settlement was released before the lodge/issue date and found only seven cases in which information was released between two months and four days before the lodge/issue date. We dropped these seven cases. We also exclude cases with multiple defendants, since the information on penalties is available at the case-level rather than the defendant-level.⁴³ Finally, as is standard in studies of the stock-market response to events of interest (e.g. [Armour et al., 2017](#)), we exclude those cases where a summa we find news of significant events involving the same firm occurring at around the same time as the settlement, as these events could also be reflected in stock-market fluctuations. In the right panel of [Table 1](#) we show summary statistics for the selected cases used in our stock market analysis. All the monetary values are expressed in 2019 dollars.

The mean cash and in-kind settlements are comparable, at around \$300,000; they both have a large dispersion, with maximum values equal to roughly \$16 and \$8 million respectively (not shown in table), and they are relatively minor as a share of the average market capitalization of the defendants (\approx \$20 billion, not shown in table). The compliance action cost and recovery amount, summed in the category *Other*, are substantially larger than the penalties (mean = \$12 million) and they have an even greater dispersion. The settlements stretch over a mean period of 72 days (measured as the time between the compliance action being filed and the final order being issued; not shown in table).

⁴²The FE&C data record a number of milestone activities dates for each case. For judicial cases, the most important milestone dates are: the day when the complaint is filed, the day when the final order is lodged, the day when the final order is entered, and the day when the action is closed. For administrative cases, the most important milestone dates are: the day when the complaint is filed, the day when the final order is issued, and the day when the action is closed. See <https://echo.epa.gov/help/enforcement-case-search-help#admin>. We focus on the date when the decision to include a cash or in-kind settlement, and the respective dollar amounts, are announced; this should allow us to best capture the different stock-market response by settlement type.

⁴³In a few cases, the EPA data report that there was more than one defendant even though these are subsidiaries of the same parent company, or plants owned by the same parent company. In these cases, we proceeded as though they had one defendant.

3.1 Stock-market event study methodology

We examine abnormal stock-market returns upon announcement of a final settlement. An enforcement action involves a sequence of visible steps that possibly stretch over years (Armour et al., 2017), however, we only focus on the stock-market response to the settlement announcement, since this is when investors learn about the settlement type (cash or in-kind), and the respective dollar amounts. The time of the lodging (for judicial cases) or the issuing (for administrative cases) of the decisions corresponds to the announcement of the settlement type and amount.

We use a panel regression approach in the spirit of Dube et al. (2011). Our main specification regresses the raw returns of individual stocks on (a) an indicator for the time-window when we estimate the stock-market response, and (b) an interaction term that allows the stock-market response to differ between cash and in-kind settlements. We consider different estimation windows for the stock-market response, varying the treatment and the sample, from the day before to up to 30 days after the settlement, and use data on stock market returns for 364 trading days before the settlement to account for market-induced variations in stock-prices. We augment the regression with the three Fama-French factors interacted with firm-settlement dummies, to capture market-wide conditions that vary across firms-by-settlement.^{44,45}

Our regression specification is:

$$R_{fjt} = \phi_{fj} \cdot R_{mt} + \gamma_1 \mathbf{1}[t \in \mathbf{W}] + \gamma_2 \mathbf{1}[t \in \mathbf{W}] \cdot \mathbf{1}[In-kind] + \varepsilon_{fjt} \quad (1)$$

R_{fjt} is the one-day raw stock return, calculated based on the change between the closing price at date $t - 1$ and the closing price at day t , $\mathbf{1}[t \in \mathbf{W}]$ is an indicator for the trading day t falling in a window \mathbf{W} , and $\mathbf{1}[In-kind]$ is an indicator for in-kind settlements. We use data for trading days $t = \{\tau - 365, \tau + 30\}$, where τ is the settlement date, which we refer to as day 0. We estimate

⁴⁴The Fama-French factors are: (1) the average return on the three small portfolios minus the average return on the three big portfolios (2) the average return on the two value portfolios minus the average return on the two growth portfolios, and (3) the excess return on the market.

⁴⁵We use firm-by-settlement rather than firm fixed-effects because the same firm can appear as defendant in different settlements over time; practically speaking, we treat these as different firms.

equation (1) 60 times, varying the window of treatment \mathbf{W} , and consequently the number of observations. Following other stock-market event studies, we start measuring the stock-market response to the settlement from day -1, because the settlement may be concluded the day before the order is lodged and information might diffuse immediately (see [Armour et al. \(2017\)](#)). Specifically, we start with \mathbf{W} being an indicator for only one day before the settlement announcement (day -1), and include observations from 365 to 1 day before the settlement announcement (days -365 to -1). We then increase the window \mathbf{W} such that it indicates both days -1 and 0 as treated, and also increasing the number of observations in the estimation by one. We proceed until the treatment window includes all dates from one day before to 30 days after the settlement date. Next, we run placebo regressions to test for anticipation, by constructing treatment windows that aggregate backward from days -2 to -30 before the settlement, and using information from days -365 to -2 from the settlement. R_{mt} includes the three Fama-French factors and ϕ_{fj} are firm-by-settlement fixed effects. Based on this specification, γ_1 is the average abnormal stock-market return in a time window \mathbf{W} after a cash settlement, and γ_2 estimates the difference in average abnormal stock-market return between cash and in-kind settlements.⁴⁶ Standard errors are two-way clustered at the date and firm-settlement-level. We estimate equation (1) on the sample of selected settlements described in Section 3 (see *Stock market data*, summary statistics in Table 1).

3.2 Results from the stock-market analysis

We show results from equation (1) in Figure 3. The graphs display coefficients (γ_1 and γ_2) and confidence intervals for regressions with different time-windows \mathbf{W} . For instance, the coefficient and confidence interval for day -1 refer to the stock market abnormal return one day before the

⁴⁶For companies that are cited in more than one settlement on the same date, we sum the monetary payments across all the settlements (the same company appears in multiple settlements mostly when it is involved in a national case). When the same company is cited as a defendant in multiple consecutive cases, we check that these cases are at least 31 days apart, not to confound the effects of different settlements. When the cases are less than 21 days apart we drop them. Moreover, for the windows before the event, we follow [Dube et al. \(2011\)](#) and augment equation (1) with a dummy that takes value 1 if a date coincides with the “after” of another settlement at the same firm. Finally, as in [Dube et al. \(2011\)](#) we drop firms that during the sample period have at least one of the following events: (a) company name change, (b) change in stock-market price larger than 50%, and (c) change in outstanding share by more than 5%.

final order is lodged or issued as compared to the previous 364 days. The coefficient and confidence interval for day 0 represent the average abnormal return on the day the order is lodged or issued and one day before, as compared to the previous 364 days.

Based on Figure 3a, a number of conclusions emerge: first, there is no evidence of significant abnormal stock-market returns post-cash settlements but there is increased noise around the settlement day; second, in-kind settlements appear to be associated with more positive abnormal returns within 5 days from the settlement, but the respective point estimates are not statistically significant.

These conclusions apparently collide with the results in Karpoff et al. (2005), who find a significant negative stock-market impact of press announcements disclosing environmental violations in the US between 1980 and 2000, nearly half of which are settlement announcements. The discrepancy between our results and Karpoff et al. (2005)'s may be due to their focus on news in the press, which likely cover only the largest settlements. Thus, in a similar spirit, we re-estimate equation 1 on samples of progressively larger settlements, while allowing for different responses to cash and in-kind settlements.

When we study settlements with a total punishment (cash + in-kind) larger than the median (Figure 3b) or the 75th percentile (Figure 3c) the conclusions of the analysis are largely unchanged, with no significant abnormal returns associated with cash settlements and a possibly significant positive response to in-kind settlements.⁴⁷ Instead, once our sample is further restricted to 68 very large cases (punishment larger than the 90th percentile)⁴⁸, we document a significant decline in shares prices as a result of a cash settlement, and an opposite response to in-kind settlements (Figure 3d). The difference in response is statistically significant at conventional level, whereas

⁴⁷We use percentiles of the sum of cash and in-kind punishment to select samples of progressively larger cases; the median punishment is nearly \$79,000 for settlements larger than the median, nearly \$234,000 for settlements larger than the 75th percentile, and around \$1,140,000 for settlements larger than the 90th percentile.

⁴⁸Of the largest settlements, 55 are cash settlements and 13 are in-kind. The former have a median cash punishment equal to approximately \$890,790; for the latter, the median cash punishment is nearly \$780,000 and the median in-kind punishment is approximately \$341,000, for a total median punishment of roughly \$1,400,000. All in all, the size of the punishment is largely comparable between cash and in-kind settlements. Notice also that among large cases the share of in-kind settlements is larger than in the overall sample.

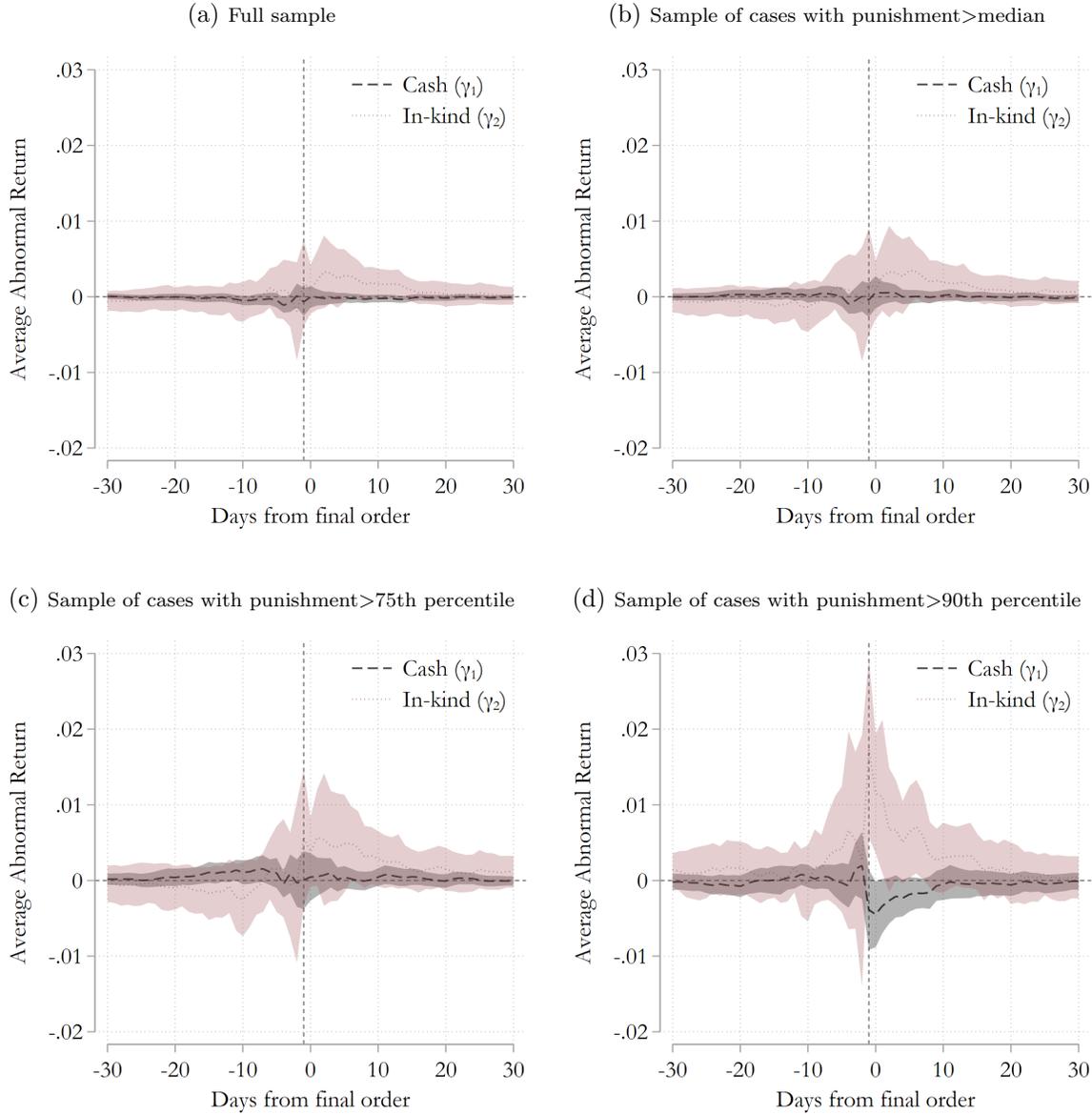


Figure 3: Average abnormal returns

Notes: The figures depict the average abnormal returns for different windows around the settlement date from four different samples. Darker line depicts the average abnormal return from a cash settlement and the lighter line the difference in average abnormal returns between cash and in-kind settlements, obtained from coefficients γ_1 and γ_2 in equation (1). The x-axis labels represent the window over which we estimate the average abnormal return. Following the literature, each window starts at one day before the final order is issued or lodged. For example, the label 5 refers to the average abnormal return between one day prior and six days after the order is issued, and -5 refers to the average return between the one day prior and four days prior. The shaded areas depict 95% confidence intervals.

there are no statistically significant differences in abnormal stock-market returns by settlement type in the 30 days leading up to the settlement announcement. These conclusions are also confirmed when we add controls, study the intensive margin of the treatment focusing on the

sample of settlements in-kind, and produce “leave-one-out” estimates where we exclude one in-kind settlement at time from the estimation sample (see Sections 3.3 and A3.2).

In quantitative terms, large cash settlements are associated to an average drop in defendant’s share price equal to 0.45% on the day the order is lodged or issued and the day before. For comparison, [Karpoff et al. \(2005\)](#) also consider the two-day window consisting of the day before and the day of the press report and estimate an average negative abnormal return for settlement announcements equal to 0.35%. For those settlements that include an in-kind punishment, however, our estimates imply an average positive abnormal return during the same time window of around 0.70%.⁴⁹

This analysis shows that environmental enforcement actions generate a discernible stock-market response as long as the penalty amounts are large enough, and, together with the survey evidence, supports the presumption that in-kind settlements be advantageous for companies that settle for environmental violations. Given that penalties usefully deter future violations ([Shimshack, 2014](#)), our findings imply potential differences in deterrence as well, motivating the analysis in Section 5.

3.3 Identification in the stock-market analysis

Concluding that the opposite stock-market response to in-kind and cash settlements is due to the settlement type requires assuming that in-kind and cash settlements are similar in any characteristic that influences share prices upon the settlement announcement. In this Section we consider a number of potential violations of this assumption.

First, a concern is that the share price of defendants involved in in-kind settlements drops more in previous stages of the enforcement action; then, the more positive evaluations are only revisions upon the settlement announcement. However, in roughly 70% of the cases that we

⁴⁹Notice that these estimates do not necessarily capture the stock-market response to the entire enforcement action, whose quantification is beyond the scope of this paper. The enforcement action can stretch over a variable number of days: while in most of the cases in our sample (72%, 68% among the largest cases) the settlement is announced on the same day when the complaint is filed, sometimes the lag between these actions can be quite large.

study, the complaint, that officially starts an enforcement action, was filed on the same day as the settlement announcement, implying that in most of the cases we actually likely capture the entire stock-market response to the enforcement action.

Second, a concern is that those firms volunteering in-kind settlements are systematically different in ways that make the stock market response to their wrong-doing different. For instance, the firms volunteering in-kind might also be better at spinning the settlement to the public, and could have observed a positive response even in absence of an in-kind project. However, when we consider a number of observables we fail to find evidence of significant differences between cases resulting in in-kind versus cash punishment, or between their respective defendants. Specifically, we exploit information on the size of the case, as measured by the fine and other expenditures included in the settlement, its duration, the specific civil procedure followed (i.e. whether the case was led by the State or the EPA, whether it resulted from self-disclosure, and whether it was administrative or judicial), measures of the size of the defendant (market capitalization, number of employees, operating revenues, assets, and number of companies in corporate group), and whether the defendant is a consumer-goods producer, which would likely make it more exposed to consumers' pressure (the consumer-good indicator is based on the 4-digit NAICS sector where the company operates). As we show in Table 3, for all of these variables except one we fail to reject the null that there are no statistically significant differences between in-kind and cash settlements.⁵⁰

The only exception is that in-kind settlements are always initiated by the EPA, whereas cash settlements in rare cases arise from a State-led initiative. In Section A3.1 in the Appendix we show that limiting the analysis to EPA-led cases leaves the conclusions virtually unchanged. Further, since some of the differences in Table 3 are large, albeit not statistically significant (see the variable *Other*), we also consider the sample of large cases and estimate variations of equation 1 where we control for $\mathbf{1}[t \in \mathbf{W}] \cdot x$, where x stands for each of the control variables in Table 3. Figure A5 in the Appendix shows that the observed difference in stock-market response is not explained by any of the case-level and defendant-level characteristics that we consider.

⁵⁰We compare means by estimating t-tests that allow for unequal variance between cash and in-kind settlements; when we impose equal variance all the p-values are strictly larger than 0.05.

Table 3: Comparison of case and firm characteristics across settlement types

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Cash-only settlements			In-kind settlements			Equality of means
	Obs	Mean	(Std. Err.)	Obs	Mean	(Std. Err.)	<i>p</i> -value
Case-level variables							
Cash (\$ 000)	615	228	(431)	63	488	(236)	.28
Other (\$ millions)	615	7	(5)	63	.7	(.5)	.18
Settlement duration (days)	559	68	(12)	62	107	(41)	.36
I(Self disclosure)	603	.05	(.01)	61	.03	(.02)	.45
I(Judicial case)	615	.09	(.01)	63	.11	(.04)	.55
I(Led by EPA)	615	.98	(.01)	63	1	(0)	.00
I(Notification and settlement same day)	615	.71	(.02)	63	.71	(.06)	.96
Defendant-level variables							
Market cap (\$ millions)	615	20,543	(2,120)	63	16,689	(4,385)	.43
Number of employees (000)	504	62.6	(11.6)	49	73.5	(44.8)	.81
Operating revenue (\$ millions)	517	26.3	(3.1)	50	25.7	(10.7)	.95
Assets (\$ millions)	515	36	(7)	50	25.4	(5)	.23
Number of companies in corporate group	518	408	(30)	50	316	(39)	.06
I(Consumer goods producer)	478	.38	(.02)	58	.40	(.06)	.81

Note: Sample of cases in the stock market analysis. Column (7) compares the cash-only cases to the in-kind cases, reporting the *p*-value from a test of equality of means with unequal variances. When we impose equal variances *p*-values are always > 0.05.

Third, a similar threat to identification is that defendants volunteer to perform an in-kind project when they expect a strong negative stock-market response to the punishment announcement. Importantly, if this were the case, our estimate of the difference in abnormal stock-market returns would be a lower bound of the positive stock-market response to in-kind settlements.

Fourth, one hypothesis is that the defendants that volunteer to perform an in-kind project are those that expect the larger benefits from settling in-kind, for instance because their investors and stakeholders are particularly sensitive to green advertisement; such treatment-effect heterogeneity has implications only for the interpretation of our findings, and not for identification, as long as cash settlements provide a useful counterfactual for investors' response in absence of the in-kind project. In other words, one possibility is that in-kind projects benefit those defendants that volunteer to perform them, but were other defendants induced to settle in-kind the benefits to them would not be necessarily the same.

In Appendix Section A3 we also present evidence from an alternative strategy that exploits the intensive margin of the treatment (e.g. cash and in-kind amount) focusing only on in-kind settlements. The sample of cases considered is likely more homogeneous; nevertheless, cash and in-kind amounts lead to opposite stock-market responses, corroborating the conclusions from the

main analysis.

4 Which communities are getting in-kind settlements?

EPA guidelines and survey respondents demonstrate strong preference for targeting in-kind settlements to communities with EJ concerns, yet it is not clear whether we would see more in-kind settlements in these communities, due to a number of factors. First, there may be differences in exposure to violations. The environmental justice literature points to a number of reasons why pollution might be positively correlated with demographic indicating vulnerability, namely firms siting decisions based on economic factors such as land, labor, or proximity to transportation networks (Wolverton, 2009), households sorting based on tradeoffs between housing prices and environmental quality (Banzhaf and Walsh, 2008; Kuminoff et al., 2013), differences in access to information (Hausman and Stolper, 2020), or racial steering by real estate agents (Christensen and Timmins, 2018). Indeed the high incidence of pollution in communities with EJ concerns is the main reason why the EPA uses an EJ index to tag communities as being more deserving of in-kind projects.⁵¹ Second, defendants operating in EJ communities might be more or less willing to perform a Supplemental Environmental Project. Third, the probability of detecting a violation might be different for EJ communities; structural racism (Bailey et al., 2017) could result in fewer inspections and less detection of environmental violations. Fourth, even upon detection, limited access to power, formal education, or language barriers could result in less ability to organize and be heard (Hamilton, 1995). The EPA encourages community involvement in the development of in-kind settlements, by using community involvement as a criterion to determine the extent that a Supplemental Environmental Projects will mitigate a cash penalty. Guidelines for community involvement suggest communities develop SEP-idea libraries such that these can be accessed by defendants in the case of an enforcement action, with the EPA suggesting ideas come “through

⁵¹Consistent with the findings in the EJ literature, we find a strong correlation between our measure of EJ and our indicators of environmental pollution (discussed below), see Appendix Figure A8.

town meetings, publications, the internet, or public hearings.”⁵² However, the EPA acknowledges the difficulty of harnessing community involvement when there are court-ordered timelines, disagreement within the community, or unwillingness of defendant.

We study whether the EPA effort to promote in-kind settlements in EJ communities effectively results in more in-kind projects following those enforcement cases that involve such communities. To classify communities as susceptible to environmental justice concerns we use a census-block-group demographic index that the EPA uses for the same purpose, namely to screen for areas that may be candidates for outreach, analysis, or activities, as part of a program called EJSCREEN. The EPA constructs EJ indices interacting the demographic index with population and 11 environmental indicators. The environmental indicators however do not cover all areas or time periods of our sample. In the rest of our paper, we use only the demographic index, not EJ indices to obtain more years than available through EJSCREEN.⁵³ We use data from the census’ *Integrated Public Use Microdata Series (2017)* and re-construct the EPA’s demographic index. The demographic index is the block-group average of the percent minority and percent low income.⁵⁴ We use the zip-code of the facility where the case occurred as the location of the in-kind project, given the rule that the project be within 50-miles of the violation, and assign the block-group demographics falling in the respective zip-code following boundaries from the *United States Census Bureau (2017)*. We note that a 50-mile radius might encompass more than one zip code and we are therefore missing valuable information on where the in-kind project is targeted as compared to where the violation occurred. With this assumption, our findings only speak to the likelihood of cases in EJ areas to settle with in-kind projects, and we might miss some nuances as to the likelihood of

⁵²Interim Guidance on Community Involvement in Supplemental Environmental Projects, Environmental Protection Agency, Federal Register, Vol. 68, No. 116 (June 17, 2003).

⁵³One concern of using the demographic index and not the EJ indices, is that we are missing important information on which communities are overburdened by pollution. Later we show that the demographic index is correlated with environmental indicators, suggesting it might be a good proxy to capture overburden (Figure).

⁵⁴Following the EPA’s EJSCREEN methodology, percent minority is the percent of individuals in a block group who list their racial status as other than “non-Hispanic white-alone.” Percent low income is calculated as the percent of the population for whom poverty status is determined, that have income below two times the federal poverty threshold. The EPA then takes the average: Demographic Index = (% minority + % low-income)/2.

in-kind projects being targeted to EJ areas.⁵⁵ Using the demographic index of the facility of the case, we categorize case locations into deciles, determined from the nation-wide distribution of the demographic index across all US zip codes. Our results present information of the likelihood of settlement type using variation from areas of 50-mile radii across the US.

For each decile of the demographic index, we calculate the percent of cases that settle in-kind and find a U-shaped relationship (Figure 4). While there are fewer total cases in the first and tenth decile (as represented by the size of the circles), these are also the two deciles most likely to have an in-kind settlement when there is a case.⁵⁶ More specifically, the first decile, indicating the whitest and richest communities, is the most likely to receive an in-kind settlement, and the 10th decile, indicating communities with the highest share of minority and poor individuals, is the second most likely. Summing up, the EPA’s effort to prioritize EJ communities is partly overshadowed by systemic factors that determine settlement decisions.

5 What is the optimal use of in-kind settlements?

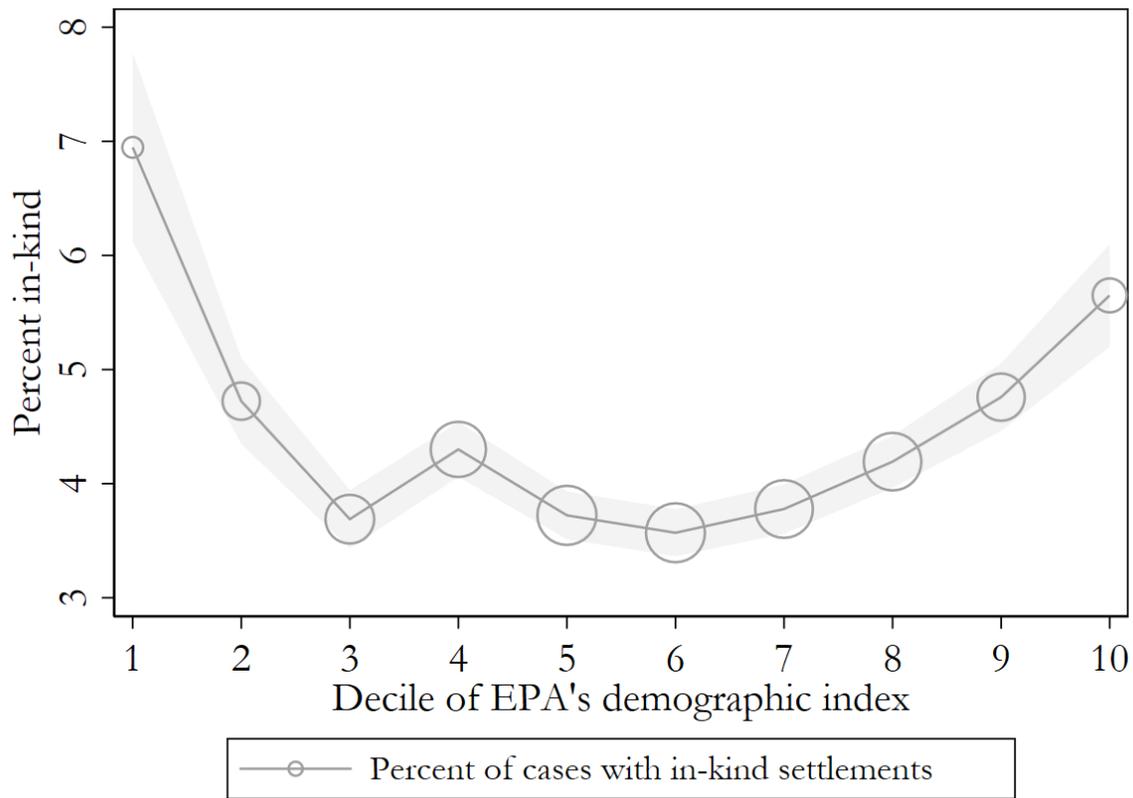
5.1 A dynamic discrete choice model of settlement type

Recent dynamic empirical models show that enforcement policies can be tweaked to improve environmental outcomes. For example, compliance can be improved by discretionarily targeting dirtier facilities with more inspections (Duflo et al., 2018) or by legislatively targeting repeat-offenders with larger sanctions (Blundell et al., 2020). Here we ask whether overall welfare can be

⁵⁵Using the facility’s zip code as the location of violation also requires some caveats. Error would arise in a handful of cases when the violation occurs outside of the facility. The two largest settlements in the dataset, the BP oil spill and the Volkswagen Clean Air Act violation would fall into this category, and are dropped from our data. Similar smaller cases, however, are still included in the dataset. Additional error could stem from assuming that the violation affects everyone in the zip code equally, even though these zip codes vary in size. Further, the match with the affected area is imprecise when the nuisance is located near the zip code’s boundary. Nevertheless, our reading of the cases leads us to conclude that the facility’s zip code is the best indicator of where the violation occurred.

⁵⁶We only include cases that have some form of monetary penalty, but the first and tenth decile also are the most likely to have in-kind settlements if we include all cases, even those that don’t result in a punishment of any kind.

Figure 4: In-kind settlements by decile of EJ susceptibility



Note: Data include all cases from 1997-2017. Markers designate the percent of cases which resulted in one or more in-kind settlements, for each decile of EJ susceptibility. Following the EPA, a zip code's susceptibility is calculated as the average between % low income and % minority and the decile is determined from the nation-wide distribution of zip codes. The size of each marker indicates the number of cases in each decile bin and the grey area designates one standard deviation above and below the mean percent.

improved by changing the way cases are settled across communities of different EJ vulnerability-levels. The answer depends on the implications of an in-kind settlement on future environmental quality and the utility thereof. We conduct a thought experiment and model a hypothetical decision maker choosing between cash to the US Treasury or an in-kind project in a community afflicted by an environmental violation. We abstract from the decision for the size and type of in-kind project if an in-kind project is chosen.

In the current decision process of including an in-kind settlement, there is no social planner. The EPA does not have the statutory authority to mandate an in-kind settlement, they can only guide a company, with community input, to volunteer to include an in-kind settlement. Our approach is, therefore, normative. First, we model the discrete choice of settlement type as if a social planner were optimizing a dynamic social welfare function which includes social welfare weights that depend on the environmental justice decile of the community. Second, armed with the record of historical decisions, we estimate the social welfare weights. The estimated social welfare weights represent what a hypothetical social planner, constrained by the Miscellaneous Receipts Act, would have had to use in order to reconcile the model with the decisions actually made. Ultimately our goal is to model the past decision of where Supplemental Environmental Projects went. While we recover the social welfare weights that reconcile the past allocation, we are not attributing the weights to a social planner per se, because they are formed from the negotiations between the firm and EPA. Rather the welfare weights simply represent the degree of redistribution resulting from the current system. With the estimated social welfare weights and history of case in-kind settlements, we have an estimate of the social welfare under the current system. Third, we run counterfactual experiments to predict how different case settlements would change welfare.

We consider the simplest case in which all i communities have the same utility function, increasing and concave in consumption, C , and environmental quality, Q : $u_i = u(C_i, Q_i)$. The social welfare function is the sum of utilities in all i of N communities. Following a typical model of social welfare, we include social welfare weights, ω_i , to be placed on communities i through N ,

such that more or less weight is placed on different communities when summing the social welfare function:

$$\text{SWF} = \sum_{i=1}^N \omega_i u(C_i, Q_i)$$

In this framework, a utilitarian, advocating for egalitarianism, would put equal social welfare weights on all communities. A Rawlsian, advocating for equality of opportunity, would put all weight on the most disadvantaged group. One of the EPA's stated goals is to reduce environmental justice concerns and so in our model disadvantagedness is based on the EPA-defined metric for EJ. Specifically, we classify communities into where they fall in terms of deciles of EJ across the U.S., which results in the model having ten different welfare weights.

The decision of a social planner to use an in-kind or a cash-only settlement would involve both current-period and future-period tradeoffs. First consider the current-period tradeoff. When a social planner decides to give community i an in-kind settlement, then environmental quality in community i will increase by q , denoted in dollar terms. Cash settlements are treated differently. According to the Miscellaneous Receipts Act, all cash penalties must to go to the US Treasury. Therefore, when the social planner chooses a cash settlement, the consumption of all communities increases by their N th share of the cash equivalent of q .⁵⁷

$$\text{SWF}(C, Q) = \begin{cases} \omega_i u(C_i, Q_i + q) + \sum_{j \neq i}^{N-1} \omega_j u(C_j, Q_j) & \text{if d=in-kind} \\ \omega_i u(C_i + \frac{q}{N}, Q_i) + \sum_{j \neq i}^{N-1} \omega_j u(C_j + \frac{q}{N}, Q_j) & \text{if d=cash} \end{cases} \quad (2)$$

Given the size of N , one community's share of the cash settlement ($\frac{q}{N}$) is negligible, and equation (2) can be simplified to include one less term. Similarly, the second term in the social welfare function can be further simplified: since cash penalties must go to the Treasury, the

⁵⁷Environmental quality is expressed in dollar terms and for simplicity of exposition we denote both the in-kind and cash settlement with q .

difference between $\sum_{j \neq i}^{N-1} \omega_j u(C_j, Q_j)$ and $\sum_{j \neq i}^{N-1} \omega_j u(C_j + \frac{q}{N}, Q_j)$ can be equated to the cash equivalent of q in the governments hands, or more specifically the distortionary and administrative costs to obtain the funds, or the marginal cost of public funds, M . We multiply q by the marginal cost of public funds commonly assumed in the literature, $M = 1.3$ (see for example [Olken, 2007](#) or [Finkelstein and McKnight, 2008](#)).⁵⁸ The expression of the current-period payoff of in-kind versus cash simplifies to:

$$\text{SWF}(C, Q) = \begin{cases} \omega_i u(C_i, Q_i + q) & \text{if d=in-kind} \\ \omega_i u(C_i, Q_i) + (1 - \omega_i)Mq & \text{if d=cash} \end{cases} \quad (3)$$

We don't know the functional form of utility. We use the simplest case, of a utility function that is linear in consumption and environmental quality, with α , a constant utility for environmental quality, consistent with other literature, e.g., [Andreoni and Levinson, 2001](#):

$$u_i = C + \alpha Q$$

By restricting the marginal utility of consumption to be independent from environmental quality, then consumption remains the same in either choice and falls out of equation 3. Non-linearities in environmental quality might arise if for example there are differences in underlying health or willingness to pay for defensive expenditures, which would give an additional reason to redistribute beyond the social welfare weights. In the Appendix we explore non-linear utility functions, with environmental quality both separable and non-separable from consumption (Table A3). The simplest case, of separable, linear utility, has the highest log likelihood, but we note that other functional forms do not lead to quantitatively or qualitatively different policy outcomes.

Next, consider future tradeoffs. From the survey responses and the stock market analysis (Sections 2 and 3) we know that an in-kind settlement might be a more lenient sanction than a cash-only settlement, which elicits the question of whether there are dynamic implications of

⁵⁸An alternative to using the marginal cost of public funds would be to use a central estimate of the marginal value of public funds; [Hendren and Sprung-Keyser \(2020\)](#) finds a range of less than .5 to more than 5.

more violations in the future. On the other hand, we know that in-kind settlements often include improvements of a plant’s equipment, reducing future non-compliance, or maybe induce other plants in the vicinity to use in-kind settlements, increasing the community’s environmental quality in the future. We model the changes in environmental quality as a Markov process. Today’s quality, Q , will transition into environmental quality in the next period, Q' , following a probability distribution that depends on whether the settlement was in cash or in-kind, $f(Q'|Q, d)$. Thus the dynamic social welfare function is made up of today’s social welfare (equation 2) and the expected social welfare in the future, discounted by discount factor β , and can be expressed as a Bellman equation:

$$V(Q) = \max_d \left[\text{SWF}(Q) + \beta \int_{q'} V(Q') f(Q'|Q, d) dQ' \right]. \quad (4)$$

We assume that the utility function remains constant over time. Using historical data on the communities that faced a court case and Rust’s (1987) Nested Fixed Point Algorithm, we obtain estimates of parameters in the Bellman equation. Specifically, we estimate the parameters that govern the transition probability of environmental quality $f(Q'|Q, d)$, the parameters in the utility function, and the parameters that define social welfare weights ω_i . To reconcile the data with the model, we add an additively separable error term, ϵ , to each choice in equation (3). The error captures any unobserved, current period event that increases or decreases the community’s utility from the given settlement type (for example, a new public park might be frequented by more or less people). Following Blackwell’s theorem (Rust et al., 1994) the social welfare function can be expressed as the unique solution to the Bellman equation:

$$V(Q, \epsilon) = \max_d \left[\text{SWF}(Q) + \beta \int_{q'} \int_{\epsilon'} V(Q', \epsilon') h(Q', \epsilon'|Q, d, \epsilon) dQ' d\epsilon' \right]. \quad (5)$$

We assume the error is independent and identically distributed (i.i.d.) across settlement type, environmental quality, and time. Adopting Rust (1987)’s Conditional Independence assumption, the transition probability can be factorized as $h(Q', \epsilon'|Q, d, \epsilon) = f(Q'|Q, d) \rho(\epsilon'|Q')$. Assuming that

ϵ comes from a Type I Extreme Value, the Bellman equation becomes:

$$V_\theta(Q, \epsilon) = \max_d [v_\theta(Q, d) + b\epsilon(d)]$$

where θ are the parameters to be estimated (specifically, the parameters in the utility function, social welfare weights, and transition of environmental quality) and v_θ is the fixed point of $v_\theta = \Gamma(v_\theta)$, where Γ_θ is a contraction mapping:

$$\Gamma_\theta(v)(Q, d) = \text{SWF}(Q, d, \theta) + \beta \int_{Q'} b \log \sum_{d'=1}^2 \left[\exp \left\{ \frac{v_\theta(Q', d')}{b} \right\} \right] f(Q'|Q, d) dQ' \quad (6)$$

with location parameter of the Extreme Value distribution of ϵ normalized to zero and scale parameter, b , to one.⁵⁹

The assumption of the Extreme Value distribution allows for a closed form solution of the choice probabilities—that of the multinomial logit:

$$p(d|Q, \theta) = \frac{\exp \frac{v_\theta(Q, d)}{b}}{\sum_{d'} \exp \frac{v_\theta(Q, d')}{b}} \quad (7)$$

5.2 Identification of the parameters in the social welfare function

We use the observed historical allocation (cash versus in-kind) exploiting variation across communities in environmental quality and the EJ-vulnerability index (percent minority and percent low income). Our identification of social welfare weights relies on the assumption that utility functions are homogenous over time (i.e., $(u_t(C, Q) = u_{t'}(C, Q))$ and communities (i.e., $u_i(C, Q) = u_j(C, Q)$). The homogeneity over time is in line with the stationary Markovian structure that simplifies the infinite-horizon model. The homogeneity over communities is for simplification of the interpretation of our estimates. If we allowed for utilities to vary by community, then the allocation might depend on the different utilities and not just the social welfare weights. Remember that the true

⁵⁹In the units used, a scale parameter of one represents \$100K. A location parameter of zero means that ϵ has a mean zero; a scale parameter of one would mean ϵ has a variance of $\pi^2/6$.

data-generating process does not involve a social planner, but rather we are estimating the weights as if there had been a social planner. We argue that our parsimonious approach of obtaining social welfare weights given homogenous utility functions provides a more informative measure of the implicit weights placed on communities than an alternative model which would allow different utilities (e.g., a hypothetical planner's thoughts on different utilities). In a similar simplifying assumption, we are also assuming that the transition probability functions of environmental quality are the same in all communities. One could imagine a scenario in which different communities will have different responses to in-kind punishment. We opt for using a state transition probability function that is the average across communities to reduce the dimensionality of the state space (i.e., circumventing the need to keep track of community-specific environmental quality) as well as to reduce data limitations (i.e., we would need observations from each community over time). Nested in the homogenous utility also is our assumption that any unobservable neighborhood characteristics are uncorrelated with the choice of settlement type. Following Rust (1987), our error term is independent and identically distributed and captures any unobserved, current period event that might impact the community's utility from the given settlement type (for example, a new public park might be frequented by more or less people), but is uncorrelated with the settlement choice. A benefit of our homogeneity assumption is that the interpretation of our social welfare weights is then also more informative in and of itself, because the welfare weights capture preferences for redistribution *ceteris paribus*.

In our estimation, we don't estimate all parameters, but rather set some of the parameters to pre-specified values before estimation. Specifically, we set the discount factor, β , to .90.⁶⁰ We also normalize the error term to have a location parameter of zero and scale parameter of one (or equivalent to \$100 thousand dollars).

⁶⁰We estimated the model using larger discount factors (.95 and .98) however with larger discount factors we did not do as well matching the estimated choices to the real choices, and so settled on .90 which allowed us to best replicate the data.

5.3 Measuring environmental quality

To estimate the welfare impacts of changing the allocation of in-kind settlements, we need a measure of how an in-kind settlement changes environmental quality today and in the future, for example, if a plant is more or less likely to violate in the future. This measure of environmental quality needs to be denominated in dollars to compare with a cash settlement. However, environmental quality is difficult to measure: it encompasses different mediums (e.g., air, water, and soil), different time frames (e.g., short term and long term damages), is often sparsely reported, and its translation into monetary costs may not exist. Given these difficulties, we construct a proxy for environmental quality based on the size of EPA monetary fines within the community within three year intervals. We can think of the cash penalty as a measure of community-level environmental degradation and in-kind settlements as an environmental improvement. Specifically, a dollar of a cash settlement is translated into a dollar of environmental degradation, and a dollar of an in-kind settlement is translated into 20 cents of environmental improvement (see Appendix A4). Later when we estimate changes in environmental quality over time within a community, before and after a settlement, we do not include changes from the settlement itself.

We argue this proxy is useful for the following reasons: (1) it is consistently available across our communities over our sample period, (2) it represents information that EPA regulators have, (3) it captures environmental degradation to the degree that penalties are based on the severity of the violation (referred to as “gravity” by the EPA), and (4) it is expressed in dollar terms. While one might argue that EPA penalties are often much lower than the value of environmental damages, for our purposes this proxy is nonetheless useful for comparing settlement types, because it is expressed in the same “unit” as the decision we are modelling. One might also argue that our proxy depends on consistency over time and space in detection and enforcement, something that is not very likely.

Given these concerns, a natural question is whether our variable is a good proxy for environmental quality. We compare our constructed environmental quality with 11 environmental indicators gathered by the EPA for all block groups in 2017 (see Appendix A4). Reassuringly, our

proxy of environmental quality is negatively correlated with all indicators of pollution (Figure A7), with the exception of ozone pollution.⁶¹ As expected, our proxy does particularly well capturing pollution from large point sources (e.g., by proximity to superfund sites or wastewater discharge facilities).⁶²

5.4 Estimates of the parameters in the social welfare function

In a first stage, we estimate the parameters that govern the transition probability density function, $f(Q'|Q, d)$. For each enforcement case, we have a proxy for environmental quality in the zip code before the case (from the three years prior to the case) and the quality after the case (from the three years after the case, not including the year of the settlement). We include the whole zip code, because a sanction at a plant might not only deter that plant from violating in the future, but could also deter nearby plants (Shimshack and Ward, 2005; Gray and Shadbegian, 2007; Johnson, 2020). For each case, we calculate the level change in environmental quality in the zip code from one period to the next, $\Delta = Q' - Q$, and plot the distribution (Figure 5). Importantly we note that the change in environmental quality *excludes* changes in environmental quality from the in-kind settlement itself, q . The change from the settlement itself is already incorporated in the current period social welfare function. The transition probability, $f(Q'|Q, d)$, is driven from future violations and settlements from the violating facility or other facilities in the same zip code. A choice of in-kind settlement today, could result in more plants opting for more in-kind settlements in the future. We approximate the distribution of Δ as two exponential functions spliced together. Using the observations of an improvement ($\Delta > 0$) following an in-kind case we can estimate the parameter governing the size of the improvement, $\lambda(\text{Improve})^{\text{In-kind}}$, by maximizing the likelihood over areas $N_{\text{Improve}}^{\text{Kind}}$, across all time periods in the sample:

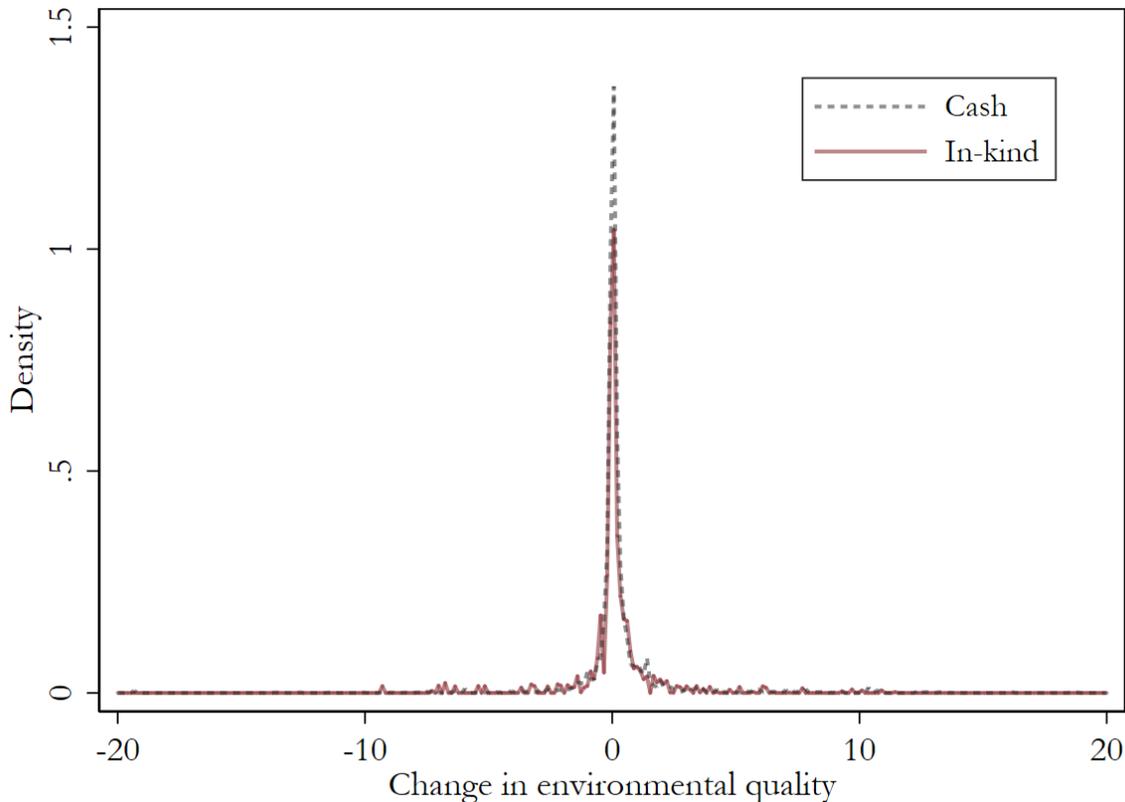
⁶¹Ozone formation is a complex non-linear process that depends on emissions of volatile organic compounds, VOCs, and nitrogen oxides, NOx, heat, and sunlight. Ozone is a regional pollutant that depends on many factors including wind and even time zones (Adler and Severnini, 2020). NOx serves as both a precursor to ozone and a quencher of ozone (Jhun et al., 2015), and so ozone might be lower near large point sources of NOx production. Moreover, an inverse relationship between NOx and ozone has been documented on weekends (e.g., Atkinson-Palombo et al. (2006) and Marr and Harley (2002), amongst many), and during COVID-19 (Sicard et al., 2020).

⁶²In line with findings from the EJ literature, based on our proxy environmental quality is lower in communities that are more vulnerable to EJ concerns (see Figure A8).

$$L(\lambda_{\text{Improve}}^{\text{In-kind}}) = \prod_{n=1}^{N_{\text{Improve}}^{\text{Kind}}} \prod_{t=1}^T \lambda \exp(-\lambda_{\text{Improve}}^{\text{In-kind}} |\Delta|)$$

And likewise, we can estimate a different likelihood estimation for the size of environmental degradation, $\lambda(\text{Diminish})^{\text{In-kind}}$ using the observations of the absolute value of the change ($|\Delta|$). Similarly, we can then estimate parameters for cash-only cases, $\lambda(\text{Improve})^{\text{Cash}}$ and $\lambda(\text{Diminish})^{\text{Cash}}$. The resulting probability density functions are then weighted by the empirical probability of an improvement, $p(\text{Improve})$, degradation, $p(\text{Diminish})$, or to stay the same, $p(\text{Stay Same})$ following an in-kind or cash settlement.

Figure 5: Transition of environmental quality over time



Note: Figure depicts the density of changes in environmental quality, depending on type of settlement. The change in environmental quality is the difference in quality at the zip code before the case and after the case, not including the case in question; any change is attributed to other cases in the vicinity. Positive domain indicates environmental improvements in millions of dollars and negative domain indicates environmental degradation. Environmental quality before the settlement is calculated based on the cases in the zip code the past three years. Environmental quality after the settlement is calculated from cases near the zip code in the three years after the settlement.

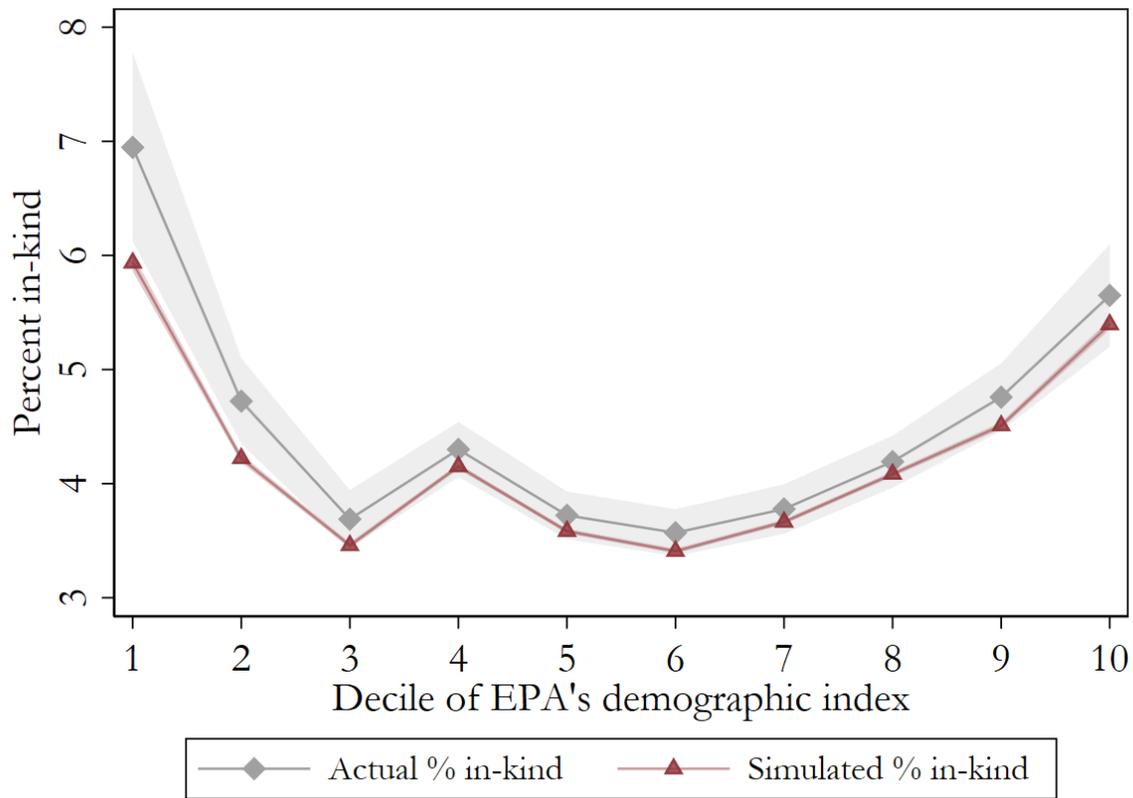
We then use the parameters governing the transition of environmental quality (θ_{1st}) in the

second stage estimation of the remaining parameters (i.e., the utility function parameters and social welfare weights, $\theta_{2nd} = \alpha, \omega_i$). To estimate the second stage, we maximize the likelihood of multinomial logit choice probabilities (equation 7):

$$L(\theta_{2nd}) = \prod_{n=1}^N \prod_{t=1}^T p(d|Q, \theta_{2nd}, \hat{\theta}_{1st})$$

The changes in environmental quality after an in-kind or cash settlement are similar (as depicted in Figure 5), and differences arise in the empirical probability of any change at all occurring as well as in the extreme tails of the distribution of how large an increase or decrease will be. The tails are wider in the case of the distribution of changes following in-kind settlements, such that there are both larger environmental improvements and degradation. Overall, on average, environmental quality improves and more so following in-kind settlements. Parameter estimates are found in Table 4, where we show that the social welfare weight is highest for the communities with the *lowest* environmental justice concerns. We use the estimated model to re-predict the allocation of in-kind settlements and find that our model matches the actual allocation well (Figure 6).

Figure 6: Simulated in-kind settlements by decile of an environmental justice index



Note: Figure depicts how well our estimated social welfare function can replicate the actual allocation of in-kind settlements. Cases are divided into deciles of EPA's measure for demographics representing EJ vulnerability (i.e., the average of % low income and % minority). The first decile therefore represents the richest and most white communities, and the tenth decile represents the poorest and least-white communities.

Table 4: Estimates of parameters in the social welfare function

	Estimate	(Standard error)
<u>Social welfare weights by demographic decile:</u>		
ω_1	0.155	(0.025)
ω_2	0.108	(0.012)
ω_3	0.078	(0.009)
ω_4	0.103	(0.009)
ω_5	0.083	(0.008)
ω_6	0.073	(0.009)
ω_7	0.084	(0.008)
ω_8	0.093	(0.008)
ω_9	0.103	(0.009)
ω_{10}	0.119	(0.010)
<u>Parameter on q in utility function:</u>		
α	0.770	(0.162)
<u>Parameters in transition probability of Q:</u>		
$p(\text{Stay Same})^{\text{Cash}}$	0.120	(0.002)
$p(\text{Stay Same})^{\text{In-kind}}$	0.188	(0.009)
$p(\text{Improve})^{\text{Cash}}$	0.536	(0.002)
$\lambda(\text{Improve})^{\text{Cash}}$	1.192	(0.022)
$p(\text{Improve})^{\text{In-kind}}$	0.499	(0.010)
$\lambda(\text{Improve})^{\text{In-kind}}$	0.797	(0.067)
$p(\text{Diminish})^{\text{Cash}}$	0.344	(0.002)
$\lambda(\text{Diminish})^{\text{Cash}}$	2.382	(0.054)
$p(\text{Diminish})^{\text{In-kind}}$	0.313	(0.010)
$\lambda(\text{Diminish})^{\text{In-kind}}$	1.822	(0.159)
Log Likelihood	-97,29.42	(157.046)
Number of observations	56,631	

Notes: Partial likelihood estimates from the nested fixed point algorithm. Discount factor, β , set at .90 and scale parameter, b , set at 1, equalling \$100 thousand dollars. Standard errors are the standard deviation of the estimates across 200 bootstraps with replacement.

5.5 Counterfactual simulations

With our estimated Bellman equation we have a measure of social welfare under the current allocation given by the estimated social welfare weights. Remember, the social welfare weights are not assigned by an actual social planner, but we can use counterfactuals to shed light on how far the current allocation is from one of a social planner with different redistributive preferences. Counterfactuals can also be used to see the importance of the dynamic aspects of the decision

process.

We examine three counterfactual simulations.⁶³ Our first experiment sheds light on the importance of the dynamic implications on future environmental quality. We set the transition probability of environmental quality following an in-kind settlement to be the same transition probability as following a cash-settlement.⁶⁴ We discussed reasons why it is ex-ante unclear whether in-kind settlements might lead to an improvement or degradation of environmental quality. If in-kind settlements were on average net positive for future environmental quality, then we would see fewer in-kind settlements in the counterfactual compared to the actual allocation.

The next two counterfactuals test how far the current allocation is from optimal allocations resulting from different representative social welfare functions: a utilitarian and a Rawlsian social welfare function. In the utilitarian welfare function we set welfare weights such that each community is given equal weight. In the Rawlsian case, instead, all weight is placed on the communities with the highest decile of environmental justice concerns. For these two counterfactuals, to estimate the difference in social welfare from the actual allocation, we compare social welfare calculated from the same social welfare function (utilitarian or Rawlsian), only changing the allocation. We normalize the social welfare from the optimal allocation to one, to represent 100% welfare for this allocation given the counterfactual social welfare function (following a similar comparison found in [Olken, 2006](#)).

Table 5 shows the different counts of in-kind versus cash settlements according to the actual allocation (column 1), our predictions of the actual from the estimated model (column 2), and the three counterfactual scenarios (column 3). Comparing columns (1) and (2), our model does a good job in predicting the count of in-kind settlements (also shown in Figure 6). Comparing columns (2) and (3), or the estimated actual allocation and the counterfactual in which future environmental quality is determined by the cash-transition probability, we see fewer in-kind settlements in the

⁶³Our counterfactuals are constrained by the same institutional constraint present in the estimation: in-kind projects must occur in the community of violation.

⁶⁴This scenario becomes closer to the Canadian model of in-kind settlements. In Canada, in-kind projects can follow environmental violations, but penalties from violations first go to a general fund and then are used to finance environmental projects, making the connection between firms and the final project less salient.

counterfactual. This finding is in line with in-kind settlements resulting in larger increases in environmental quality than cash settlements. Specifically, the in-kind settlement leads to either more in-kind settlements in the future or fewer violations, implying that the concern for reduced deterrence is of second-order importance. Comparing (2) and (4), a utilitarian approach would result in more in-kind settlements overall, but would be much more evenly distributed across demographic deciles (Figure A10). Comparing (2) and (5), we see that in the Rawlsian case we have many more in-kind settlements occurring, and all in the decile most vulnerable to EJ. If Rawlsian redistribution is a preferred distribution, the current allocation is far from reaching this goal; in the Rawlsian case nearly all cases in the most vulnerable-to-EJ decile would settle in-kind, but in reality the percentage of in-kind is as low as roughly 5.5%. Using the counterfactual social welfare weights, we calculate welfare under the estimated allocation and welfare under the counterfactual optimal allocation, which we then normalize to one. The differences in welfare, measured as the ratio between the actual allocation and the optimal allocation, are small—but this is expected given that the vast majority of settlements are cash to the Treasury in all scenarios. All in all, the welfare loss resulting from the EPA’s inability to steer the allocation of in-kind settlements according to some preferred welfare function is not large; such loss would be relatively larger if the EPA was Rawlsian rather than utilitarian, and in the former case the entire loss is borne by the EJ communities, whose vulnerability the EPA is committed to address.

Table 5: Counterfactual Simulations

	(1) Actual	(2) Estimated Actual	(3) Cash Transition Probability	(4) Utilitarian Welfare Weights	(5) Rawlsian Welfare Weights
# in-kind	2,344	2,223 (46)	1,871 (41)	2,369 (46)	3,587 (28)
# cash-only	54,287	54,760 (46)	54,408 (41)	54,262 (46)	53,044 (28)
Welfare comparisons:					
Estimated transition and actual allocation			1		
Counterfactual transition and optimal allocation			1.0003		
Counterfactual weights and actual allocation				1.0000	.9979
Counterfactual weights and optimal allocation				1	1

Notes: Actual represents the actual count of in-kind and cash settlements in the data. Estimated actual represents the simulated count when using the estimated parameters (found in Table 4). “Cash Transition Probability” represents a counterfactual in which the change in environmental quality does not depend on which settlement type is chosen. Utilitarian weights represent a counterfactual simulation in which all social welfare weights are set to be equal across the each decile of the EPA’s demographics index ($\omega_i = .1$). Rawlsian weights represent a counterfactual in which the social welfare weight on the most susceptible decile is set to one ($\omega_{10} = 1$) and the rest to zero ($\omega_{i \neq 10} = 0$). Standard errors, in parentheses, are calculated as the standard deviation across 100 simulations. For the simulated allocation across different deciles see Figure A10.

6 Conclusion

The EPA’s Supplemental Environmental Projects policy encourages environmentally beneficial projects destined to communities exposed to environmental violations, particularly those with environmental justice concerns. We use data from approximately 56,000 environmental enforcement cases in the US between 1997 and 2017 as well as information from an online survey and stock-market data to study the implications of in-kind settlements for firms and communities.

We find a strong preference for targeting in-kind projects to afflicted communities in an online choice experiment: the overwhelming majority of online respondents would be willing to forgo large amounts of cash to the public fund in exchange for local environmental projects, particularly in the case of areas with environmental justice concerns. These results provide the first-ever insights into the public preference for the use of in-kind settlements, at least within the US institutional

context.⁶⁵ With an online randomized survey we also show that the public perceives a firm more favourably after the firm settles with an in-kind project instead of a cash penalty. The impact on the public's perception of the firm is also found in stock-market reactions to settlements involving publicly listed firms: cash settlements are associated with negative reactions whereas in-kind projects are associated with positive reactions. Importantly for the ultimate merits of in-kind punishment, we do not find a large difference in changes to future environmental quality following in-kind versus cash punishment, and even a small increase in environmental quality. Our results suggest that in-kind punishment is likely a win-win for firms and local communities.

However, the EPA does not have the authority to mandate the use of in-kind punishment, but rather can only accept or reject in-kind projects proposed by defendants. Thus, even though the EPA encourages the use of in-kind projects in areas with environmental justice concerns, the ultimate allocation is not confined to these areas. We document that the share of cases resulting in in-kind settlements is largest in communities that are least vulnerable to environmental justice concerns. We use data on the historical choices of settlement type to estimate the social welfare weights that would reconcile the choices made had a hypothetical social planner been making the decision. Through our normative hypothetical experiment, we demonstrate a new revealed preference approach to estimate social welfare weights, which could be used in other contexts involving dynamic discrete choices. With our estimated model, we predict that leaving the allocation up to the negotiation between firms and the EPA is consequential for the frequency of in-kind settlements. If a social planner had allocated in-kind settlements using utilitarian welfare weights, weighting all communities equally, the number of in-kind settlements during the period studied would have been nearly 7% larger. The increase in in-kind settlements would have been especially striking if the social planner had put all weight on the communities most vulnerable to environmental justice: the number of in-kind settlements, all destined to such communities, would have been 61% higher. Put it differently, given the desire to address vulnerable communities, if the EPA could mandate in-kind settlements we would likely see them more frequently, because, unlike

⁶⁵The preferences for in-kind might be different if the choice was between cash to the community or in-kind project; however, in this paper we have focused on the cash to the Treasury versus in-kind to the community because, within the context of the Miscellaneous Receipt Act, alternative arrangements can not be considered.

the cash option, they allow targeting and appear beneficial to the community in terms of future environmental quality. Our estimates also suggest that the welfare cost from the EPA not being able to optimally allocate in-kind projects is small, although larger when we assume that the EPA is Rawlsian rather than utilitarian; moreover, in the Rawlsian case all the welfare cost is borne by the most vulnerable communities, whose welfare arguably we should be especially concerned about.

In response to the suspension of Supplemental Environmental Projects in civil judicial cases, our paper suggests that on economic grounds, the use of Supplemental Environmental Projects is beneficial and worth continuing. The US experience suggests that environmental agencies worldwide can fruitfully use in-kind settlements as recommended by the OECD (OECD, 2009); their effort would be likely met with large support from the public and the regulated community and is unlikely to have large consequences for deterrence.

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Appendix for Online Publication: Addressing Environmental Justice through In-Kind Court Settlements

Pamela Campa and Lucija Muehlenbachs

A1 Examples of In-Kind Settlements

Table A1: Examples of in-kind settlements by category

Category	Frequency	Average Cost	Example
Emergency Planning and Preparedness	527 (20.80%)	\$43,854	Purchase and donate equipment to the local fire department/emergency management agency/local emergency planning committee.
Pollution Prevention	527 (20.80%)	\$246,151	Retrofit of 4 heaters on-site with next generation-ultra low NOx burners.
Pollution Reduction	400 (15.79%)	\$316,845	Conceptual design and installation of an exhaust fan and carbon filter for the outer extruder area.
Environmental Restoration and Protection	301 (11.88%)	\$402,750	Purchase and protection of 36 acres of Wetlands, in perpetuity.
Multiple Categories	235 (9.27%)	\$730,680	[1] Install Novo Bioreef system [2] Install on-site wastewater treatment system.
Other Program Specific SEP	226 (8.92%)	\$229,105	Develop a green chemistry curriculum for implementation throughout local public schools.
Public Health	216 (8.52%)	\$171,453	Form a Health Care Project to establish a program to pay for medical care for asbestos-related illnesses.
Environmental Compliance Promotion	57 (2.25%)	\$93,224	Develop and deliver training for the roofing industry on proper handling of hazardous wastes.
Assessments and Audits	45 (1.78%)	\$120,977	Perform certified lead-based paint inspection.
Total	2534 (100%)	\$265,224	

Notes: Categories are defined by the EPA; we aggregated Pollution Prevention which is broken into 7 subcategories (Energy Efficiency-Conservation / Equipment-Technology Modification / Improved Housekeeping, O&M, Training, Inventory Control / In-Process Recycling / Process-Procedure Modification / Product Reformulation, Redesign / Raw Materials Substitution).

Table A2: Examples of in-kind settlements by law violated

Statute	Example in-kind project
Clean Water Act	Preservation of an 11.54 acre Wetland parcel and construction of nature trails.
Clean Air Act	Installation of a new roof ventilation hood to collect fumes.
Safe Drinking Water Act	Properly plug and abandon orphan wells.
Resource Conservation and Recovery Act	Replacement of 6 refrigeration units for units that will use non-ozone depleting substances.
Federal Insecticide, Fungicide and Rodenticide Act	Perform a pesticide safety and compliance training program.
Comprehensive Environmental Response, Compensation and Liability Act	Provide equipment for local emergency planning committee & funding for local emergency planning committee conference.
Toxic Substances Control Act	Replacement of 40 windows to reduce lead-based paint and lead-based paint dust hazards.
Emergency Planning and Community Right-to-Know Act	Purchase and donate equipment to the local fire department/emergency management agency/local emergency planning committee.
Marine Protection, Research and Sanctuaries Act	Placement of artificial reef materials within a authorized artificial reef site.

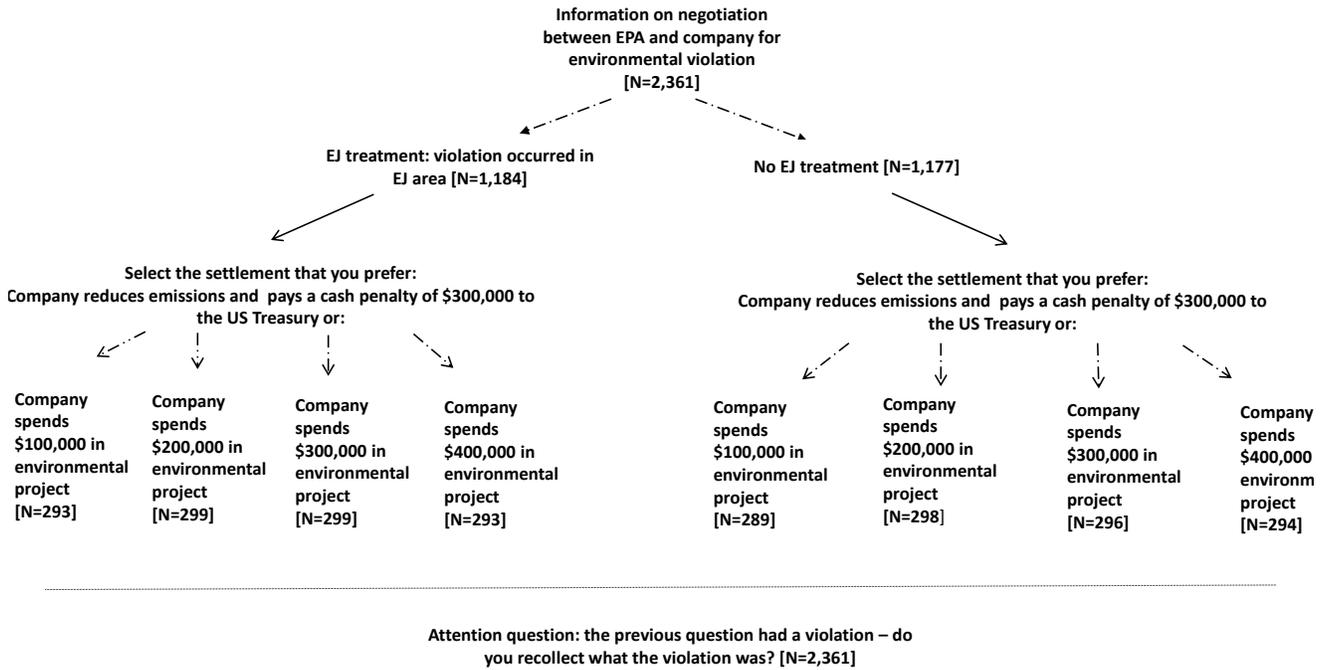
Notes: Examples of Supplemental Environmental Projects assigned by the federal statute that was violated.

A2 Additional information about survey design and results

We posted a Qualtrics survey on Prolific. The description stated that we would pay £0.60 for an estimated time of 3 minutes, i.e., a £12.00/h wage. Respondents could take up to 23 minutes to answer the survey.

The initial sample that we receive from Prolific is made of 2,434 respondent with unique id. Of these, 39 withdrew their survey answers (i.e. completed the survey but withdrew the authorization to use it), 21 were timed-out, and for 13 we could not find a match in the Qualtrics sample, likely because of typos when the respondents inserted their unique id. As a result the attrition rate is of 2.5%. In Figure [A1](#) we show what part of the survey we randomized and the size of our samples. In Figure [A3](#) we show screenshots of example questions.

(a) Part A: Choice experiment and an attention Question



(b) Part B: Randomized survey

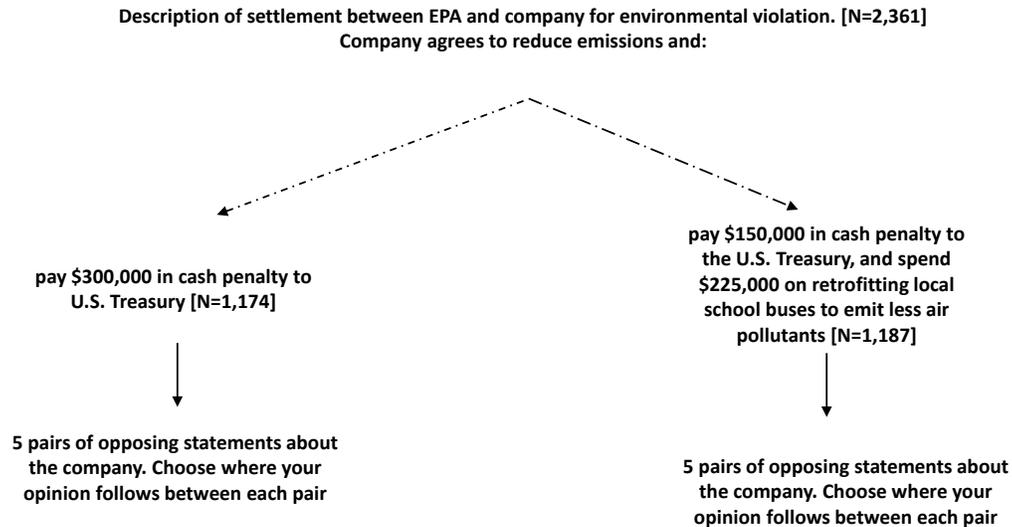


Figure A1: The structure of the survey experiments

Notes: Figure summarizes the survey design. Dashed arrows indicate random assignment of the treatment. The order in which participants answered Part A and Part B is also randomized across participants, and in Part B, the order in which the 5 pairs of statements are shown is also randomized. N is number of subjects that answered each question. Example screenshots from the survey are found in Appendix Figures A2 to A4.



We are researchers at the University of Calgary and Stockholm School of Economics. Our goal is to provide information on the public's preferences for different types of environmental enforcement actions made by the US Environmental Protection Agency.

This survey consists of **only three questions**. No matter what your views are, by completing this survey you are contributing to our knowledge as a society.

If you would like to participate, please enter your unique Prolific ID and continue.

Figure A2: Screenshot of survey start page

(a) Survey Part A

The U.S. Environmental Protection Agency is negotiating a settlement with a company for exceeding regulatory limits on harmful air pollution emissions. The company's facility is located in a community vulnerable to Environmental Justice concerns, namely a community with a high share of low-income populations and minorities, that are both more prone and more susceptible to pollution. Select the settlement you prefer.

The company agrees to reduce emissions below regulatory limits and...

the company pays a cash penalty of \$300,000 to the U.S. Treasury.

the company spends \$100,000 on an environmental project in the community (e.g., retrofitting local school buses, implementing an environmental training program, or installing pollution-reduction equipment at their own plant).

(b) Survey Part B

Consider the following situation: the U.S. Environmental Protection Agency has announced a settlement with a company to resolve alleged Clean Air Act violations resulting from exceedances of emission limits. As a result of the settlement, the company agrees to reduce emissions and pay \$300,000 in a cash penalty to the U.S. Treasury.

Please choose where your opinion about the company would fall within the following opposing statements:

I feel negatively toward the company.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	I feel positively toward the company.
The company will have a hard time getting community approval to expand operations in the area.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	The company will have an easy time getting community approval to expand operations in the area.
The company will have a hard time hiring workers.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	The company will have an easy time hiring workers.
An investment in the company would be a bad investment.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	An investment in the company would be a good investment.
The company is unlikely to comply with environmental regulations in the future.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	The company is likely to comply with environmental regulations in the future.

Figure A3: Screenshot of the survey

Notes: The figures are screenshots of one version of the survey as seen by respondents. Order of appearance of Part A or Part B is randomized across respondents. In Part A we randomize (a) whether environmental justice concerns are mentioned and (b) the size of the proposed environmental project in dollar amounts. In Part B we randomize (a) whether the settlement description includes an in-kind project and (b) the order in which we list the pairs of opposing statements.



(This question will help us assess how much attention was paid in answering)
The previous question had a violation--do you recollect what the violation was?

Exceeding regulatory limits on harmful air pollution emissions.

Discharging hazardous waste into a source of drinking water.

Figure A4: Attention question after Part A

A3 Additional stock-market analysis

A3.1 Alternative specifications

In this Section we test the robustness of the stock-market results to two alternative specifications, namely (a) we augment equation (1) with a battery of controls, and (b) we study the intensive margin of the treatment using only information from cases that include an in-kind settlement.

Controls Figure A5 corresponds to the results in Figure 3d, but accounts for different stock-market responses by case-level and defendant-level characteristics. The conclusions are fundamentally unchanged with respect to the main analysis, although in some specification the estimates are less precise likely due to the lower number of observations (the defendant-level control variables are missing for a number of cases).

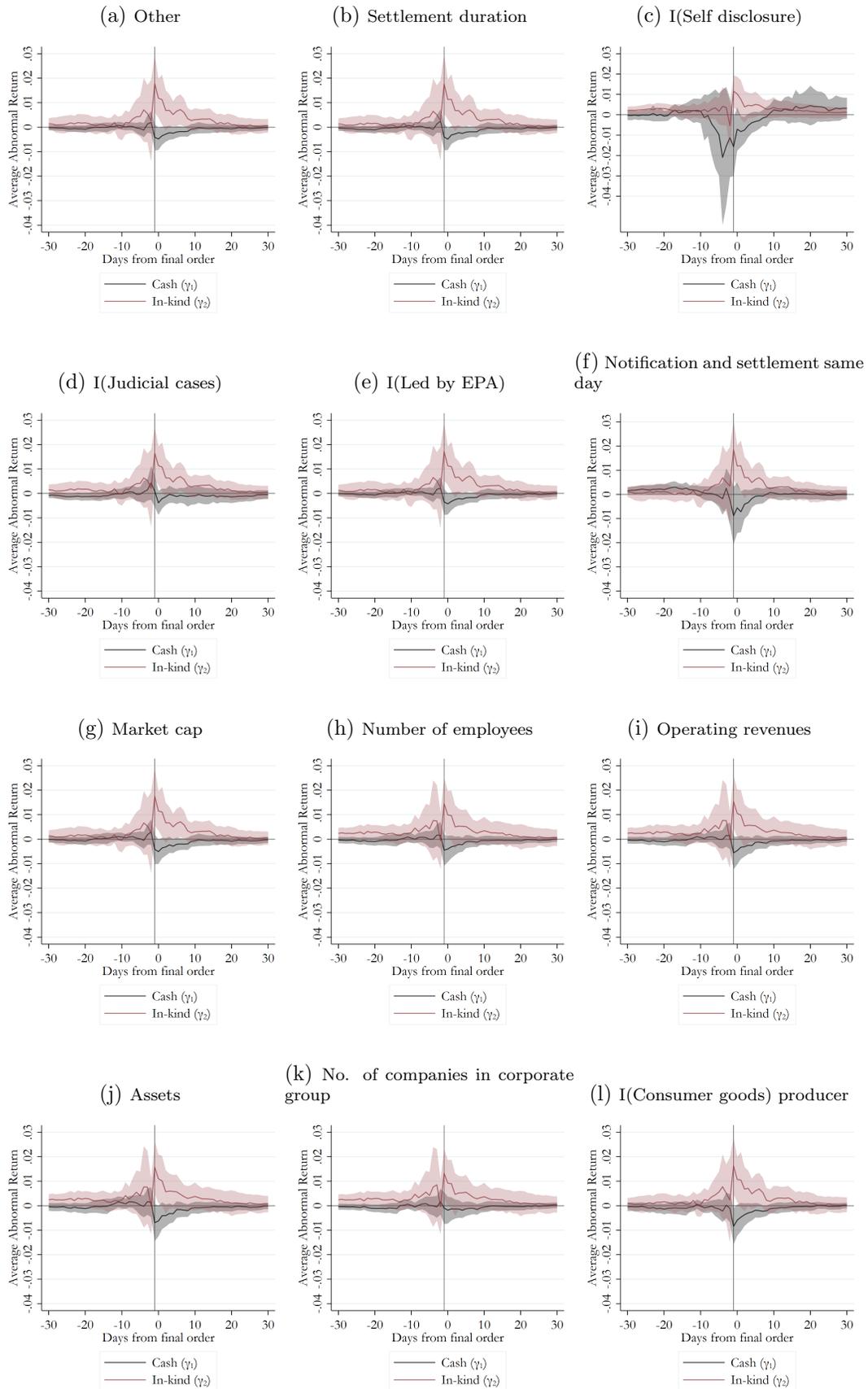


Figure A5: Robustness including interaction terms

Notes: We replicate the analysis in Figure 3d but also account for an interaction between $\mathbf{1}[t \in \mathbf{W}]$ and each of the characteristics listed in the subtitles (see equation 1). The figure I(Led by EPA) shows results from replicating the analysis in Figure 3d after excluding those cash settlements where the case was led by a State; this is because all in-kind settlements in our relevant sample are led by the EPA.

Intensive margin of the treatment, only cases with in-kind settlements. The advantage of this approach is two-fold: first we limit the comparison to a more homogeneous sample of cases, i.e. those that result in in-kind settlements, and second we let the stock-market response to the settlement announcement depend on cash and in-kind amounts, as suggested by the evidence in Section 3.2.⁶⁶ The estimated equation is:

$$R_{fjt} = \phi_j \cdot R_{mt} + \theta_1 \text{cash}_{fjt} \cdot \mathbf{1}[t \in \mathbf{W}] + \theta_2 \text{in-kind}_{fjt} \cdot \mathbf{1}[t \in \mathbf{W}] + \varepsilon_{fjt} \quad (8)$$

The variables in-kind_{fjt} and cash_{fjt} represent the estimated cost of the in-kind project and the cash penalty respectively. We set in-kind_{fjt} and cash_{fjt} to their respective dollar amount for all days in the window \mathbf{W} , and to zero for all days before the settlement.

As shown in Figure A6, the larger is the cash settlement the more negative is the stock-market response; the converse is true for in-kind settlements, whose size is associated with more positive variations in share prices. Notice that this specification allows estimating the impact of a larger in-kind settlement while accounting for the size of the cash penalty, and vice-versa. In sum, studying the intensive margin of the treatment on the sample of cases with in-kind settlements confirms the conclusion from the main analysis: the stock-market views a cash settlement as a bad news for the company, whereas the in-kind settlement is treated as a good news.

A3.2 Alternative samples of the large-settlement cases

Given that the 90th percentile sample includes relatively few in-kind settlements (13), a concern might be that the results are driven by a limited number of settlements. We thus re-estimate equation (1) in 13 alternative samples, each of which excludes one of the in-kind settlements at time, whereas the number of cash settlements remains the same (55). As shown in Figure A6, the conclusions from the analysis are unaffected.

⁶⁶Despite the advantages of studying the intensive margin of the treatment, we emphasize the extensive margin specification as our main analysis because (a) the point estimates are easier to interpret and to compare with the existing literature, and (b) identification of θ_1 and θ_2 is less straightforward given that cash amount and in-kind amount are jointly determined and thus endogenous to each other.

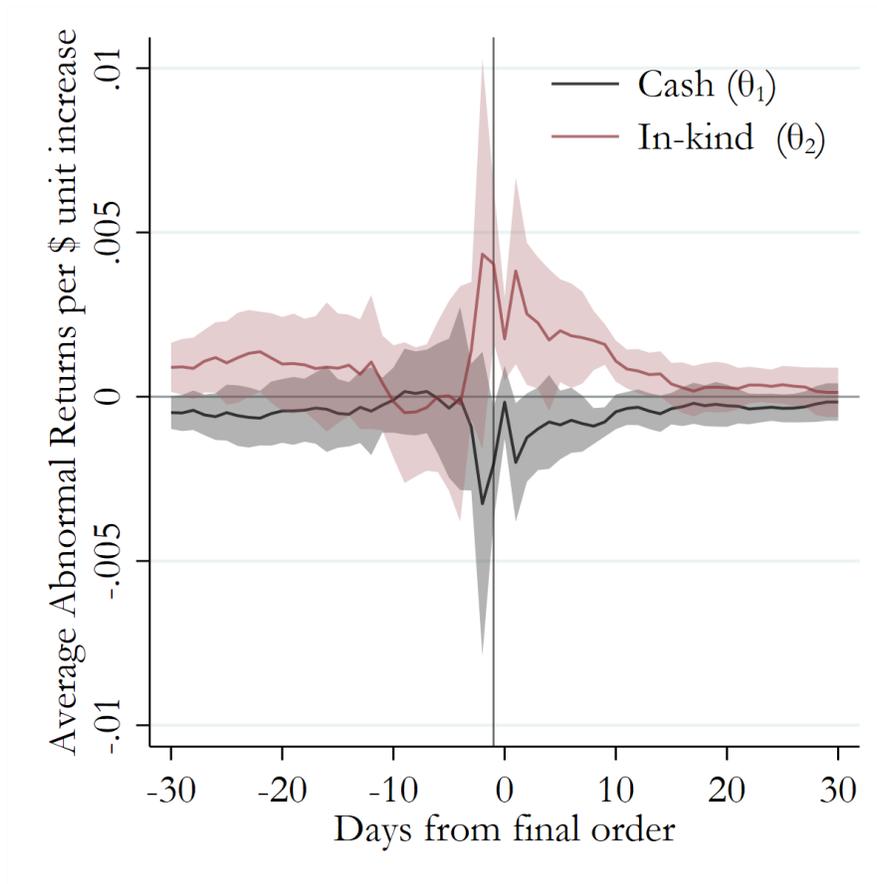
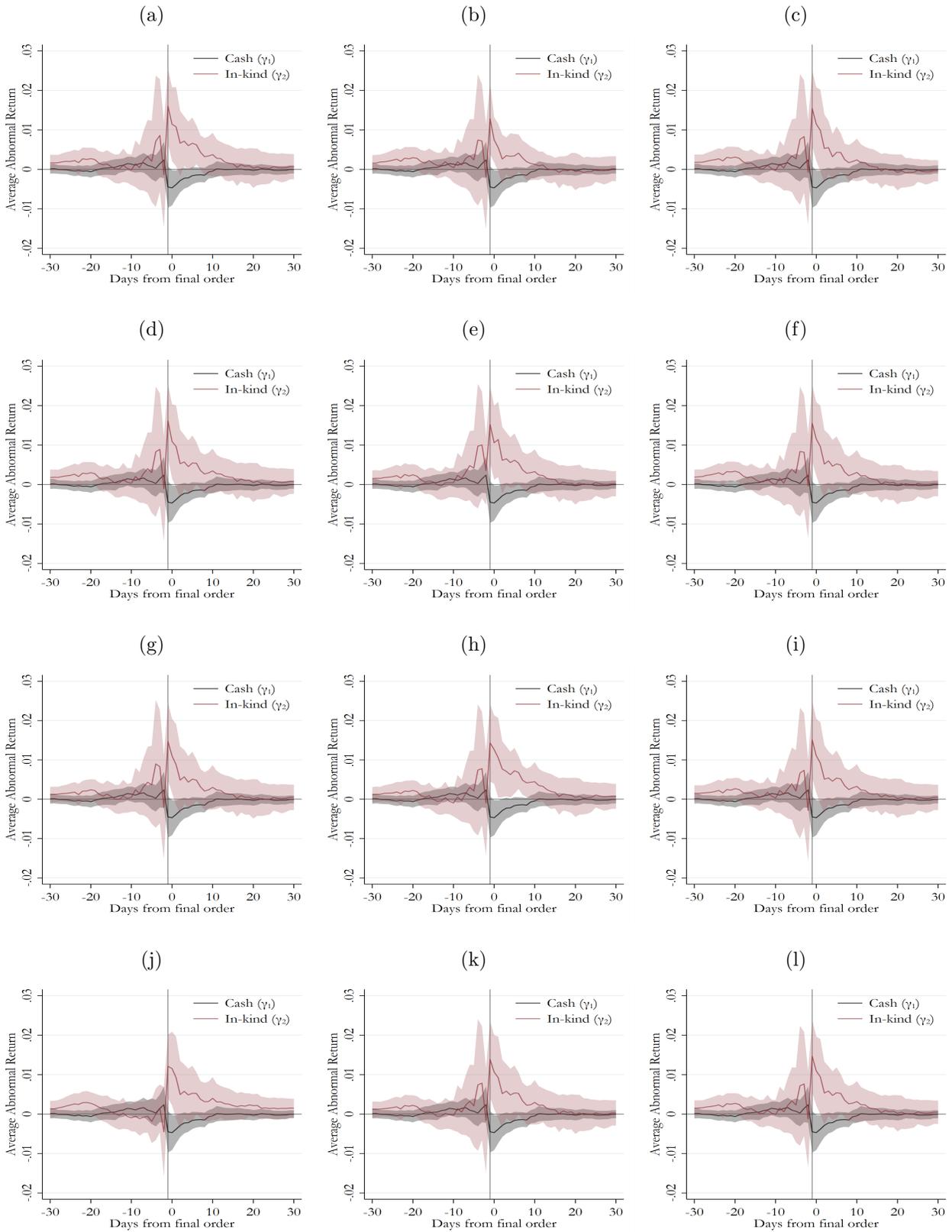


Figure A6: Average abnormal returns per unit increase in settlement amount

Notes: We replicate the analysis for Figure 3d but instead examine the intensive margin of the treatment, namely the stock-market impact of the dollar amount for cash and in-kind settlements. This corresponds to estimating to θ_1 and θ_2 in equation (8).



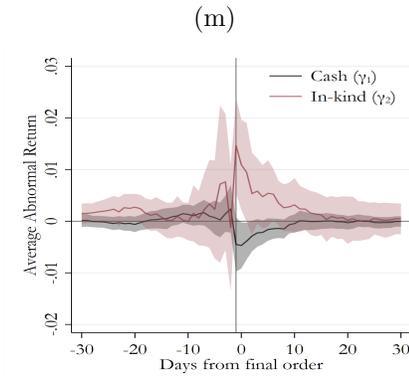


Figure A6: Average abnormal returns in alternative samples

Notes: Given the small sample of cases in the 90th percentile of penalty amount, we replicate the analysis for Figure 3d but each time omitting one case. Our results remain whether or not individual cases are included in the analysis.

A4 How well does our measure of environmental quality capture environmental quality?

Our measure of environmental quality was chosen for being a single variable, expressed in dollar terms, available from the beginning of our sample.

We constructed our measure of environmental quality from the outcome of past enforcement cases. A dollar of a cash penalty is translated into a dollar of environmental degradation, and a dollar of an in-kind settlement is translated into 20 cents of environmental improvement. The conversion is because SEP guidelines allow for SEPs to only mitigate penalties at a rate of at most 80 cents to the dollar, so one dollar of a SEP would imply environmental degradation of 80 cents (which gets offset by the SEP) and an additional 20 cents of environmental improvements. That is, the overall level of environmental degradation is equal to *Unmitigated Penalty - In-kind settlement*. *Unmitigated penalty* is equal to the observed penalty plus 0.80 of the SEP, which then leads us to conclude that environmental degradation Q is equal to *Observed penalty + 0.20 In-kind settlement*. In a robustness check, one of our utility functions includes a power of a fraction, so we linearly transpose Q to be in the positive domain.

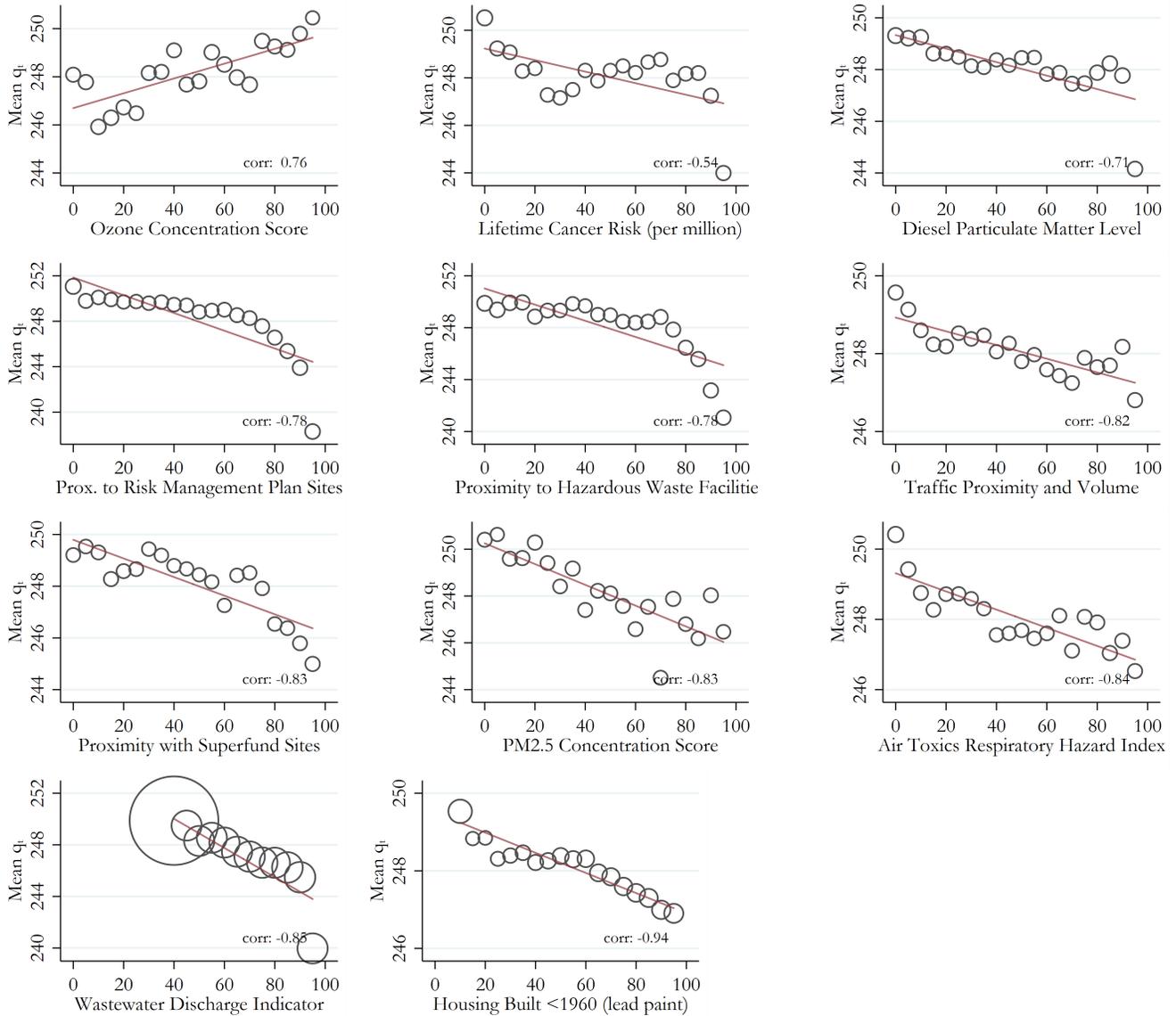
Given differences in detection and enforcement, a natural question to ask is whether our variable indeed captures environmental quality. From the EPA we obtained block-group data on 11 environmental indicators used to construct their EJSCREEN tool. The EPA data are available starting in 2015, for nine indicators, and starting in 2016 for 11 indicators.

The EPA's 11 environmental indicators are defined as: *Ozone concentration score* is the ozone summer seasonal average of the daily maximum 8-hour concentration in air. *Percent of housing units built before 1960* is an indicator of potential lead paint exposure. *Diesel particulate matter* is the concentration in air. *Lifetime cancer risk* is determined from the inhalation of the more risky air toxics. *Air toxics respiratory*

hazard index is the ratio of exposure concentration to health-based reference concentration. For both the cancer and respiratory hazard index, individuals are assumed to spend their entire lifetimes exposed to these air toxics. *PM2.5 levels* are the annual average in air. *Traffic proximity and volume* is the count of vehicles (average annual daily traffic) at major roads within 500 meters, divided by distance in meters. *Wastewater discharge indicator* is a measure of stream proximity and toxic concentration, using modeled toxic concentrations at stream segments within 500 meters, divided by distance in kilometers (using the EPA's Risk-Screening Environmental Indicators, RSEI model). *Proximity with superfund sites* are the count of proposed or listed sites on the National Priorities List within 5 km (or nearest one beyond 5 km), each divided by distance in kilometers. *Proximity to Risk Management Plan (RMP) sites* are potential chemical accident management plan sites. The RMP index is based on the count of RMP facilities within 5 km (or nearest one beyond 5 km), each divided by distance in kilometers.

Figure A7 shows how our measure compares to the EJSCREEN measures. We compare our measure of environmental quality in 2017, the last year in our sample, to the 11 environmental indicators in 2017. The EPA indicators are expressed in percentiles which we broke into bins of 5-percentiles, and then for all block groups in each 5-percentile bin we calculated the mean of our environmental quality variable. In the case of ozone pollution we find an unexpected positive correlation between our quality measure and the EPA's pollution measure. However, for all other indicators, we see a negative correlation as one would expect. We do best capturing environmental quality near industrial complexes, such as waste water discharge facilities, superfund sites, or potential chemical accident management plans. We interpret the results to mean that our variable is good at capturing large point sources of pollution, and less so for dispersed pollution.

Figure A7: Correlation between our measure of environmental quality and the EPA’s environmental indicators

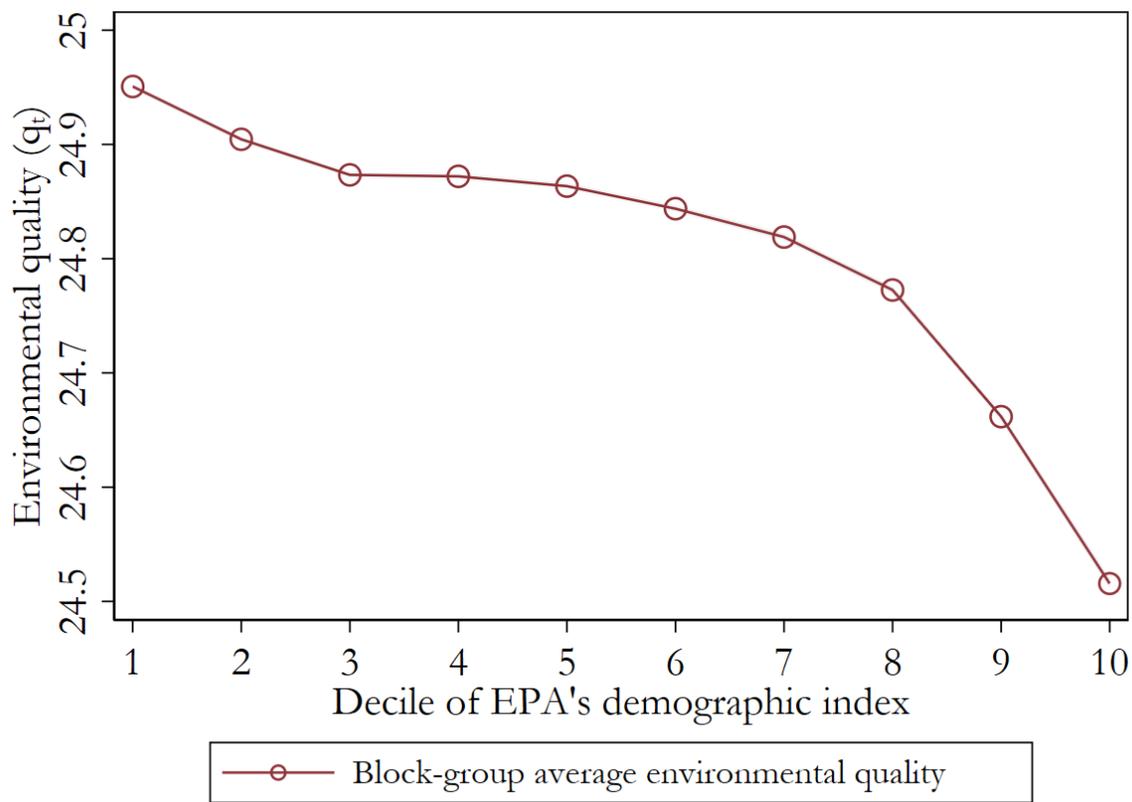


Note: Figures compare our environmental quality variable in 2017, described in Section 5.3, with the EPA’s environmental indicators in 2017. Each figure depicts the mean of our measure of environmental quality for all the block groups falling in bins of the EPA’s environmental quality indicators. The EPA indicators are reported in percentiles, and the size of each marker indicates the number of block groups we have in each bin of the EPA’s percentiles.

A5 Comparison of environmental quality and sociodemographics

As one might predict from the EJ literature, we see a strong negative correlation between our measure of environmental quality and a block group’s EJ index A8. Figure A9 depicts the location of cases and in a different scale the location of in-kind settlements.

Figure A8: Environmental Quality by Environmental Justice Decile



Note: Using data on zip codes from 1997-2017, by each decile of EJ susceptibility. Following the EPA, a zip code's susceptibility is calculated as the average between % low income and % minority and the decile is determined from the nation-wide distribution of zip codes.

A6 Counterfactual simulations

Table 5 shows the summary of number of in-kind settlements under different counterfactual simulations. To show how the allocation changes across EJ-deciles, we show how the counterfactuals compare to the estimated-real simulated in-kind allocation in Figure A10

A6.1 Different utility specifications

The main text uses a linear specification for the utility function. Table A3 shows how the predicted number of in-kind settlements varies depending on the specification. In all cases In the case of non-linear, separable utility function, consumption is additive and therefore cancels out across both choices. That is,

$$u_i = \frac{C^{1-\eta} - 1}{1 - \eta} + \frac{Q^{1-\eta} - 1}{1 - \eta}$$

is the same as modeling:

$$u_i = \frac{Q^{1-\eta} - 1}{1 - \eta}$$

In the case of a non-linear, non-separable utility, for consumption, consumption does not cancel out, and we must include consumption as a state variable.

$$u_i = ((1 - \alpha)C^{(1-\eta)} + (\alpha)Q^{(1-\eta)})^{1/(1-\eta)}$$

We don't have data on consumption, so we use the average median income across all block groups in the zip code. The linear utility specification does best in terms of the highest log-likelihood and matching the real data. However, nonetheless, our findings remain regardless of utility specification, that utility increases with utilitarian welfare weights, decreases with Rawlsian welfare weights, and remains roughly the same with the same transition probabilities.

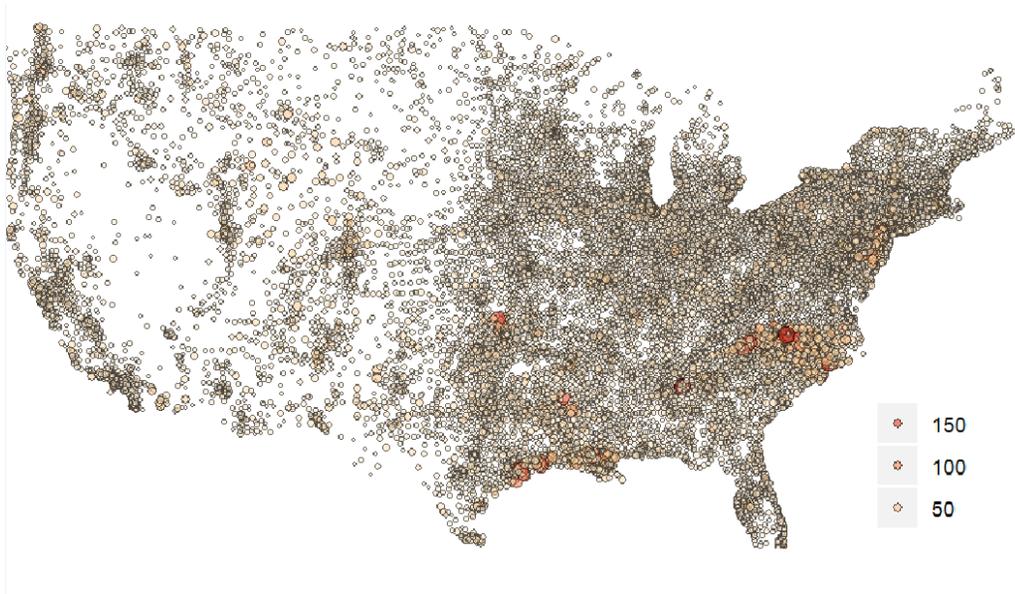
Known heterogenous utilities would bring richness to the model, but for identification of both the welfare weights and the utility parameters we cannot include heterogenous utilities. Our priority is to recover welfare weights. We could have different utilities that vary depending on income or environmental quality but these will be correlated to the demographics deciles. We could not set up the model with utilities that vary by demographic deciles and both identify the social welfare weights and the differences in utility functions. To simplify our findings we stick to the same utilities, but admit that our finding of higher social welfare weights in the decile least vulnerable to EJ could be driven by equal social welfare weights but rather some knowledge that these groups have higher utility for environmental quality.

Table A3: Estimates when using different utility specifications

	Log-Likelihood	Difference between Estimated Actual and			
		Actual # In-kind	Utilitarian # In-kind	Rawlsian # In-kind	Same-deterrence # In-kind
Linear utility (as found in main text): $u_i = C + \alpha Q$	-972,942	-5.08%	16.51%	-5.87%	-60.70%
Non-linear, separable utility: $u_i = \frac{C^{1-\eta} - 1}{1 - \eta} + \frac{Q^{1-\eta} - 1}{1 - \eta}$	-973,082	-5.78%	15.84%	-7.04%	-61.70%
Non-linear, non-separable utility: $u_i = ((1 - \alpha)C^{(1-\eta)} + (\alpha)Q^{(1-\eta)})^{1/(1-\eta)}$	-979,233	-20.57%	21.43%	-2.29%	-64.22%

Notes: Each cell represents a different simulation with a different utility specification. The first row is the specification used in the main text. The first column shows the log likelihood from the estimation. The second column shows the percent difference between the estimated number of in-kind settlements and the actual number of in-kind settlements. The remaining columns show the difference between the the estimated predicted number in-kind and the optimal predicted in-kind given the counterfactual.

(a) Cases

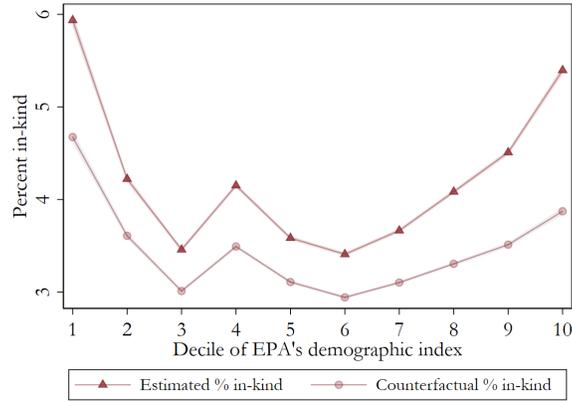


(b) In-kind settlements

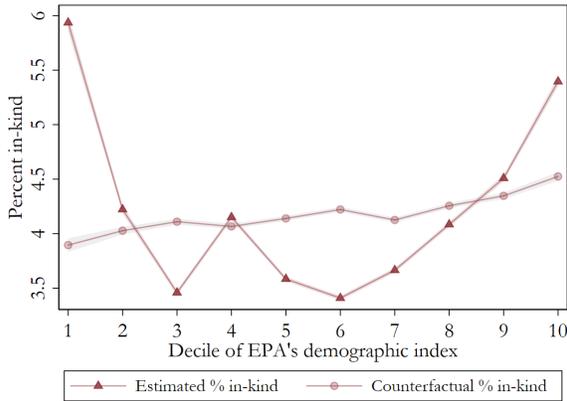


Figure A9: Location of cases and in-kind settlements (1997-2017)

(a) Post-cash transition probability for environmental quality



(b) Utilitarian social welfare weights



(c) Rawlsian social welfare weights

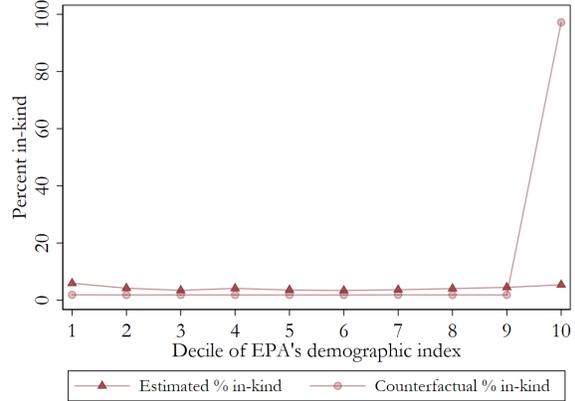


Figure A10: Counterfactual Allocations

Notes: Estimated represents the simulated count when using the estimated social welfare weights (found in Table 4). The first counterfactual (a) sets the state transition probability of environmental quality to be the same for both cash and in-kind settlements, specifically, that estimated post-cash settlements. Utilitarian weights (b) set all social welfare weights to be equal across the 10 demographic deciles ($\omega_i = .1$). Rawlsian weights (c) set the social welfare weight on the most-EJ vulnerable community to one ($\omega_{10} = 1$) and the rest zero.