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Prevention and cleanup of dynamic harm under environmental liability ☆

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ABSTRACT

This paper explores incentives for accident prevention and cleanup when firms are subject to environmental liability. In our two-period setup, the level of environmental harm in the second period depends on first-period harm when cleanup was incomplete. Under strict liability, in the first period, firms with a positive probability of going out of business before the second period have inadequate prevention and cleanup incentives. The fundamental disconnect between private incentives and social optimality cannot be remedied by using a multiple of harm as the level of compensation. Under negligence with a causation requirement, incentive problems remain; however, under negligence without such a requirement, first-best incentives may emerge, and using a multiple of harm as the level of compensation can ensure the efficient solution.

Introduction

Motivation and main results

The environment is a complex system. For example, the use of natural resources beyond a defined tipping point may have disastrous consequences for the environment (e.g., Mäler et al., 2003; Lenton et al., 2008), including irreversible biodiversity effects such as the destruction of rare native species and natural habitats. In many environmental contexts, when cleanup is incomplete, the environment will be more susceptible to future contamination or disruption afterwards. Indeed, the disruption of the environment that results from an incident often persists for many years. Peterson et al. (2003) describe the massive long-term repercussions of the *Exxon Valdez* oil spill in 1989 for the Alaskan coastal ecosystem, pointing to the unexpected diminution of dispersion and degradation over time. For example, in some affected areas, sea otter populations had not made any recovery at all by the year 2000. Similarly drastic and long-lasting repercussions will in all likelihood emerge in Brazil following the nation's worst environmental disaster, namely the collapse of a mining dam in November 2015. The spillage of tons of mining waste carrying harmful bacteria and toxic substances (e.g., mercury) into the

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Doce River and downstream will result in severe and enduring harm to the marine ecosystem and native species.[1] Environmental accidents of this magnitude have the potential not only to destroy entire segments of the ecosystem but also to enduringly increase the vulnerability of other segments. Importantly, such incidents are often not singular events. For example, from 1988 to 2014, the firm Synthron, a subsidiary of Protex International, has repeatedly experienced accidents (e.g., explosions and flooding) at its plant in Auzouer-en-Touraine, each entailing severe and long-lasting repercussions for the La Brenne River.[2]

The socially optimal approach requires the incorporation of such dynamic effects arising from environmental accidents in the determination of prevention and cleanup levels. From an efficiency point of view, one implication of an accident in the present period may be the need for additional precautions in the future; in other words, the marginal benefits from higher levels of precaution in the present include the avoidance of higher future costs. However, when long time horizons are relevant, inducing decentralized polluters to fully internalize their influence on these future social costs may be challenging. Note, for example, that about 35% of remediation expenditures in the European Union come from public budgets because the legally responsible polluters no longer exist, cannot be identified, or are insolvent (EPA 2009).

To some extent, regulatory attempts at pollution control reflect the dynamics outlined above. For example, the US Clean Water Act requires that impaired water bodies be regulated on the basis of total maximum daily pollution loads. For private agents, this implies that compliance after a contamination incident causing the water body's impairment is often more costly than before. However, the regulation under the Clean Water Act takes into account the *designated use* of a water body, thereby instituting an antidegradation policy that is multi-tiered in terms of its stringency.[3] As a result, when a major incident precludes some potential uses of the water body with implications for the designated use, compliance costs may actually be smaller afterwards. In light of its distinction between attainment and nonattainment counties, the strictness of the regulatory oversight under the US Clean Air Act is also to some extent path-dependent (e.g., Greenstone, 2004).[4] Another important piece of regulation is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) addressing the release or potential release of hazardous substances and imposing liability on responsible parties. Interestingly (for our purposes), the cleanup standards mandated by CERCLA may result in incomplete decontamination (42 US Code §9621). CERCLA cleanup standards also reflect possible site uses: The Act's stated objective is to reduce risk to human health as well as ecological risk, such that the proximity to human populations and sensitive environments critically influences the standards determined in any given case. Furthermore, standards must be chosen with the resulting costs in mind. A pre-existing environmental degradation may thus lower or raise the cost of cleanup for later incidents. Moreover, CERCLA regulations take a variety of temporal spillovers into account. For example, the lessee/owner of a property may be held liable for a pre-existing contamination if it is determined that this individual or firm failed to exercise appropriate care (e.g., Smith, 1989). On a somewhat related note, jurisdictions have ruled that the costs of later incidents may be lowered by relocating either the potentially harmful activity or the potential victims, as addressed by the European Directive 2012/18/EU and exemplified by the reaction to the AZF factory explosion in Toulouse in 2001.

Our paper analyzes *private* prevention and cleanup incentives in a simple two-period setting in which injurers are subject to environmental liability and the potential second-period harm depends on the level of environmental harm remaining after the first period. We analyze environmental liability law with reference to two alternative liability rules: strict liability and negligence. Under strict liability, polluters are required to compensate victims independent of their prevention or treatment behavior. Under negligence, whether a polluter will be held liable is contingent on the breach of a behavioral norm. Which liability rule applies in a given situation generally depends on the activity undertaken. For instance, the Environmental Liability Directive of the European Union 2004/35/EC lists dangerous activities in its Annex III that fall under strict liability. We seek to contribute to the long-standing debate over which liability rule performs best in well-specified circumstances (e.g., Schäfer and Müller-Langer, 2009), providing the first analysis of the potential implications of dynamic harm.

We find that neither strict liability nor negligence ensures socially optimal prevention and cleanup levels in the first period when firms anticipate that they may no longer be in business in the second period and the level of compensation is equal to the level of environmental harm. However, behavior in the second period is efficient given first-period choices.

Under strict liability, firms discount the additional influence on payoffs in the second period based on the probability of staying in business and thus choose inefficient prevention and cleanup levels in the first period. In the law and economics literature, using a multiple of the level of harm as the level of compensation is suggested as a remedy in circumstances in which the defendant may *disappear* (e.g., Cooter, 1989). However, we show that using a multiple of harm as the level of compensation is not sufficient to induce the first-best outcome in our setup under strict liability. The intuition is that two

[1] For a recent assessment of the effects of the dam collapse, see *Samarco dam collapse: one year on from Brazil's worst environmental disaster* at http://theguardian.com/sustainable-business/2016/oct/15/samarco-dam-collapse-brazil-worst-environmental-disaster-bhp-billiton-vale-mining.

[2] These repeated accidents have triggered several court trials resulting in Synthron's payments of fines and damages. See, for instance, the statement of a French environmental association on a legal decision in 2008 at https://www.fne.asso.fr/actualites/nouvelle-condamnation-de-synthron-pour-pollution-de-la-brenne. Likewise, in the year 2012, the chemical group Arkema was made to pay a fine and damages for repeated releases from its plant at Saint-Auban into the La Durance River during the years 2003 to 2005.

[3] See, for example, the Texas Surface Water Quality Standards codified in Chapter 307 of the Texas Administrative Code.

[4] See, for example, the current and historical list of nonattainment areas by county in Indiana at http://in.gov/idem/airquality/files/nonattainment_county_list.pdf.