# Deterring and Compensating Oil-Spill Catastrophes: The Need for Strict and Two-Tier Liability

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## I. INTRODUCTION: THE CHALLENGE OF CATASTROPHIC ENVIRONMENTAL RISKS

On April 20, 2010, an explosion on the BP *Deepwater Horizon* rig set off the nation's largest coastal oil spill.[1] This disaster killed eleven workers, ultimately dumped an estimated 4.9 million barrels of oil into the Gulf of Mexico,[2] and imposed financial costs in the tens of billions of dollars.[3] President Obama declared it the worst environmental disaster in U.S. history.[4] Matters could have been much worse, both financially and environmentally. Had a medium-sized or even large firm, rather than a giant like BP, generated the spill, the financial consequences would have been far graver. Resource damages would have been left unabated, and financial losses would have been at best partly compensated. BP's unusually deep pockets made full compensation feasible.

Just like the financial damages, the environmental damage turned out to be less than feared. The best-estimate projections of environmental harm were well above the damage that the spill actually inflicted.[5] Far greater ecological harms were expected, including severe long-term damage to prime beach areas along the Gulf Coast. Among the factors that reduced costs below expectations were the underanticipated capabilities of the oil-eating microbes that broke down much of the crude oil and the Gulf currents that conveyed

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1. NAT'L COMM'N ON THE BP *DEEPWATER HORIZON* OIL SPILL & OFFSHORE DRILLING, DEEP WATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING, REPORT TO THE PRESIDENT, at vi–vii (2011) [hereinafter BP COMM'N REPORT], *available at* http://www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_ReporttothePresident_FINAL.pdf.

2. *Id.* at 55, 167.

3. *Id.* at vi ("The costs from this one industrial accident are not yet fully counted, but it is already clear that . . . economic losses total tens of billions of dollars.").

4. *Id.* at 173 ("Already, this oil spill is the worst environmental disaster America has ever faced." (quoting President Barack Obama, Remarks by the President to the Nation on the BP Oil Spill (June 15, 2010), (transcript available at http://www.whitehouse.gov/the-press-office/remarks-president-nation-bp-oil-spill))).

5. *Id.* at 174 ("However widespread (and in many cases severe) the natural resource damages are, those observed so far have fallen short of some of the worst expectations and reported conjectures during the early stages of the spill." (citing Leslie Kaufman & Shaila Dewan, *Oiled Gulf May Defy Direst Predictions*, N.Y. TIMES, Sept. 14, 2010, at D1, *available at* http://www.nytimes.com/2010/09/14/science/earth/14spill.html)). Given the fat-tailed property of losses from many types of catastrophes, a small number of big outliers will account for most of the losses. This implies that expected losses will exceed actual losses most of the time. *See* discussion *infra* Part II.

the oil away from areas where it would have caused greater damage.[6] Even though the BP spill was the greatest environmental disaster the nation has seen, under the current liability and regulatory regime a future spill could be much more devastating. Further compounding the harm caused by a new catastrophe is the fact that the responsible firm is unlikely to have BP's financial resources.

The BP *Deepwater Horizon* oil spill exposed glaring safety failures in both the private and public sectors. All three major companies involved in the spill had safety shortcomings, which together almost certainly created the conditions for the massive spill that resulted.[7] The spill also highlighted the deficiencies of the current regulatory and liability structures for addressing catastrophic risks. Deepwater drilling provides a timely case study of how to structure liability for an economic activity that poses a potential catastrophic loss. Damages that could far exceed the injurer's financial resources diminish the ability of the tort liability system to create incentives for safety and to provide compensation. The current liability and regulatory regime for deepwater drilling should hardly be thought of as a system; rather, the regime consists of a hodgepodge of liability structures, damages limits, and ineffective regulatory efforts. In this Article, we propose that the government jettison this regime and bring on board a sounder structure. The predominant risk-control mechanism of our proposed regime is an effective liability system.

Our governmental institutions' inadequate performance controlling drilling risks received considerable notice. In May 2010, through Executive Order 13,543, President Obama established the National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling ("Commission") to address the spill.[8] The Commission issued multiple reports in 2010 criticizing the Obama

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6. *See* BP COMM'N REPORT, *supra* note 1, at 174 (citing Richard Camilli et al., *Tracking Hydrocarbon Plume Transport and Biodegradation at* Deepwater Horizon, 330 SCIENCE 201, 201–04 (2010); Terry C. Hazen et al., *Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria*, 330 SCIENCE 204, 204–07 (2010); David L. Valentine et al., *Propane Respiration Jump-Starts Microbial Response to a Deep Oil Spill*, 330 SCIENCE 208, 208–11 (2010); Brian Hamacher, *Wind Keeps Oil From Loop Current & Away From Florida Shores*, NBC MIAMI (July 19, 2010, 1:16 PM), http://www.nbcmiami.com/news/local/Wind-Keeps-Oil-From-Loop-Current-Away-From-Florida-Shores-98757749.html.

7. *See* BP COMM'N REPORT, *supra* note 1, at 90 ("Better management by BP, Halliburton, and Transocean would almost certainly have prevented the blowout by improving the ability of individuals involved to identify the risks they faced, and to properly evaluate, communicate, and address them.").

8. Exec. Order No. 13,543, 75 Fed. Reg. 29,397 (May 21, 2010).

Administration's handling of the spill.[9] In January 2011 the Commission's final report detailed a series of proposed reforms, including revamping the agencies that regulate deepwater drilling.[10]

As we wrote this Article, Japan experienced an environmental disaster of far graver consequence from another energy-related industry: explosions, partial meltdowns, and radioactive releases at four of its nuclear plants.[11] A massive earthquake triggered these events.[12] To be sure, nature played a far more consequential role in Japan than it did with the BP spill. However, it would be inappropriate to scrutinize America's greatest environmental disaster without paying attention to Japan's disaster, which occurred within the same twelve months. Analysis of that disaster, including the allocation of responsibility, will have to wait for another day.[13] Nevertheless, we examine these principles in light of the Japanese experience by identifying similarities and differences and exploring the implications for creating desirable regulatory and liability structures. We draw one central lesson from these two disasters and many others studied: it is extremely difficult to predict the nature or magnitude of catastrophic events. The losses entailed, even within a class of disasters such as hurricanes or earthquakes, have fat-tailed distributions, implying potentially huge outlier events, which we will discuss further below.[14]

This analysis seeks neither to lay blame for the past nor to describe specific actions that would appropriately limit losses in the future. Rather, it defines a regulatory and liability framework that will encourage the parties involved in offshore drilling, or any other economic activity that could produce catastrophic environmental consequences, to take appropriate actions. Our underlying assumption is that decisions relating to such activities are highly complex and

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9. *E.g.*, John M. Broder, *Reports Fault Administration on Spill*, N.Y. TIMES, Oct. 7, 2010, at A20, *available at* http://www.nytimes.com/2010/10/07/science/earth/07spill.html.

10. BP COMM'N REPORT, *supra* note 1, at iii, 250–91.

11. *Status of the Nuclear Reactors at the Fukushima Daiichi Power Plant*, N.Y. TIMES, Apr. 29, 2011, http://www.nytimes.com/interactive/2011/03/16/world/asia/reactors-status.html.

12. *Id.*

13. At the present time, it appears that the Tokyo Electric Power Co. (Tepco) may not be able to cover the tens of billions of dollars of losses. *See* Yuka Hayashi, *Japan Confronts Liabilities for Crisis*, WALL ST. J., May 4, 2011, at A13, *available at* http://online.wsj.com/article/SB10001424052748703367004576288692867523776.html. The Tepco Chairman, Tsunehisa Katsumata, made the following observation: "No matter how much money we have, it will not be enough." *Id.*

14. *See infra* Part III. For fat-tailed distributions of losses, there are a larger number of very large loss events than one would expect if losses were normally distributed.

constantly evolving and that the only way to achieve desirable outcomes is to have parties face appropriate incentives. In a technologically advanced and advancing society, regulation alone will not be sufficient because the government will likely direct it at yesterday's problems. Moreover, liability schemes that might function well for traditional environmental externalities are not well equipped to deal with extreme potential outcomes.

Given that few corporations have sufficient resources to cover the most extreme outcomes, the efficient-control regime must incorporate not merely regulation and liability, but it must also include some tax charges for any extreme risks imposed on external parties that will not be remedied should the company's financial resources be exhausted. This Article develops a ten-point proposal for overhauling the current liability and regulatory regime for deepwater drilling. The principles that we advocate also apply to many other contexts in which private entities undertake actions that could create potentially catastrophic environmental risks.

The problem that we address is the following: Should the government cap firms' liability for damages? Some firms could potentially generate hazards that inflict damages beyond their financial resources. The government must deal with these low-probability, high-loss situations. With a modest damages limit, few firms will be daunted by the prospect of paying losses but damages will go unpaid. With unlimited liability to exposure, fewer firms will enter the field but more damages will be paid after a catastrophe. Either of these extremes would work poorly. The first would lead firms to take excessive risks. The second would impose losses exceeding many firms' financial resources. Thus, firms with few financial resources to lose would enter and engage in excessively risky behavior.

Our proposal jettisons the current structure of a low damages cap coupled with ineffective regulation.[15] It replaces that system with a greatly expanded level of liability coupled with a tax to provide incentives for risks beyond the liability limit, which we call a two-tier liability system. This system creates strong financial incentives for safety. If welcomed by the risk-control community, this structure can provide the framework not only for addressing deepwater-drilling risks, but also for other catastrophic risks. With modest modifications,

15. The Oil Pollution Act ("OPA") has a nominal damages cap of $75 million for firms that have not committed gross negligence or willful misconduct. *See* 33 U.S.C. § 2704(a)(3) (2006). Given the BP experience, however, firms in the future might not expect that this cap will be binding for major oil spills. *See* discussion *infra* Parts V–VI.

the government could employ our proposal to address a broad range of catastrophic environmental risks.

Our proposal starts by recognizing that the potential for catastrophic accidents generally, and the BP accident specifically, represents a challenge of effectively controlling risks that impose extreme damages on others. Controlling risks is always difficult because of asymmetric information; the need for regulation and litigation to be effectively aligned; the dual needs of deterrence and efficient compensation; a range of additional analytic issues; and, of course, politics. This analysis addresses the cluster of considerations that must enter any risk-control regime while paying particular attention to extreme risks. It leaves politics aside because we think that a well-structured regime, when chosen far in advance of the next accident, has a reasonable chance to win political approval. By contrast, once an accident happens, strong interests become established, and there is little reasoned discourse or clear thinking in the political arena. Because accidents are low probability events, it is difficult to identify either victims or responsible parties in advance.

The BP spill is an outlier among environmental accidents for three reasons. First, its mere magnitude as the largest coastal spill in U.S. history, both in terms of the quantity of oil and the number of people affected, makes it stand out. Second, multiple parties—three important ones—helped contribute to the situation producing the catastrophe. That is often the case, but many models of risk deterrence assume only one responsible party, or at least one predominantly responsible party. Third, the magnitude of the damages assessed would bankrupt almost all companies. Fortunately, that was not true in the case of BP, which will pay all or virtually all of the damages independent of culpability.

Our proposal incorporates two basic principles. First, the overall goal of a risk-control structure should be to minimize the sum of two costs: the costs of losses plus the costs of avoiding losses. Second, no structure for controlling catastrophic losses can effectively meet the cluster of goals that all would agree are desirable for such a scheme. The components of our reform proposal, also summarized in Table 1, are as follows:

Identifiable responsible party. The oil company that owns the lease and undertakes the drilling is fully responsible for all financial harms directly associated with the spill.[16] This ensures that there is

16. For concreteness, our analysis refers to the "oil company" as the company owning the lease and operating the well. We realize that there may be other institutional arrangements.

one party overseeing the whole process, a party who coordinates and monitors the actions of those beneath it. There is no separate liability for other firms involved in the drilling.[17] Thus, for example, there is no joint and several liability under this system. The oil company can establish whatever contractual arrangements it wishes with other firms involved in the drilling operations, and the oil company in turn can recoup costs due to negligence or other specified behavior of its corporate partners based on whatever contractual arrangements it makes with them.

Strict Liability. The responsible party is strictly liable for all losses due to the spill. There is consequently no need to ascertain the appropriate level of care and whether the drilling operations met that level of care. Nor is there a need to evaluate the behavior of other partners in the drilling effort. The only informational requirement for implementing our liability proposal is to determine the amount of damages.

Tax on noncompensable risk imposed. No corporation has sufficient resources to cover the most extreme potential losses from an accident. In the case of a megacatastrophe, the government will pay significant amounts and/or losses will go uncompensated. The operator is essentially judgment proof for extreme accidents. Absent other arrangements, operators will therefore take excessive risks. To correct this propensity, the operator should pay a tax for the expected external losses imposed beyond the amount that it will be able to pay. Having this arrangement in place will allow operators to drill even if they do not have the resources to cover losses in excess of the BP *Deepwater Horizon* spill. This tax establishes what we term a tiered-liability system when imposed in conjunction with liability for damages up to the cap specified in the demonstration of financial capacity.

Demonstration of financial capacity. The government should restrict deepwater oil drilling to firms that can demonstrate a combination of adequate financial resources, expected compensation

17. The Japanese nuclear disaster liability system provides an interesting contrast with the U.S. liability system. In the Japanese system, the plant operator bears almost all liability. *See* [Act on Compensation for Nuclear Damage], Law No. 147 of 1961, pt. II, ch. 1, § 3 (Japan), *translated in Act on Compensation for Nuclear Damage*, NUCLEAR ENERGY AGENCY (Apr. 17, 2009), http://www.oecd-nea.org/law/legislation/japan-docs/Japan-Nuclear-Damage-Compensation-Act.pdf. Thus, for example, General Electric, which manufactured the Mark I reactor, which has encountered a range of safety issues, will most likely not bear significant financial responsibility. *See* Andrew Longstreth, *GE Unlikely to Face Liability in Japanese Nuclear Crisis*, REUTERS, Apr. 1, 2011, http://www.reuters.com/article/2011/04/01/us-japan-ge-liability-idUSTRE7302EB20110401.

from other participants, and insurance to cover the cost of catastrophic spills of the magnitude of the BP *Deepwater Horizon* spill. The responsible party will be strictly liable for all damages up to its financial capacity. Although the financial capacity requirement will vary depending on the risky activity's potential for harm, an appropriate amount for deepwater drilling in the Gulf of Mexico might be $20 billion, which is the size of the fund that BP created at President Obama's urging after the spill.[18]

Damages. There are three components to our damages proposal. First, it will completely eliminate any cap on damages. (The statutory cap set by the Oil Pollution Act is currently a paltry $75 million.)[19] Second, it will eliminate all punitive damages for oil spills. Third, it will compensate only direct losses. The elimination of the damages cap coupled with our tiered-liability system will establish efficient incentives for safety. Because catastrophic oil spills can be readily monitored by the government, the courts, and the public, additional punitive damages are not needed to establish the efficient level of care. Payments for financial and property damage losses are limited to losses the spill caused directly. More distant economic ramifications of these losses are not compensable.

Natural resource damages and restoration. For natural resource damages, the primary emphasis should be on restoration. Restoration should continue until the natural resource benefits of additional restoration no longer exceed their costs.

Recipient of net resource value losses. For any shortfall of the restoration from complete restoration, the oil company must pay the government for the natural resource damages it incurs. Such damages would also include losses for the period before a resource is restored. The government may choose to use these funds for further restoration at the site, for restoration elsewhere, for other environmental efforts, or for other purposes.

Regulatory complement. Liability should be coupled with a regulatory regime where the regulation of drilling activities is based on a comparison of the benefits and costs of these efforts, with the goal to maximize net benefits. Full adherence to regulatory standards would not protect a firm against damages from accidents.

Focused, net economic benefits. In assessing the benefits of deepwater oil drilling, there should be no additional premium accorded to the economic benefits associated with national security or

18. BP COMM'N REPORT, *supra* note 1, at 185.

19. 33 U.S.C. § 2704(a)(3) (2006).

employment effects beyond the assessed benefits for other less risky drilling activities or other sources of energy. Any crediting of oil exploration of any kind with broader economic benefits to the economy must be done on a net benefit basis that also incorporates recognition of the environmental harms associated with the production and consumption of petroleum products, including the effect on global climate change.

Moratorium on all new deepwater drilling. Until Congress adopts these proposals, the government should impose a moratorium on all new deepwater-drilling activities. Firms that accept strict liability, demonstrate adequate financial resources to pay for the costs of a major disaster, pay the tax for the expected damages beyond its financial capacity, and subject proposed drilling operations to a safety review should be exempted from the moratorium.

Although we tailored the proposals to oil drilling, they can be readily adapted to other contexts. Spills from oil tankers, such as the *Exxon Valdez*, represent an obvious extension. The hazards of nuclear reactors also represent an analogous situation of a low probability/catastrophic loss activity. Clearly, we would not extend our proposal to require that all economic activity have the tiered liability structure. But we would extend our proposal to situations in which the prospect of catastrophic losses is sufficiently prominent that legislative damages caps have been enacted. Oil drilling, oil transport, and nuclear power are among the most prominent economic activities that meet this test.

## II. EFFICIENT SAFETY LEVELS

Before considering the performance of (and possible changes in) the role of liability and regulation with respect to potentially catastrophic environmental risks, it is useful to specify the objectives we seek to promote and the criteria by which we will judge policies. Our approach assumes that the proper role of liability and regulation is to produce efficient risk outcomes in terms of establishing an appropriate balance between the benefits and costs of promoting safety.

Our working assumption is that the level of safety should be set at an economically efficient level. This assumption has two principal consequences for the design of social policies addressing

environmental risks.[20] First, the government should structure policies to maximize the net benefits to society. This is equivalent to maximizing the difference between the benefits and costs. Second, the implication of this objective is that the government should increase the level of safety until the incremental benefits from boosting the level of safety equal the incremental costs. In the usual situation, the cost of providing safety rises at an increasing rate as the level of safety increases, while the benefits of providing higher levels of safety diminish as the safety level rises.

While implementing these guidelines for catastrophic environmental risks poses considerable challenges,[21] formulating the policy objective in this manner clarifies many fundamental policy issues. At the most basic level, the optimal level of safety will seldom involve zero risk. Deepwater oil exploration is an inherently risky enterprise that in the case of the BP *Deepwater Horizon* involved drilling thirteen thousand feet below the sea floor in more than five thousand feet of Gulf water to produce a well that went down three and a half miles.[22] The mere magnitudes involved imply significant risk, but beyond that, all work at the frontiers of technology involves techniques, systems, and equipment that have not been tested in the field, imposing new risks that are little understood. Because incremental costs tend to escalate rapidly as the level of the risk approaches zero, it will usually be efficient from an economic standpoint for there to be some chance of adverse events, including potentially catastrophic environmental disasters.[23] Even for risks posing potentially catastrophic losses, it is generally neither feasible nor desirable to completely eliminate these hazards. The task for regulatory and liability policies is to ensure that the prevailing level of risk is set at the efficient level and that, if an adverse event does occur, the remediation and compensation is appropriate. The fact that deepwater drilling poses potentially serious environmental risks and has already produced a catastrophic loss is not a sufficient reason to

20. For a review of these principles, see W. KIP VISCUSI, JOHN M. VERNON & JOSEPH E. HARRINGTON, JR., ECONOMICS OF REGULATION AND ANTITRUST 30–33 (4th ed. 2005).

21. *See infra* Part VI.

22. *See* BP COMM'N REPORT, *supra* note 1, at viii–ix.

23. If the costs avoided are great, then it is perfectly rational to accept a small but positive risk of even a megacatastrophe. By analogy, we often risk our lives and those of family members—which is as bad an outcome as we can imagine for ourselves—by driving to a recreational event. No loss carries a weight of minus infinity. *See* Lawrence Summers & Richard Zeckhauser, *Policymaking for Posterity*, 37 J. RISK & UNCERTAINTY 115, 123–25 (2008) (observing that even the most severe potential loss from climate change—which could entail the end of human civilization—should not get an implied infinite weight).

ban the activity; just as the Japanese nuclear plant catastrophe does not mean that the world should abandon nuclear power. Rather, these accidents demonstrate that we should have better systems to ensure appropriate safety with both technologies.

Oil spills impose severe external financial and environmental harms that a profit-maximizing firm will not take into full account absent liability and/or government sanctions. Left unfettered, enterprise decisions will be neither socially desirable nor economically efficient.[24] Catastrophic environmental risks add an additional dimension to the traditional externalities problem—the potential that even with existing systems of liability a firm may be judgment proof for a significant portion of losses, and hence reckless. We target our policy proposals at achieving the appropriate balance between safety level and safety expenditure even when catastrophic losses are possible.

Formulating the efficiency objective highlights what factors are and are not pertinent for setting safety levels. An oft-heard argument that has played a prominent role in the deepwater-drilling debate is that the country needs to continue deepwater drilling and other risky oil industry activities to meet our national goal of achieving energy independence.[25] President Nixon, under the "Project Independence" campaign, employed energy independence as a mantra to justify significant increases in offshore-oil exploration, including additional leases off the Gulf Coast.[26] Energy independence is an effective battle cry, used by both "drill baby drill" proponents and fierce energy conservationists, but it is an unattainable goal in the foreseeable future.

"Independence" concerns are at best tangentially relevant to regulating the level of safety for deepwater drilling for several reasons. First, the world oil price and subsequent refinery and distribution costs drive the price of petroleum products in the United States and other countries. U.S. production of oil represents a very small share of the world output and is barely a dominant share of U.S.

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24. Victims of these externalities potentially could bargain with the firm to control the externality to efficient levels, but with a large number of affected parties such Coasean bargains are not feasible. *See* STEVEN SHAVELL, FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW 83–88 (2004).

25. *See* BP COMM'N REPORT, *supra* note 1, at 56.

26. *See id.* at 31.

consumption.[27] Except in situations involving cutoffs to the U.S. oil supply, such as oil embargoes and crises in other major oil producing countries, whether the oil is domestic or foreign matters little. Furthermore, the United States derives national security benefits from all U.S. oil production, not just risky drilling. An appropriate policy mechanism for reflecting concerns with maintaining domestic production for security reasons would be to provide tax subsidies for all domestic oil production, where those subsidies recognize the overall economic desirability of all U.S. oil production and do not place a differential premium on the forms of oil drilling that pose potentially catastrophic environmental risks. We propose that any credit for favorable national security effects should apply to all oil drilling, with no special premium accorded those in deep water. Thus, even allowing for national security concerns, there is no valid reason for relaxing the safety standards for offshore drilling. We also note that most major energy-producing technologies, for example nuclear power as the Fukushima incident makes evident, pose the risk of catastrophic environmental consequences. Policy assessments should treat all energy-producing technologies the same in terms of credit for associated benefits, such as national security, and associated harms, such as global warming effects.

A parallel argument applies for not considering the employment effects of deepwater drilling as an economic benefit. All economic activity generates associated employment effects, and there is no reason to subsidize either oil production generally or deepwater drilling specifically in order to create employment. We do not count secondary economic losses in our proposal because secondary economic benefits also accrue after a spill when compensation is paid or when the government spends money, as would happen with our proposal. Society should not compromise appropriate levels of safety in order to foster higher levels of employment. Nevertheless, a danger of excessively stringent regulations and liability rules is that they will discourage economically efficient industries and activities. That would have undesirable labor market effects. Employment consequences matter, and they should be recognized as a potential source of costs of excessively stringent policies, but they do not provide an independent basis for justifying situations that put the environment at excess risk.

27. U.S. ENERGY INFO. ADMIN., MONTHLY ENERGY REVIEW AUGUST 2011, at 40 fig.3.3a (2011), *available at* http://205.254.135.24/totalenergy/data/monthly/pdf/sec3_6.pdf (noting that petroleum imports made up forty-seven percent of U.S. demand in the first half of 2011).

Our proposed policy principles also specify that any tally of the broader economic ramifications of oil exploration must recognize the net consequences of petroleum products, including their negative effects. Chief among these is environmental pollution, including global climate change. Policies should be based on a comprehensive approach to assessing the desirability of oil exploration that considers all consequences and bases policy on the difference between positive and negative effects. The prime negatives—the conventional pollutants associated with petroleum products and their climate-change impact—are substantial.[28] Only a net tally, which also takes account of taxes at end use, could tell us whether the nation should subsidize oil exploration, as it presently does with generous depletion allowances.

Though conceptually simple, it is difficult in practice to establish the appropriate balance between safety costs and net benefits. The most significant difficulty is assessing both the expected environmental costs of deepwater drilling and how more stringent control will reduce these costs. The expected cost is defined as the product of the probability of an adverse outcome and the size of the loss. The calculation for multiple possible events consists of the sum of these expected costs for all types of possible adverse outcomes.

There are substantial gaps in our knowledge pertaining to both the probabilities and the potential harms associated with major oil spills, the two components of the calculation. Very frequently occurring risks that pose moderate or minor harms create little difficulty for assessing the likelihoods or magnitudes of losses. These events occur quite often, so it is straightforward to learn both their likelihood and magnitude. Moreover, because the events are frequent and the stakes are modest, taking a period to learn about the actual level of the risks and the value of damages is not too costly. Consequently, it is usually both feasible and desirable to become informed about such hazards. Situations in which the probabilities and the consequences are well known are situations of risk.

Matters become quite different once we venture into the low-probability, high-loss world of catastrophic risks. Because the probabilities are very small, there are few opportunities to learn about the magnitude of the risk. Thus, we may be aware of the presence of hazards but have only a poor idea of the size of the probabilities that

28. For a discussion of conventional pollutants that are linked to petroleum products, see W. Kip Viscusi et al., *Environmentally Responsible Energy Pricing*, 15 ENERGY J. 23, 28–42. For linkage to global climate change, see Ralph E.H. Sims et al., Intergovernmental Panel on Climate Change, *Energy Supply*, *in* CLIMATE CHANGE 2007: MITIGATION 251, 305 (B. Metz et al. eds., 2007).

are involved, making this a situation of uncertainty—one where probabilities are not known—rather than a situation of risk. Probability assessments become even more complicated when trying to ascertain the incremental effect of safety measures, as there may be even less knowledge of how these small probabilities will change as different safety precautions are taken. Similarly, the magnitude of the losses—the other component of the loss calculation—may be highly unpredictable even after an oil spill occurs. Even a year after the BP *Deepwater Horizon* spill, there remains substantial disagreement about what the ultimate harm will be.

Indeed, matters may be more difficult: some types of hazards may not be identifiable in advance. When the states of the world (as decision theorists call them) are unknown, we are in a world of "ignorance" rather than one of mere uncertainty.[29] As one Shell geophysicist commented, "[Y]ou just don't know what you don't know."[30]

One approach for dealing with dimly understood or, worse, hard-to-imagine risks is to take advantage of information that develops as these disasters need not be a complete surprise. The BP *Deepwater Horizon* well had developed unexpected pressure anomalies that cast doubt on the integrity of the cement casing for the well, but this information was not fully exploited.[31] Establishing greater corporate responsibility for liability will provide incentives for the oil-drilling company to develop and use such ongoing informational inputs in making its safety decisions. The government should take measures to collect and facilitate sharing of such information among companies.

## III. BEHAVIORAL DECISIONS, FAT TAILS, AND THE SEPARATION OF PROBABILITY AND SIZE OF LOSS

Our discussion and most analyses of losses due to environmental catastrophes assume a rational approach to policy decisions. Yet a broad strand of research developed over the past three decades in the field of behavioral decisionmaking demonstrates that individuals have great difficulty assessing and evaluating low-probability, high-loss events. They fall prey to errors both systematic

29. Richard Zeckhauser introduces this concept in the context of the climate debate. *See* Richard J. Zeckhauser, *The Strategy of Choice*, *in* STRATEGY AND CHOICE 16–17 (Richard J. Zeckhauser ed., 1991).

30. BP COMM'N REPORT, *supra* note 1, at 32.

31. *See id.* at 98, 105–09.

and severe, as we illustrate below. Though the study of institutions, such as government agencies and corporations, and their ability to deal with such situations is less well developed, there is little evidence that their decisions come any closer to optimality.[32]

To illustrate, consider the availability heuristic.[33] It tells us that decisionmakers judge the likelihood of an event by how easily they can bring an instance to mind. Thus, in light of the recent Japanese nuclear power disaster, it seems clear that both citizens and governments will think the probability of a nuclear meltdown is much higher than they would have a few months earlier. Yet an earthquake of the magnitude of the Japanese quake is exceedingly unusual. The Japanese quake ranks as one of the largest earthquakes ever recorded.[34] Indeed, mere event similarity may be sufficient to dramatically influence policy decisions. The Three Mile Island incident in the United States effectively shut down nuclear power construction for decades, even though the esteemed Kemeny Commission estimated that less than one life was lost from the radiation released.[35] But citizens, legislators, and even regulators assumed that a major life-loss incident from a to-be-built nuclear power plant was much more likely than it would have been.

Daniel Kahneman and Amos Tversky's *Prospect Theory: An Analysis of Decision under Risk* is a seminal article in the behavioral decision field.[36] Kahneman and Tversky note that individuals make decisions reflecting severe biases relative to prescriptive decision analysis both in valuing outcomes and in weighing probabilities.[37] In valuing outcomes, they hypothesized that individuals are appropriately risk-averse in achieving gains, but contrary to rational

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32. W. KIP VISCUSI, RATIONAL RISK POLICY 2 (1998).

33. *See, e.g.*, Amos Tversky & Daniel Kahneman, *Availability: A Heuristic for Judging Frequency and Probability*, 5 COGNITIVE PSYCHOL. 207, 207 (1973) (discussing how the availability heuristic leads to the "phenomenon of illusory correlation").

34. *See, e.g.*, *Largest Earthquakes in the World Since 1900*, U.S. GEOLOGICAL SURV., http://earthquake.usgs.gov/earthquakes/world/10_largest_world.php (last visited Sept. 28, 2011) (ranking the Japanese quake as the fourth largest earthquake since 1990, behind earthquakes in Chile, the United States, and Indonesia).

35. *See* PRESIDENT'S COMM'N ON THE ACCIDENT AT THREE MILE ISLAND, THE NEED FOR CHANGE: THE LEGACY OF TMI 12 (1979) [hereinafter TMI REPORT] ("[T]he radiation doses were so low that we conclude that the overall health effects will be minimal. . . . [A] projection derived for the total number of radiation-induced cancers among the population affected by the accident at TMI was 0.7.").

36. Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision under Risk*, 47 ECONOMETRICA 263 (1979).

37. *Id.* at 263.

prescription, are risk-preferring in the loss domain.[38] Thus, for instance, they would rather take a fifty percent chance of losing four hundred dollars than lose two hundred dollars for sure. The implications for catastrophic environmental losses are profound. For example, we may do too little to control them relative to other risks that have lesser-expected consequences but greater probabilities of occurrence.[39]

Prescriptive decision analysis tells us that probabilities should be weighted linearly; a ten percent chance of a loss is twice as consequential as a five percent chance. Prospect Theory and empirical studies documenting its predicted patterns of risk beliefs show that, for actual decisions, individuals are quite unresponsive to differences in probabilities. Thus, a ten percent probability may count only 1.2 times as much as a five percent probability.[40] And when the probabilities are much smaller—as with catastrophic environmental risks—individuals may hardly notice even a ten-fold reduction in risk, although this brings about a ten-fold reduction in expected consequences. Untrained decision processes will both overestimate small risks and undervalue significant reductions in low-probability, high-loss risks.

Prescriptive decision analysis separates out the consideration of consequences and probabilities, the two different essential components of outcomes. There are strong supporting normative principles for treating them independently.[41] Hence, we recommend separation between the two for policymakers and analysts who are attempting to assess catastrophic environmental risks. Instead of making distinctions, they should consider that for catastrophic outcomes "a risk is a risk is a risk." Fallacious reasoning came to the fore in discussing Japan's nuclear calamity, where many television analysts, and presumably their advisors, lumped the Japan disaster in with Three Mile Island (no documented health losses) and Chernobyl

38. *Id.*

39. Political processes reinforce this bias since politicians are strongly oriented toward "not on my watch" behavior. This implies that high-probability disasters count much more than low-probability disasters that impose much greater expected losses.

40. This result is true more generally when people lack full information and act as rational decisionmakers. *See* W. Kip Viscusi, *Sources of Inconsistency in Societal Responses to Health Risks*, 80 AM. ECON. REV. 257, 257 (1990) (discussing "how the character of individual risk perceptions can generate inconsistent patterns of response").

41. *See generally* HOWARD RAIFFA, DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICES UNDER UNCERTAINTY 297 (1968) (indicating "how a decisionmaker's preferences for consequences, attitudes towards risk, and judgments about uncertain events" can be better incorporated into formal analysis to reduce decisionmaker biases).

(extreme health losses).[42] The former is trivially small relative to the Japan situation, while the latter is many times worse.

Proper assessment of the magnitude of losses from a catastrophe reveals the disturbing reality that losses from disasters tend to have fat-tailed distributions (i.e., distributions where there is a nontrivial chance of extremely large losses). Such distributions look nothing like the normal distributions that are familiar, such as that used to characterize the distribution of human heights, and that play a central role in most empirical investigations in the social sciences. Even lognormal distributions, which pay greater attention to extreme outcomes, do not come close to having the fat tails found in the distributions of losses from catastrophes. Disaster losses—such as those from earthquakes, hurricanes, and floods—are much better described by a power law distribution. With a power law distribution, the greatest loss may easily be three times or even ten times as great as the second greatest loss, whereas no such variation is observed with respect to normally distributed variables such as individual height.

Figure 1 uses the power law scales to illustrate the distribution of fatalities from U.S. hurricanes, tornadoes, floods, and earthquakes.[43] The vertical axis is the cumulative number of each type of event per year, while the horizontal axis is the number of fatalities per event. Note that both scales have a progression in terms of orders of magnitude. For example, on the vertical axis one hundred is twice as high as ten, even though one hundred is an order of magnitude—ten times—greater than ten. The data indicate roughly linear relationships over two to three orders of magnitude—that is, factors of one hundred to one thousand—in the number of fatalities.[44]

The following examples illustrate the wide variability that may occur in the upper tail of the loss distribution. One of the most severe U.S. wildfire losses in terms of acres burned was the Yellowstone fire

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42. *See, e.g.*, Jenny Marder, *Japan's Nuclear Crisis: Does it Compare to Three Mile Island, Chernobyl?*, PBS NEWSHOUR, Mar. 14, 2011, http://www.pbs.org/newshour/rundown/2011/03/cooling-system-fails-at-nuclear-reactors-fuel-talk-of-past-disasters.html (contrasting the causes and outcomes of the pending Fukushima meltdown to those of Chernobyl and Three Mile Island). *Compare* TMI REPORT, *supra* note 35, at 12 (discussing the minimal health losses at Three Mile Island), *with* CHERNOBYL FORUM, CHERNOBYL'S LEGACY: HEALTH, ENVIRONMENTAL & SOCIO-ECONOMIC IMPACTS & RECOMMENDATIONS TO THE GOVERNMENTS OF BELARUS, THE RUSSIAN FEDERATION & UKRAINE 7–8 (2d ed. 2005), *available at* http://www.iaea.org/Publications/Booklets/Chernobyl/chernobyl.pdf.

43. A variable $p(x)$ has a power law distribution if it can be characterized as $p(x) = cx^d$, where $c$ and $d$ are constants, so that $\log p(x) = \log c + d \log x$.

44. *Fact Sheet: Natural Disasters—Forecasting Economic and Life Losses*, U.S. GEOLOGICAL SURV., http://pubs.usgs.gov/fs/natural-disasters/index.html (last visited Sept. 28, 2011).

in 1988, which consumed about 1.6 million acres.[45] Before that, the most recent wildfire that burned more than one million acres happened ninety years ago: the 1918 Cloquet-Moose Lake fire in Minnesota that burned 1.2 million acres.[46] The deadliest earthquake since 1900 was the 1976 Tangshan, China earthquake, which officially killed 255,000, although many estimate the death toll to be actually as high as 655,000.[47] The 2004 Sumatra earthquake ranks second with a death toll of 227,898.[48] When human action is a critical trigger, record-setting losses also can differ dramatically. The largest North American oil spill was the 1910 Lakeview Gusher spill in California, which poured out 9 million barrels of oil.[49] The 2010 BP *Deepwater Horizon* spill ranks second, with 4.9 million barrels.[50] The 1979 Ixtoc well off the coast of Mexico spilled 3.3 million barrels.[51] Terrorist events display similar variability. Prior to 9/11, the greatest loss in the United States was the 1995 Oklahoma City bombing, when 168 people died.[52] The 9/11 attacks killed nearly 3,000 people.[53]

There are two implications of catastrophes being characterized by fat-tailed distributions. First, where disasters are concerned, the past may not be prologue. A future disaster could easily be many times worse. Second, a single extreme outcome may readily account for most of the losses from a particular type of catastrophe. This second implication influences our policy recommendation. It would be infeasible to restrict drilling to companies that could cover any conceivable cost; possibly no company qualifies. But to proceed with our everyday activities, we must let processes that impose risks go

45. *See Historically Significant Wildland Fires*, NAT'L INTERAGENCY FIRE CTR., http://www.nifc.gov/fireInfo/fireInfo_stats_histSigFires.html (last visited Aug. 31, 2011) (listing several of the largest wildland fires in U.S. history). For a sense of the variation in monetary losses, see *Deadliest/Large-Loss Fires: The 10 Largest Loss Wildland Fires in the U.S.*, NAT'L FIRE PROT. ASS'N, http://www.nfpa.org/itemDetail.asp?categoryID=954&itemID=44745&URL=Research/Fire%20statistics/Deadliest/large-loss%20fires (last visited Sept. 28, 2011).

46. NAT'L INTERAGENCY FIRE CTR., *supra* note 45.

47. *Earthquakes with 50,000 or More Deaths*, U.S. GEOLOGICAL SURV., http://earthquake.usgs.gov/earthquakes/world/most_destructive.php (last visited Sept. 28, 2011).

48. *Id.*

49. *See World's Largest Oil Spills Map*, GEOLOGY, http://geology.com/articles/largest-oil-spills-map/ (last visited Aug. 31, 2011). These measures are in terms of barrels of oil. Should the loss be converted to dollars, we would expect even more variability.

50. *Id.*

51. *Id.*

52. *Oklahoma City Bombing, 1995*, FEMA, http://www.fema.gov/emergency/usr/usrok95.shtm (last visited Sept. 28, 2011).

53. *9/11 Attacks*, N.Y. TIMES, http://topics.nytimes.com/topics/reference/timestopics/subjects/s/sept_11_2001/attacks/index.html (last visited Oct. 26, 2011) (listing the number of dead as 2,992).

forward. Thus, when they do, we should charge the operators for the expected risks they impose beyond the maximum amount that we require or could possibly expect them to pay.

The failure to prepare for such unprecedented risks manifested when the forty-seven-foot-high tsunami struck Fukushima in March 2011.

In 2002, following new, nonbinding guidelines by a government advisory group, Tokyo Electric Power Co., Japan's biggest utility, raised its maximum projected tsunami at Fukushima Daiichi to between 17.7 and 18.7 feet—considerably higher than the 13-foot-high bluff. Yet the company appeared to respond only by raising the level of an electric pump near the coast by eight inches, presumably to protect it from high water, regulators said.

"We can only work on precedent, and there was no precedent," said Tsuneo Futami, a former Tokyo Electric nuclear engineer who was the director of Fukushima Daiichi in the late 1990s. "When I headed the plant, the thought of a tsunami never crossed my mind."[54]

## IV. INSURANCE PRINCIPLES, COMPENSATION, AND NONTRANSFERABLE LOSSES

Beyond generating an efficient level of safety, a central policy objective is to provide appropriate levels of compensation for environmental harms. There are many potential rationales for compensating injuries caused by environmental disasters. The most important rationale arises when the victims have property rights to the resources that have been lost. In that instance, it is widely viewed as fair and equitable to compensate them. But quite apart from restoring equity, payment of compensation usually performs two additional functions: deterring excess risks through a liability system and providing efficient insurance.

The insurance function of compensation seeks to provide efficient risk spreading for those who have lost value. The standard rationale for the insurance function of liability is that addressing financial losses is desirable because most people tend to be risk-averse. Liability payments that restore people to their prespill level of financial well-being are generally desirable. The "make whole" principle for setting damages for financial loss, apart from its equity

54. Norimitsu Onishi & James Glanz, *Old Science on Tsunami Risk Guided by Japan's Nuclear Rules*, N.Y. TIMES, Mar. 27, 2011, at A1.

accomplishments, simultaneously insures such losses to an optimal level.

However, this insurance analogy and the desirability of making people whole does not carry over to nontransferable goods, such as environmental quality or severe adverse health effects—both frequent consequences of environmental catastrophes. People will surely regret suffering environmental damage, and payment of money could improve their well-being, and perhaps even get them back to their original level of welfare. But even if there were no liability or compensation system, no one would expect people to purchase insurance that would provide a monetary payment if the environment is harmed since money and environmental resources are not easily substitutable goods.

The inability of money to substitute for nontransferable losses is particularly evident for situations involving fatalities. Compensation levels in wrongful-death cases do not involve payment levels sufficient to restore the person's well-being to the same level as when alive. For starters, after a person's death the deceased cannot reap any direct welfare benefits from such payments so that even posing the question in terms of making the victim whole is either an irrelevant abstraction or a logical impossibility. Similarly, anticipation of such a bequest before death will rarely make a person indifferent to a fatal injury.

The widespread lack of substitutability between money and health has been documented empirically for job-related injuries.[55] Serious injuries often impede a person's ability to increase individual welfare through financial expenditures. Because serious injuries reduce the degree to which money enhances well-being, people would generally choose insurance coverage that falls far short of the amount needed to restore them to the pre-injury level of welfare.[56]

Similarly, if environmental harms are not readily reversed through monetary expenditure, there will be no compelling rationale for insurance. The same argument applies to environmental injuries that do not hurt humans directly. Millions of Americans may feel that

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55. W. Kip Viscusi & Williams N. Evans, *Utility Functions that Depend on Health Status: Estimates and Economic Implications*, 80 AM. ECON. REV. 353, 354 (1990).

56. More technically, if actuarially fair insurance is available, a rational individual will purchase sufficient insurance so that his marginal utility of income is constant across states. If back pain does not affect the marginal utility of income, then one would not insure at all against an injury causing such pain. Indeed, if back pain prevented one from engaging in an expensive recreation, say skiing, then suffering pain would reduce the marginal utility of income. A rational person would anti-insure, paying in the bad state (back pain) to have more money in the good state (unimpaired).

they are injured because sea turtles will no longer frequent certain areas of the Gulf of Mexico, but these are not the types of losses that can be replaced by paying people for the loss.

Consequently, in the case of environmental harms from oil spills, the emphasis should be on ameliorating the environmental harm to an efficient level rather than compensating the public for the lessened value of the environmental amenity that they experience. The emphasis of current policies on restoration of environmental losses rather than direct payments to the citizenry is well founded.[57] To the extent that there is a deterrence rationale for additional sanctions, such funds should be paid to the U.S. Treasury rather than to any particular parties who experience a loss.

## V. THE CURRENT LIABILITY STRUCTURE: RETROSPECTIVE LIABILITY

Two different law and economics approaches can generate efficient liability regimes from the standpoint of deterrence—payment of the full damages for the harm after the harm has occurred and payment ex ante of an amount equal to the expected loss, which could be thought of as paying the expected value of the externality one is imposing.[58] Ex ante payments are more than hypothetical policy designs. Carbon taxes could be viewed as a way of charging firms for pollution costs ex ante, and regulatory sanctions for violations in situations in which no harm has occurred likewise can similarly serve a prospective deterrence role. Our tiered liability proposal will incorporate a prospective liability component of tax changes for externalities beyond the damages amount that the company can pay. Standard analyses of the deterrence equivalence of the retrospective and prospective liability approaches generally deal with the simple financial loss case, which is a useful starting point for conceptualizing the issues.[59]

Under the conventional retrospective liability approach, payment for all damages leads the injurer to internalize costs and to

57. Determining what level of recovery achieves restoration is not always straightforward because the resources being restored may have been evolving even in the absence of the spill. *See* BP COMM'N REPORT, *supra* note 1, at 212.

58. John W. Pratt & Richard J. Zeckhauser, *Incentive-based Decentralization: Expected-Externality Payment Induced Efficient Behavior in Groups*, *in* ARROW AND THE ASCENT OF MODERN ECONOMIC THEORY 439, 445 (George R. Feiwel ed., 1987).

59. In addition, if the expected loss amounts are equal to the amount of damages, then this formulation also imposes at least an implicit assumption of risk neutrality. If the harm leads to large losses to particular individuals who are risk-averse, then the appropriate measure of losses is the certainty equivalent of the harm.

take appropriate levels of care. This liability system, which follows the usual tort law approach, also generates damages payments that can be used for purposes of compensation, thus serving a dual function.[60] For this approach to be workable, two principal requirements must be met. First, it must be possible to determine the magnitude of the harm. Rarely is this task straightforward for catastrophic losses. For example, there is still no approximate price tag available for the financial and environmental damage caused by the BP *Deepwater Horizon* spill. Second, the injurer must be able to pay the damages. If the defendant has insufficient resources, then the full damages that might be paid will be effectively capped, and deterrence incentives will be insufficient. For that reason, we propose that firms engaged in deepwater drilling in the Gulf of Mexico should have to demonstrate that they have the financial resources to pay for damages equal to the fund created by BP to pay for the BP *Deepwater Horizon* oil spill, that amount being $20 billion. Regulators could require a different demonstrated financial capacity amount depending on the nature and location of a well. What is critical is that the amount be substantial relative to potential damages.

Given the fat tails associated with the distribution of losses from catastrophes, it is frequently impossible or undesirable to limit risky activities solely to firms that can pay any conceivable level of damages. Hence, we recommend below a two-tier liability system for such activities. At the first tier, the responsible party would have to show a significant ability to pay for the likely range of losses through its assets and insurance should there be an accident. For other risky endeavors, a guideline might be the highest previous damages amount for such activities or a calculated estimate of only one chance in one hundred to be exceeded in the next decade.

Estimates of the fat-tailed, loss-distribution function for an activity can provide guidance in conjunction with the annual payment the firm would pay to a federal fund to cover expected losses beyond its financial capacity amount. For example, if government regulators thought that a deepwater well in the Gulf had an annual one in one thousand chance of imposing losses beyond $20 billion, and if the expected magnitude of total losses in such a case were $50 billion, then the well operator would pay $30 million annually into the fund,

60. The tort liability situation is one in which the injured parties are strangers, not customers of the firm. The ability of strict liability to both compensate victims and establish incentives is discussed in SHAVELL, *supra* note 24, at 208–12.

which is (1/1000) × ($50 billion - $20 billion).[61] Both the Clean Water Act[62] and the Oil Pollution Act of 1990[63] ("OPA") include liability provisions pertaining to oil spills. The OPA is the principal federal statute pertaining to the damages caused by oil spills and is the focus of the discussion here. Other federal statutes may also be pertinent depending on the nature and consequences of the spill.[64] The OPA imposes strict, joint and several liability for the damages caused by oil spills.[65] The damages components pertain to financial consequences as well as natural resource damages. In particular, the pertinent damages include removal costs and damages to natural resources, real or personal property, subsistence use, revenues, profits and earning capacity, and public services.[66] Thus, under § 2702(b)(2)(B) of the United States Code, claimants can recover "injury to, or economic losses resulting from destruction of, real or personal property" if the claimant "owns or leases that property."[67] Section 2702(b)(2)(E) addressed other financial losses by permitting "any claimant" to recover "[d]amages equal to the loss of profits or impairment of earning capacity due to the injury, destruction, or loss of real property, personal property, or natural resources."[68] Section 2702(b)(2)(C) addresses damages for the loss or destruction of natural resources.[69]

The total amount of damages is subject to various caps depending on the entity responsible for the spill, such as the type of vessel or whether it was an offshore facility.[70] For oil spills resulting from offshore facilities as in the BP situation, the applicable cap on all

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61. These numbers are purely illustrative. Before an actual scheme is put into effect, considerable work should be done estimating the distribution of potential losses for different activities. Once that is done, a financial capacity floor can be established for each. A higher floor makes compensation more secure and incentives more straightforward. Against those benefits, there is the cost that it significantly limits the pool of firms that could undertake an activity, thus reducing both competition and efficiency.

62. Clean Water Act of 1977, Pub. L. No. 95-217, 91 Stat. 1566 (2006) (codified as amended in scattered sections of 33 U.S.C.).

63. Oil Pollution Act of 1990, Pub. L. No. 101-380, 104 Stat. 484 (2006) (codified as amended in scattered titles and sections of U.S.C.).

64. *See* National Marine Sanctuaries Act of 1972 § 312, 16 U.S.C. § 1443 (2006) (containing liability provisions pertaining to those involved in the operations of hazardous materials, pollutants, or other materials that cause injury to sanctuary resources); Comprehensive Environmental Response, Compensation and Liability Act §107, 42 U.S.C. § 9607 (2006) (same); Trans-Alaska Pipeline Authorization Act of 1973 § 204, 43 U.S.C. § 1653 (2006) (same).

65. 33 U.S.C. § 2702(a) (2006).

66. *Id.* § 2702(b).

67. *Id.* § 2702(b)(2)(B).

68. *Id.* § 2702(b)(2)(E).

69. *Id.* § 2702(b)(2)(C).

70. *Id.* § 2704(a).

damages paid is $75 million.[71] This cap is set at such a paltry level that damages paid will be meaningless for major spills such as the BP *Deepwater Horizon* spill. However, these caps do not apply in situations of gross negligence, willful misconduct, or violation of applicable federal regulations pertaining to safety, construction, or operation.[72] The existence of a massive oil spill could potentially lead jurors to conclude that the company was guilty of gross negligence. Such judgments may be appropriate or may be influenced by hindsight bias, with jurors assuming that the company either knew or should have known that the spill would have occurred given its current practices.[73]

A potentially important damages component pertains to the costs of addressing natural resource damages and any penalties for residual damages amounts. The OPA provides for three different measures of natural resource damages:

> The measure of natural resource damages under section 2702(b)(2)(A) of this title is—
>
> (A) the cost of restoring, rehabilitating, replacing, or acquiring the equivalent of, the damaged natural resources;
>
> (B) the diminution in value of those natural resources pending restoration; plus
>
> (C) the reasonable cost of assessing those damages.[74]

The OPA also provides for some coverage of the losses from a spill. If the responsible party is unable to pay for all the damages, those who have been injured by the spill can apply for reimbursement from the Oil Spill Liability Trust Fund,[75] which provides for damages payments of up to $1 billion per oil-spill incident.[76] The actual harm from the BP spill dwarfed even that larger amount.[77]

The current damages regime for oil spills consequently follows the retrospective liability approach. The company causing the damage

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71. *Id.* § 2704(a)(3).

72. *Id.* § 2704(c)(1).

73. *See* Jeffrey J. Rachlinski, *A Positive Psychological Theory of Judging in Hindsight*, 65 U. CHI. L. REV. 571 (1998) (explaining the hindsight bias in which people overstate the predictability of past events); W. Kip Viscusi, *Do Judges Do Better?*, *in* CASS R. SUNSTEIN ET AL., PUNITIVE DAMAGES: HOW JURIES DECIDE 188 (2002) (explaining the results of an experiment indicating that jury-eligible citizens are more prone to hindsight bias than judges).

74. 33 U.S.C. § 2706(d)(1).

75. *Id.* § 2712(a)(4).

76. 26 U.S.C. § 9509(c)(2) (2006).

77. *See, e.g.*, Ben Lefebvre & Tennille Tracy, *BP Spill Fund Has Paid $5 Billion to Claimants*, WALL ST. J., Aug. 24, 2011, at A2, *available at* http://online.wsj.com/article/SB10001424053111903461304576526711719321414.html (discussing the extent of the monetary damage caused by the BP oil spill).

is responsible for both the financial harm and the environmental damage.[78] Monetary payments to those who have suffered losses are appropriate for financial harm, whereas the OPA favors restoration and remediation to try to bring the resource back to its prespill condition. The OPA caps damages at $75 million except in situations where the company is found guilty of specified infractions, such as regulatory violations and gross negligence.[79] However, in the case of the BP *Deepwater Horizon* spill, BP voluntarily waived this cap but denied gross negligence.[80] This waiver was made under considerable outside pressure. President Obama stated in his address to the nation on the BP spill: "I will . . . inform [the chairman of BP] that he is to set aside whatever resources are required to compensate the workers and business owners who have been harmed as a result of his company's recklessness."[81]

It is noteworthy that BP waived the $75 million cap and agreed to pay billions in damages even though there had been no legal determination that the cap did not bind. However, the prospects for retaining such a cap appeared dim given that President Obama had concluded that the company was guilty of "recklessness."[82] BP also had at stake its corporate reputation and its ability to market its products to U.S. consumers, which might have been affected had it not paid for the harm it imposed. From BP's standpoint, overwhelming political forces swamped traditional economic/legal considerations.

In theory, both strict liability and negligence standards can produce efficient outcomes. We advocate strict liability with the responsible party identified in advance for several reasons. Determining whether a company is negligent requires a difficult assessment of the ex ante benefits and costs of safety, but strict liability has no such informational requirement. The inability to externally monitor deepwater drilling involving multiple contractors also complicates the task of apportioning blame and determining the relative negligence of the different parties. Making the oil-drilling operator responsible puts a large and knowledgeable firm with

78. 33 U.S.C. § 2702(b).

79. *Id.* § 2704(a)(3).

80. Statement of BP Exploration & Production Inc. re Applicability of Limit of Liability under Oil Pollution Act of 1990 at 1–2, *In re* Oil Spill by the Oil Rig "*Deepwater Horizon*" in the Gulf of Mexico, on Apr. 20, 2010, MDL No. 2179 (E.D. La. Oct. 18, 2010), *available at* http://www.laed.uscourts.gov/OilSpill/Orders/BPStatement.pdf.

81. Barack Obama, U.S. President, Remarks by the President to the Nation on the BP Oil Spill (June 15, 2010), *available at* http://www.whitehouse.gov/the-press-office/remarks-president-nation-bp-oil-spill.

82. *Id.*

authority in charge of the safety decisions. The operator can, of course, work out contractual arrangements with the various contractors to shift some of the liability burden. While a negligence standard would reduce the transaction costs of a flurry of lawsuits, major oil spills from deepwater drilling are likely to be relatively infrequent events.[83] The essence of our proposed arrangement is that we should have a single equivalent of a residual claimant (from whom to collect damages) and that this party should be large, knowledgeable, and powerful enough to engage whichever other parties it wishes to carry out its mission. This is the best way to place incentives in the hands of the party that knows the most and that has the greatest ability to control the outcome. Under our proposal, the responsible party in turn can contract with the other companies involved in the drilling and can specify the circumstances under which they will be liable and the amount of this liability. Moreover, the responsible party also will have an incentive to monitor the behavior of the other companies involved. The report by the Coast Guard, which placed substantial blame on Transocean Ltd., which operated the drilling rig, indicated that multiple parties may have been at fault.[84]

Because of the potential contribution to the accident of its drilling contractors, BP filed several lawsuits in an effort to recoup some of the damages it incurred.[85] As one might expect based on the Coast Guard report, BP sued Transocean.[86] Moreover, BP filed a

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83. A traditional contributory negligence approach often involves looking at the behavior of the injured party. Thus, driver A may have been a bit reckless when he crashed into B as he was passing, but B may have wandered into his lane, which would exonerate A. The equivalent in the oil-spill case would be exonerating the operator, because the fisherman should not have set up his operation in a zone close to a deepwater oil well. Such reasoning, if allowed to stand when one party imposes catastrophic risks on many others, would impede a broad range of economic activity. When you buy a house, it should not be your responsibility to assess whether the factory nearby is a fire hazard.

84. *See, e.g.*, John M. Broder, *Companies, Crews, and Regulators Share Blame in Coast Guard Report on Oil Spill*, N.Y. TIMES, Apr. 23, 2011, at A9, *available at* http://www.nytimes.com/2011/04/23/us/23spill.html (discussing the Coast Guard's report on the *Deepwater Horizon* oil spill); Russell Gold & Angel Gonzalez, *Spill Report Faults Transocean Rig*, WALL ST. J., Apr. 23, 2011, at A3, *available at* http://online.wsj.com/article/SB10001424052748703387904576279110653117564.html (discussing Transocean Ltd.'s level of fault in the *Deepwater Horizon* spill according to the Coast Guard report).

85. *See, e.g.*, Lawrence Hurley, *BP Sues 3 Companies Over Alleged Roles in Deepwater Horizon Spill*, GREENWIRE, Apr. 21, 2011, *available at* http://www.eenews.net/public/Greenwire/2011/04/21/1 (explaining BP's decision to sue Transocean Ltd., Halliburton Co., and Cameron International Corp.).

86. *See, e.g.*, Aude Lagorce, *BP Sues Halliburton, Transocean, Cameron*, MARKET WATCH (Apr. 21, 2011), http://www.marketwatch.com/story/bp-sues-halliburton-transocean-cameron-2011-04-21-954390 (discussing BP's filing of lawsuits against Transocean Ltd., Halliburton Co., and Cameron International Corp.).

lawsuit against Cameron International Corp., which manufactured what BP termed a "dangerous" blowout preventer and, in BP's view, was negligent.[87] BP also sued Halliburton, alleging misconduct and fraud.[88] Under our proposal, BP would shoulder the liability but would still be able to sue its partners unless the contracts with the partners absolved them of all liability.

Determining the value of losses is far from a simple accounting exercise. In the case of financial harms, the task is to determine who has been harmed and to what extent. As in standard damages assessments, the task in calculating the loss people have experienced as a result of the spill is to determine the income (or property value) trajectory people would have had if the spill had not occurred, the income path they have experienced to date and are expected to have in the future, and the difference between these. Calculating the compensation appropriate for a given person is complicated by the confounding effects of the prolonged recession that began in 2008. Disentangling the effects of the spill from that of macroeconomic conditions on, for example, hotel revenues would be difficult.

There is the related issue of who should be included in the set of people meriting compensation. How broadly should the compensation be structured? If a hotel has suffered a loss in revenues due to the spill and receives compensation, should all the suppliers to the hotel be compensated as well? Are there geographic boundaries to such compensation? Should these suppliers receive compensation if they are located in different parts of the country? More generally, where should the line be drawn given the ripple effects of economic activity? Our approach under policy proposal number five[89] is to make payment only for the direct effects, recognizing that such payments in turn will generate additional economic activity as well. This approach is the norm in personal injury cases as, for example, after a wrongful death, there is a payment to the survivors for the earnings that the person has lost, but there is no payment to all the stores where the deceased would have spent money.[90]

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87. *See* Russell Gold & Angel Gonzalez, *BP Sues Contractors Transocean, Cameron*, WALL ST. J., Apr. 21, 2011, http://online.wsj.com/article/SB10001424052748703838004576275510607152074.html (discussing BP's negligence claims against Cameron).

88. *See* Guy Chazan, *BP Sues Halliburton Over Gulf Disaster*, WALL ST. J., Apr. 21, 2011, http://online.wsj.com/article/SB10001424052748704071704576276421727774228.html (discussing BP's claims against Halliburton based on allegations of misconduct that contributed to the *Deepwater Horizon* oil spill).

89. *See infra* Table 1.

90. *See* 22 AM. JUR. 2D *Death* § 3 (2011).

A potentially challenging issue is how to treat losses not caused by the spill itself but which were generated by misperceptions about the spill.[91] The spill garnered enormous media attention and was the subject of an Oval Office address by President Obama, who said:

> Already, this oil spill is the worst environmental disaster America has ever faced. And unlike an earthquake or a hurricane, it's not a single event that does damage in a matter of minutes or days. The millions of gallons of oil that have spilled into the Gulf of Mexico are more like an epidemic, one that we will be fighting for months and even years.[92]

Newspapers likewise ran stories suggesting major threats to tourism due to the spill.[93] Coupled with repeated front-page coverage of the spill and its threat to the Gulf beaches, it is not surprising that there was a consumer reaction, including unwarranted responses to inaccurate news coverage that implied that the beaches were far more tarnished than they were.[94] The BP spill led to a substantial drop in tourism at Gulf Coast beaches even for beaches that the spill did not affect.[95] Given the media coverage dramatizing the historic nature of the magnitude of the spill and the forecasts of catastrophic effects, people might well have rationally chosen to act on their misperceptions and alter their vacation plans even though their fears proved to be unfounded. Losses due to loss of consumer confidence are not compensable under current laws, but these are real losses that could potentially be reduced by using credible risk-communication efforts.[96] Given the financial self-interest of the companies responsible for the spill, to be believed, such communication might best be handled by governmental entities.

## VI. WHO SHOULD PAY FOR THE DAMAGES?

As noted above, the current liability regime established by the OPA provides for strict, joint and several liability. However, with a damages cap of $75 million, except in situations such as gross

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91. Compensation for misperceptions would not be covered based on the interpretation by John C.P. Goldberg. John C.P. Goldberg, Liability for Economic Loss in Connection with the *Deepwater Horizon* Spill 9 (Nov. 22, 2010), *available at* http://dash.harvard.edu/bitstream/handle/1/4595438/Report on Economic Loss Liability 11 22 10.pdf.

92. BP COMM'N REPORT, *supra* note 1, at 173.

93. Catharine Skipp, *Florida Worries About Effect on Tourism*, N.Y. TIMES, May 20, 2010, at A18, *available at* http://www.nytimes.com/2010/05/20/science/earth/20tourism.html (discussing the *Deepwater Horizon* oil spill's negative effect on tourism in Florida).

94. BP COMM'N REPORT, *supra* note 1, at 191.

95. *Id.*

96. *Id.* at 278–79.

negligence, the seemingly stringent liability regime is not nearly as stringent as it might appear if implemented literally.[97] Moreover, without a truly meaningful financial-resource requirement imposed on firms that are permitted to undertake deepwater-drilling operations, the actual cap on damages paid would be merely the net worth of the firm plus its insurance, even if the firm is guilty of gross negligence. In some instances, that could be even less than $75 million.

In assessing the appropriateness of the liability regime, the first issue is whether the drilling firms should be subject to strict liability rather than some other legal requirement such as a negligence standard. With a strict liability standard, the oil firm is responsible for all the harm associated with drilling, even if the firm exercises an exemplary level of care. Under a negligence standard, the firm would only be liable if its level of care fell below a reasonable standard of care, such as one that strikes an efficient balance between risk and cost.

A strict liability standard is preferable to a negligence standard for deepwater-drilling operations for several reasons. First, a negligence standard requires both a determination of the standard of care used to judge negligence and a determination of whether the oil firm met that standard. Either of these determinations would be a challenging task. Oil-drilling operations are extremely complex and require considerable specialized expertise—and, even with such expertise, fully understanding the appropriate levels of care is extremely difficult for external observers. Given the information gap between what the company knows and what outside observers can determine, a strict liability standard offers the advantage of overcoming the informational asymmetry problem. With a strict liability standard, only the oil firm need know what the efficient level of care is and whether the firm has met it.

Second, there is a random element to all human behavior that is difficult to predict, and accidents combine that randomness with the uncertainties associated with technologies and nature. The oil company may have adopted sound technologies and training programs for its workers so that from an institutional standpoint its actions are responsible, but nevertheless accidents, sometimes even catastrophic accidents, do occur. As drilling operations proceed and unexpected

97. The OPA in effect treats oil spills in a manner similar to the treatment of hazardous substance sites under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"). *See* 42 U.S.C. § 9601(32) (2006); United States v. Chem-Dyne Corp., 572 F. Supp. 802, 805–11 (S.D. Ohio 1983) (imposing strict, joint, and several liability under CERCLA unless responsible parties can prove the harm is divisible).

complications arise, there may be no existing guidelines for these situations. The Commission's review of the BP spill identified numerous such judgmental errors made under conditions of substantial stress and unanticipated conditions, despite fierce incentives for BP to get things right.[98] A strict liability standard avoids the task of determining whether the company had been negligent in the training, monitoring, and operations procedures.

In the case of the BP oil spill, three major firms were involved in the operations: BP, Halliburton, and Transocean.[99] BP is the largest owner of tracts in the Gulf, as it owns more than 1,500 tracts in areas where the water is deeper than 1,500 feet and owns more than one-third of all the deepwater reserves.[100] It is also the fourth largest petroleum company in the world, with revenues of $297 billion in 2010.[101] Halliburton is an energy products company with substantial oil-drilling activities, with revenues in 2010 of $18 billion.[102] Transocean is the largest contractor of offshore oil rigs in the world, with revenues in 2009 of $11.6 billion.[103] The National Commission identified significant errors made by each of these three companies, where these errors contributed to the likelihood of the spill and the extent of the harm.[104] With eight different principal causes of the accident involving these three companies, sorting out the respective responsibility for the accident would be an impossible task.[105]

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98. BP COMM'N REPORT, *supra* note 1, at 89–129.

99. *See, e.g.*, Lagorce, *supra* note 86 (discussing BP's filing of lawsuits against Transocean Ltd., Halliburton Co., and Cameron International Corp.).

100. BP COMM'N REPORT, *supra* note 1, at 47.

101. *Id.* at 2; BP, FINANCIAL AND OPERATING INFORMATION 2006-2010, at 7 (2011), *available at* http://www.bp.com/liveassets/bp_internet/globalbp/STAGING/global_assets/downloads/F/FOI_2006_2010_full_book.pdf.

102. *Financial Reports: Comparative Highlights*, HALLIBURTON, http://ir.halliburton.com/phoenix.zhtml?c=67605&p=irol-reportsOther (last visited May 16, 2010). For cementing operations alone, Halliburton had $1.7 billion in business in 2009. BP COMM'N REPORT, *supra* note 1, at 224.

103. BP COMM'N REPORT, *supra* note 1, at 2.

104. *Id.* at 115–22.

105. BP, *DEEPWATER HORIZON* ACCIDENT INVESTIGATION REPORT 4–6 (2010), *available at* http://www.bp.com/liveassets/bp_internet/globalbp_uk_english/incident_response/STAGING/local_assets/downloads_pdfs/Deepwater_Horizon_Accident_Investigation_Report.pdf; *see also* DONALD C. WINTER, NAT'L ACAD. OF ENG'G & NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., INTERIM REPORT ON CAUSES OF THE *DEEPWATER HORIZON* OIL RIG BLOWOUT AND WAYS TO PREVENT SUCH EVENTS (2010), *available at* http://www.nationalacademies.org/includes/DH_Interim_Report_final.pdf. Sometimes, even if the production function for the accident were fully known, the task is logically impossible. Consider two extreme cases: (1) each firm alone could have avoided the accident, and (2) given the actions by the other two firms, no firm alone could have prevented the accident. For either case, apportioning blame would not be possible.

Imposing a strict liability standard with the oil-drilling firm being responsible for all losses eliminates the daunting task of calculating the extent to which negligence by each of these companies contributed to the damage.

The responsibility for a spill involving multiple parties can be allocated in various ways. The approach under the OPA is to impose joint and several liability. If the oil firm's resources are insufficient to pay for the damages, the other firms involved in the operation are liable for any excess. With a $75 million damages cap, the joint and several aspect imposes little deterrent on a highly expensive project, such as a deepwater well, except to avoid situations involving gross negligence, in which case the cap would no longer apply.

An efficient economic solution is to make all firms involved liable for the full costs of an oil spill so that each firm when making its safety decisions would take into account the full value of the losses that will occur should there be an accident. Such an approach is not appropriate in practice because it will lead to total payments well in excess of damages. Moreover, assuming full liability will discourage subcontractors from being involved in the drilling operation. Furthermore, participating firms, who together would be paying much more than the actual costs should an accident occur, would have an incentive to collude to produce excess safety. Such an excess would inhibit beneficial economic activity.

Our proposal for determining how payment should be made for an oil spill has four separate components. Our policy proposal number five specifies that there should be no cap on damages payments. The current $75 million cap, except in situations such as gross negligence, makes the responsible firm liable for only a small portion of the damage from any major spill. In order to generate the appropriate incentives for care in a strict liability regime, the oil-drilling firm must be responsible for all the harm that its actions generate.

Removal of the damages cap, or indeed any measure that leads to an increase in expected damages paid after an accident, could lead small firms with limited financial resources to engage in the activity. They would be able to effectively cap their damages by being unable to pay them. To avoid the problems associated with insolvency, we propose a requirement that the oil company demonstrate financial resources or adequate insurance sufficient to pay for most possible harms before being allowed to drill (our policy proposal number four). Current financial requirements, which are on the order of $35 million to $150 million for different offshore facilities, are more than two orders of magnitude below the kind of worst-case scenario that did in

fact occur with the BP oil spill.[106] More typically, the amount is between $10 million and $35 million depending on the facility,[107] where the President under current law can increase the amount up to $150 million.[108] To ensure protection, the government should dramatically strengthen the financial resource requirements.

Imposing such a resource requirement will prevent many small businesses from being able to engage in deepwater drilling, which is a development that is of concern to small-business advocates and has led to political opposition to raising the cap.[109] However, in our view there is no sound rationale for permitting firms to engage in activities that threaten the risk of catastrophic harms that will not be addressed. Moreover, if small firms are permitted to operate in such an environment, with the ability to escape most of the ultimate costs of their actions, these firms will have little economic incentive to incorporate the costs of potential risky outcomes when making their safety decisions. The result will be inadequate levels of care.[110]

Our policy proposals one and two replace the current OPA joint and several liability provision and place full liability on the oil company that owns the lease. Thus, rather than requiring that all companies involved in the drilling operation demonstrate adequate financial resources (including contracted-for payment from others and insurance) to cover potential damages, this requirement would only be imposed on the well operator.

Given the structure of our proposal, imposing this liability will also create substantial incentives for the company to monitor the safety-related decisions of its drilling partners and to influence those decisions through contractual arrangements should those partners contribute to an accident. A consistent theme of the President's Commission report is that assessment of the safety practices and

106. BP COMM'N REPORT, *supra* note 1, at 283. Economic losses for the spill are estimated at tens of billions of dollars. *Id.* at vi.

107. 33 U.S.C. § 2716(c)(1)(B) (2006).

108. *Id.* § 2716(c)(1)(C) (upon determination by the president that the liability is greater than the amount provided in § 2716(c)(1)(B), the party shall be liable "for an amount determined by the President not exceeding $150,000,000").

109. There may, however, be possible insurance options that would enable smaller firms to operate. *See* BP COMM'N REPORT, *supra* note 1, at 246 (discussing several insurance alternatives to self-insurance against major accidents). However, note that the possibility of obtaining insurance coverage may be reduced if all liability caps are removed.

110. An alternative would be to fully regulate their activities to assure an appropriate standard of care. We argue throughout that information asymmetries make incentives rather than regulation the preferred manner for dealing with offshore-drilling risks. Moreover, even with appropriate standards of care, accidents will happen. With small operators, desirable compensation would not be available.

technologies requires highly specialized expertise that the government currently does not have and is unlikely to ever develop because people with that expertise are highly paid, well above levels in the government pay range. As a fallback solution, the Commission suggests various alternatives such as, in effect, borrowing the talent by using an approach patterned after that employed by the Nuclear Regulatory Commission. But even if the government is successful in devising a makeshift administrative solution to assembling the requisite talent, that will only be available for reviews of continuing safety practices and actual disasters. However, the myriad decisions that the Commission identified as contributing to the BP oil spill for the most part were well beyond standard operating procedures. Responsibility for monitoring should be the primary task for the oil company operating the well, the responsible party, which has both the superior technical expertise and the on-the-field knowledge to better promote safety than do government regulators.

Deepwater-drilling operations are complex and, by necessity, may involve multiple companies bringing their distinctive expertise. Under our proposed damages regime, which makes the oil company fully responsible for the damages, there would be a disincentive to partner with others if the responsible company did not expect others' safety decisions to reflect appropriate care. Even in the case of the BP oil spill, BP operated the well and was best situated to monitor safety-related actions as well as the activities of its two main contractors, Halliburton and Transocean.[111] Our policy proposal number one addresses this issue. The oil company is the responsible party in the first place. However, it can establish a liability structure of its own, defining the circumstances under which its drilling partners would be responsible for damages and the level of these damages payments should a spill occur, depending on how the parties performed, and so forth. Thus, the oil firm and the drilling partners can agree to contractual arrangements that ensure that the oil firm will receive appropriate compensation for any financial harms attributable to its drilling partners. It will be the responsibility of the oil company to ascertain whether its collaborators have adequate financial resources and/or insurance, since the failure of these companies to reimburse the oil company for damages will not reduce the oil company's liability.

111. BP COMM'N REPORT, *supra* note 1, at 223.

## VII. PUNITIVE DAMAGES

Our proposed liability regime eliminates any productive role for punitive damages. Thus, under our proposal number five, which can be found in Table 1, firms should bear no punitive damages. Unlike the current liability structure, which caps damages at $75 million except under circumstances that closely follow criteria for punitive damages (such as "gross negligence"),[112] our proposal number five removes any damages cap. The responsible firm is liable for all damages that are incurred. This structure establishes incentives both sufficient and efficient from the standpoint of deterrence as well as appropriate levels of insurance. Eliminating the possibility of punitive damages has precedent; the Price-Anderson Act has done precisely this for nuclear power.[113]

Consider first the adequacy of deterrence if punitive damages are eliminated. In situations where damages amounts are set equal to the level of the harm, such amounts will establish efficient levels of deterrence except when the probability of detection is below 1.0.[114] However, catastrophic oil spills are paradigmatic cases of highly visible harms. Unlike midnight dumping of hazardous wastes, where the likelihood that a perpetrator will escape detection makes punitive damages desirable as a way to multiply damages, a catastrophic spill is sure to be noticed and its origin identified.

Punitive damages likewise have no constructive role from the standpoint of compensation. The insurable losses associated with financial harms are included in the required compensatory damages payments for which the oil firm is liable. The firm is required to undertake all appropriate remediation efforts for environmental harms because money is not a suitable substitute. For any shortfalls of or delays in the remediation, the firm is liable for the remaining

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112. 33 U.S.C. § 2704(a)(1)(3) (2006).

113. Price-Anderson Act, 42 U.S.C. § 2210(s) (2006). Although the Price-Anderson Act does not establish liability equivalent to our proposal, it does require private insurance by the owner of $375 million coupled with contributions to a separate fund so that total recoverable damages are $11.975 billion. U.S. NUCLEAR REGULATORY COMM'N, FACT SHEET: NUCLEAR INSURANCE AND DISASTER RELIEF FUNDS 1 (2011), *available at* http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/funds-fs.pdf.

114. This result, which dates back to the work of Jeremy Bentham, is presented in A. Mitchell Polinsky & Steven Shavell, *Punitive Damages: An Economic Analysis*, 111 HARV. L. REV. 869, 887–96 (1998). For efficient deterrence, when the probability of detection falls below 1, the damages paid should be $D/p, where $D is the level of damages and p is the probability of detection. *Id.*

natural resource damages. Because there are no gaps in the damages payment structure, there is no need for punitive damages.

Missing from this discussion is the possible role of punitive damages from the standpoint of punishment, above and beyond its deterrent or compensatory role. Given the much more stringent liability system that we have proposed, firms will already be punished much more than they presently are under the current liability system, since they will not enjoy any damages cap and will be required to have the financial resources to pay very large damages claims.

Our proposal eliminates the severe risk of the misapplication of punitive damages as a form of punishment for catastrophic environmental harms. To the extent that jurors evaluate behavior by the level of the incurred harm rather than by whether firms have struck an efficient balance between risk and cost, there will be a tendency to award punitive damages for major oil spills irrespective of whether the company has struck that balance appropriately.[115] Our proposal eliminates the risk of erroneous jury judgments, establishes a liability structure that provides strong incentives for prudence while also securing damages payments for most accidents, and raises a tax fund that could be used for payments in case of catastrophic losses.

## VIII. PROSPECTIVE LIABILITY AND GOVERNMENT REGULATION

Recognizing that not all companies have sufficiently deep pockets, one might instead adopt the prospective liability approach in which companies pay in advance for the expected losses that their activities might inflict. Indeed, the tax on the noncompensable risk component of our proposal adopts this framework. The building blocks for this analysis are different and much more demanding than those of retrospective liability. Instead of knowing the magnitude of the harm that has actually occurred, for the prospective liability approach to be workable, one must be able to ascertain the distribution of possible harms that might occur and the probabilities associated with their different levels of damages. In particular, for unpredicted risks with a fat-tailed distribution, precise judgments of this type are difficult to make.[116] The informational requirements of a prospective liability

115. *See* W. Kip Viscusi, *Corporate Risk Analysis: A Reckless Act?*, 52 STAN. L. REV. 547, 563 (2000) ("Instead of comparing expected benefits and costs, jurors may compare the enormous cost to the victim with the relatively negligible cost of the safety improvement.").

116. *See* Daniel A. Farber, *Uncertainty*, 99 GEO. L.J. 901, 926–27 (2011) ("The reason that the probabilities are difficult to estimate is that data will rarely include instances from the tail

regime, and the potential for error, exceed the informational requirements associated with retrospective liability, which is why we use retrospective liability of the responsible party as our core incentive mechanism.

The main advantage of prospective liability is that by scaling down the payments to the expected losses rather than the actual losses inflicted, paying the costs will become feasible for a broader population of firms. More companies will pay for the expected prospective damages, including those that do not experience any adverse events, thus creating incentives to foster safe drilling operations. The main ingredient that is missing when compared to the usual retrospective liability solution is that the prospective penalties are not linked to any payment by the responsible firm to those who have suffered the harm.

Although the prospective liability approach need not entail such compensation, it could do so by placing the expected liability cost payments in a compensation fund not unlike the current Oil Liability Trust Fund. In the long run, if charges were appropriately tallied, such a fund should be able to address the losses incurred provided that the risks and losses are assessed accurately and a major disaster does not occur before adequate resources have been accumulated in such a fund. Moreover, unlike the retrospective liability situation, damages would not be limited by the risk of insolvency.[117] Our proposed two-tier liability system would rely on payments by the responsible firm to cover damages, with the money raised by the tax only used for compensation for damages exceeding the firm's financial resources.

Under our proposal, despite its strong focus on liability and incentives, government regulations will still have a continuing, albeit altered, role. Indeed, regulation will be expanded in the area of ascertaining whether all companies engaged in deepwater drilling have adequate financial resources to be engaged in such dangerous activities. However, in recognition of the inability of regulators to determine and monitor efficient levels of safety, we rely on incentives created by liability to achieve that goal. Thus, the principal regulatory task is not with respect to assessing safety practices and technologies

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(because the events are rare), making it impossible to estimate just how quickly the tail tapers off.").

117. Many such schemes, such as the Pension Benefits Guaranty Corporation, tend to collect far below the actuarial value of the costs imposed. Such deficits occur because we do not properly recognize fat tails, which add substantially to expected losses.

but rather determining the financial capability of the firm operating the well.

Government regulators also will continue to have responsibility for establishing broad safety standards, as under the current regulatory regime. Note that to separate the regulatory oversight, management, and revenue functions, the Department of the Interior had to alter its organizational structure after the spill. The Minerals Management Service was reorganized into three separate entities with distinct missions: the Bureau of Ocean Energy Management, Regulation, and Enforcement; the Bureau of Safety and Environmental Enforcement; and the Office of Natural Resources Revenue.[118] Consistent with the conclusions of the Commission, these activities could be bolstered based on what has been learned about institutional shortcomings from the BP oil spill. However, unlike the Commission, we are much less sanguine about the ultimate ability of government regulators to fully address the safety concerns involved in offshore drilling or to address a range of other advanced technology tasks that have the potential to impose major risks. Government regulators failed at the oversight task for the BP spill, and there is no reason to believe that they will have the capability to control safety-related decisions adequately, which is why we have established a liability structure that makes the oil company responsible for ensuring well safety. Moreover, while the regulators can levy civil and criminal penalties for various infractions, these penalties create only modest financial incentives. The U.S. Department of the Interior levied only $919,000 in penalties in 2009 and $2,073,000 in 2010.[119]

An inherent drawback of government regulation is that government salaries for professionally qualified personnel, such as engineers, are unlikely to attract workers with the requisite skill

118. COUNCIL ON ENVTL. QUALITY, REPORT REGARDING THE MINERALS MANAGEMENT SERVICE'S NATIONAL ENVIRONMENTAL POLICY ACT POLICIES, PRACTICES, AND PROCEDURES AS THEY RELATE TO OUTER CONTINENTAL SHELF OIL AND GAS EXPLORATION AND DEVELOPMENT 1–2 (2010) [hereinafter CEQ REPORT], *available at* http://ceq.hss.doe.gov/current_developments/docs/CEQ_Report_Reviewing_MMS_OCS_NEPA_Implementation.pdf; *see also* Press Release, U.S. Department of the Interior, Salazar Divides MMS's Three Conflicting Missions (May 19, 2010), *available at* http://www.doi.gov/news/pressreleases/Salazar-Divides-MMSs-Three-Conflicting-MIssions.cfm; Secretary of the Interior, Establishment of the Bureau of Ocean Energy Management, the Bureau of Safety and Environmental Enforcement, and the Office of Natural Resources Revenue, No. 3299 (May 19, 2010), http://elips.doi.gov/app_so/act_getfiles.cfm?order_number=3299A1 (ordering the establishment of three new agencies).

119. For a list of penalties paid, see *OCS Civil/Criminal Penalties*, BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION, AND ENFORCEMENT, http://www.boemre.gov/civilpenalties/ (last visited Sept. 1, 2010).

levels to undertake the required tasks effectively.[120] Government regulators previously responsible for oversight fell short in terms of their technical expertise.[121] This deficiency is unlikely to be remedied in the future, as pay rates for those working on the rigs, including those in management positions, run well into the six figures.[122] Raising salaries can boost personnel quality modestly, but the federal pay scale at the top is far from sufficient to attract the kinds of workers necessary to improve oversight of deepwater wells.[123] The talent deficiency is sufficient to ensure that primary responsibility for securing safety should not be through regulatory controls. Moreover, even if there were government expertise, there is a profound informational asymmetry in favor of the operator, who has far greater knowledge of its technologies, operations, and procedures. For these reasons, our proposals shift the preponderance of the responsibility for safety to the oil-drilling company.

Why is deepwater drilling a special case in which government regulation is inadequate given that the government is able to regulate other activities, such as those generating air pollution and water pollution, that impinge on the environment? Deepwater drilling is hardly the only such technologically sophisticated industrial activity. However, most other environmental regulatory tasks differ in important aspects. Monitoring emissions and wastewater discharges can be done on a continuing basis, where any particular emission or discharge has only a minor relative impact. Government regulators likewise are able to monitor whether an oil-spill disaster has occurred, but the stakes are quite different, and the opportunity for learning is much less, when dealing with a one-time-only situation of catastrophic environmental harm.

Generally, government regulators can obtain and utilize information regarding safety-related behavior in order to target its regulatory energies reasonably effectively. One approach is to monitor minor mishaps, smaller spills, and accidents that suggest a lax corporate culture and to use such performance records in choosing which facilities warrant greater scrutiny. In this context, BP had a troubled record of safety violations, including an oil-refinery explosion

120. *See* JOHN DONAHUE, THE WARPING OF GOVERNMENT WORK 89–91 (2008) ("These [salary] disparities make it hard for government to get, or to keep, the very best people . . . .").

121. BP COMM'N REPORT, *supra* note 1, at 57.

122. *Id.* at 3.

123. *See id.* at 79, 258 (stating that the federal pay scale is too low to attract workers qualified to oversee the drilling and recommending use of the salary scale used by the Nuclear Regulatory Commission).

that killed fifteen workers in Texas, a major spill in Alaska due to a corroded pipeline, and a lengthy history of safety management problems.[124] That BP also had a major oil spill is not a one-time adverse event that tarnishes an otherwise exemplary safety record.

## IX. PROCEDURES FOR COMPENSATORY DAMAGES PAYMENTS

An administrative compensation scheme has and will conduct much of the payment of financial compensation after the BP oil spill. After negotiations with President Obama, BP established a $20 billion fund for damages.[125] As of May 12, 2011, the fund had paid out $4.51 billion to individuals and businesses and $1.27 billion to government entities.[126] The Gulf Coast Claims Facility handles payments to individuals and businesses,[127] while governmental claims are handled separately.[128] This fund approach provided payments to those who suffered financial loss faster than if people had to file individual lawsuits, though many claims are still being processed.[129]

The operation of the Gulf Coast Claims Facility, which is administered by Kenneth Feinberg, has been as follows: Participation in the program is voluntary, as people could choose to file a damages claim without availing themselves of the administrative compensation structure. The criterion for receiving payment involves demonstrating a financial loss from the BP spill.[130] The particular categories of covered loss parallel those under the OPA and include claims for "removal and clean up costs, damage to real or personal property, lost earnings or profits, loss of subsistence use of natural resources, or physical injury or death."[131] The fund does not cover nonfinancial

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124. *Id.* at 2, 221.

125. *Id.* at 185.

126. BP, CLAIMS AND GOVERNMENT PAYMENTS: GULF OF MEXICO OIL SPILL, PUBLIC REPORT—5/12/2011 (2011), *available at* http://responsedata.bp.com/files/PublicClaimsStatus Tracking05122011.pdf.

127. Claims by individuals and businesses can be filed at http://www.gulfcoastclaimsfacility .com/index.

128. Government claims are filed at http://www.bp.com/governmentclaim.

129. *See* BP COMM'N REPORT, *supra* note 1, at 185 ("In its first eight weeks of operation, as of November 23, [2010,] the independently administered Gulf Coast Claims Facility had paid out more than $2 billion to approximately 127,000 claimants.").

130. *Id.* at 287 ("Eligible claims include: (1) removal and clean-up costs; (2) physical damages to real or personal property; (3) lost profits or impairment of earning capacity; (4) loss of subsistence use of natural resources; and (5) physical injury or death.").

131. *Frequently Asked Questions* § 7, GULF COAST CLAIMS FACILITY, http://www. gulfcoastclaimsfacility.com/faq (last visited May 16, 2010). Compensation for injury and death is not included under the OPA. 33 U.S.C. § 2702(b) (2006).

harms, such as mental anguish and stress resulting from the spill.[132] In addition, the fund reimbursed governmental costs such as the costs incurred by Louisiana and Florida for seafood testing.[133] For any compensation system, there will always be questions about whether the calculations of the losses were accurate and whether the compensation addressed all pertinent losses and only pertinent losses. Overall, this compensation fund approach performed reasonably well in terms of providing appropriate compensation according to the insurance principles advocated above.

## X. NATURAL RESOURCE DAMAGES

The BP oil spill in the Gulf of Mexico is the largest offshore oil spill in U.S. history, and one of the largest oil spills ever recorded. Costs associated with stopping the spill, cleanup of the damages it caused, financial losses imposed on businesses and workers, remediation of natural resource damages, and compensation for natural resource damages are among the prominent loss components. The degree to which the responsible parties should clean up the spill and undertake remediation efforts should depend on the benefits derived from those efforts and the costs of doing them. Under our proposal number six, which is located in Table 1, the emphasis should be on remediation. However, remediation should only be carried out where and to the extent that benefits exceed the costs. A natural resource damages assessment can be used to assess these benefits and to determine the value of lost resources that are not remediated.

Damaged natural resources have multiple dimensions. The identified wildlife that were harmed include "8,183 birds, 1,144 sea turtles, and 109 marine mammals affected by the spill—alive or dead, visibly oiled or not."[134] There is also potential harm to fish due to oiling of seaweed, which imposes risks on mahi mahi, billfish, and cobia.[135] Other fish potentially harmed include the bluefin tuna, the Gulf sturgeon, and several species of shark.[136] Offshore birds, such as royal terns and gulls, and open-water, near-shore and marsh birds

132. *See* GULF COAST CLAIMS FACILITY, *supra* note 131, § 10 ("An injury that relates to emotional or mental health . . . is not an eligible claim.").

133. BP COMM'N REPORT, *supra* note 1, at 188.

134. *Id.* at 181.

135. RAY MABUS, SEC. OF THE NAVY, AMERICA'S GULF COAST: A LONG TERM RECOVERY PLAN AFTER THE *DEEPWATER HORIZON* OIL SPILL 28–29 (2010), *available at* http://www.restorethegulf.gov/sites/default/files/documents/pdf/gulf-recovery-sep-2010.pdf.

136. *Id.*

might have been affected if their feeding grounds became oiled.[137] Some oil reached 650 miles of Gulf coastal habitats, with 130 miles categorized as moderately or heavily oiled.[138] The oil also poses longer-term risks to marine habitats, wetlands, corals, and other habitats.[139] Any damage to beaches, marshes, and the ecology of the Gulf and affected marshes would also be included under the natural resource damages heading, as would any effects on recreational activities such as fishing and swimming.

The debate over putting a price tag on natural resource damages that are not remediated achieved prominence after the 1989 *Exxon Valdez* oil spill ("EVOS"), which was the largest U.S. coastal oil spill to that time. The plaintiffs in the EVOS litigation prepared assessments of the natural resource damages loss to citizens based on surveys of the public's valuation of damages.[140] These surveys were subjected to a variety of strident critiques in the academic literature, many of which were based on studies funded by Exxon. As a result of this controversy over methodology, the National Oceanic and Atmospheric Administration commissioned an expert panel to develop guidelines for the use of surveys to value natural resource damages.[141]

There are three natural resource damages components pertaining to the environmental loss that the citizenry has experienced. The first damages category pertains to the cost the party responsible for the oil spill must incur. Restoration efforts may involve cleaning up beaches and other efforts to restore the environment to the prespill condition. The company responsible for the spill will incur many of the costs directly, as demonstrated by Exxon's efforts to clean up the Prince William Sound area after the EVOS.[142] Estimates of the restoration costs associated with the BP oil spill are in the range of $15 billion to $20 billion.[143] The third component of damages consists

137. *See Affected Gulf Resources: NOAA Gulf Spill Restoration*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., U.S. DEP'T OF COMMERCE, http://www.gulfspillrestoration.noaa.gov/oil-spill/affected-gulf-resources/ (last visited Sept. 3, 2011) (noting that the presence of discharged oil in the environment may cause decreased "habitat" and that such "birds depend on healthy habitats to provide food, shelter, and breeding grounds").

138. BP COMM'N REPORT, *supra* note 1, at 175–77.

139. *See* MABUS, *supra* note 135, at 28–29 (noting that the "long-term effects of oil on these habitats have yet to be determined").

140. Richard T. Carson, et al., *Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill*, 25 ENVTL. & RESOURCE ECON. 257, 259–60 (2003).

141. Advance Notice of Proposed Rulemaking, Natural Resource Damage Assessments Under the Oil Pollution Act of 1990, 58 Fed. Reg. 4601 (Jan. 15, 1993).

142. *Questions and Answers*, EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL, http://www.evostc.state.ak.us/facts/qanda.cfm (last visited Sept. 3, 2011).

143. BP COMM'N REPORT, *supra* note 1, at 279.

of the cost of damages assessment, which one would expect to be a minor component relative to other damages associated with oil spills of the magnitude of the BP spill.

Economists' studies of natural resource damages assessments have focused on the second natural resources damages component, which pertains to the losses that occur from the time of the oil spill until the natural resources have been fully restored. A variety of natural actions can ameliorate natural resource damages, as Gulf-based, methane-eating bacteria did with the BP spill.[144] Beyond natural recovery, there could be removal of oil at the sites, restoration of natural resources, and either off-site replacement of the resource or provision of equivalent natural resources that substitute for the loss.[145]

Should the environment not be fully restored, or if there is a temporary natural resource damages loss before full restoration, then there is a natural resource damages component meriting compensation. We propose that the government should receive such compensation for two reasons. First, as indicated above in the discussion of optimal insurance, environmental losses are not the kinds of harms for which people would purchase insurance and for which monetary payments can substitute. Second, because the nation owns the resources on the outer continental shelf, payments made to the government will correspond with compensating the resource owner.[146]

Let us consider the value of damages after the level of cleanup and restoration has been determined and completed. What is the value of the damages that remain? How should we conceptualize losses? The reference point for determining the baseline situation from which all damages are assessed is analogous to the approach used in other damages contexts, which is to inquire what the situation would have been "but for" the wrongful conduct. Thus, the analysis starts by computing the trajectory over time of the value that the natural resources would have had absent the spill. It then computes the drop in the value of the natural resource from the time of the spill until full restoration of the loss occurs, which may never happen. The loss at any point of time is the decrease in the value of the natural resources,

144. John D. Kessler et al., *A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico*, 331 SCIENCE 312, 312 (2011).

145. For a description of these, see Carol Adaire Jones, *Compensation for Natural Resource Damages from Oil Spills: A Comparison of US Law and International Conventions*, 11 INT'L J. ENV'T & POLLUTION 86 (1999).

146. BP COMM'N REPORT, *supra* note 1, at 57.

and the total loss consists of the total value of these per-period losses from the time of the spill forward. Such assessments may be complicated by unrelated ongoing environmental deterioration as, for example, Louisiana has lost two-thousand square miles of wetlands since the 1930s.[147]

As is standard in economic damages contexts, once losses that occur at different points in time have been determined, the value of those losses must be discounted to, or brought back to, present value using a reasonable rate of interest.[148] Because of the role of discounting, even losses that may never be fully restored will nevertheless have a finite value provided that the losses are not increasing over time at a rate exceeding the rate of discount.[149]

Conceptualizing the damages in terms of trajectories highlights the dynamic nature of the damages assessment. What is at issue is not simply the initial loss in natural resources, but also how fast the natural resources will recover and to what extent. Thus, the valuation process must, by necessity, take reductions in loss over time into account. If, for example, some birds die, these losses are real even if ultimately the population will recover fully. However, the speed of recovery and the ultimate well-being of the bird population are also consequential, further complicating the assessment of the environmental damage. Sometimes, of course, losses compound over time, and equivalent procedures looking at future consequences are required.

The different benefit components can be categorized in terms of the services associated with them where the breakdowns may involve a mix of components, some that have market price analogs and others that do not.[150] Commercial/productive services pertain largely to financial components associated with natural resource damages, such as effects on agricultural irrigation, municipal drinking water, and commercial fishing. In most instances, such losses will have either a

147. MABUS, *supra* note 135, at 26.

148. Thus, if the interest rate is r, then the present value of $1 in losses one year from now is 1/(1+r). Losses from the past should receive compound interest from the time of loss. Although the appropriate rate of discount and interest remains a matter of economic debate, the U.S. Office of Management and Budget's guidelines for U.S. regulatory policies specify the use of discount rates of 3% and 7%. The 3% rate is much closer to current rates of return on U.S. Treasury bills and bonds.

149. Thus, if losses were growing at a rate g > r, then the present value of losses next year would be (1+g)/(1+r), which would be greater than 1. Should such a pattern continue with losses growing indefinitely faster than the rate of interest, losses would be infinite.

150. For a detailed discussion of the OPA process for resource compensation, see Jones, *supra* note 145, at 96.

market price or information on the impact on corporate profitability. Consequently, they can be linked directly to some kind of market-based effect. Such market-related benefit components are not the focus of our analysis as they should be relatively less problematic than calculating losses for which no market guidance is available.

Other services categories often involve nonmarket effects that make benefit assessment more difficult. Recreational and aesthetic damages pertain to using beaches, swimming, and fishing, and include activities, such as bird watching. Ecological consequences include nutrient cycling and the well-being of fish apart from their commercial or recreational value. There may also be cultural or historical uses of resources. Finally, there is a category known as passive use, which is sometimes referred to as nonuse. Even if people do not directly use the resource, they may nevertheless value it, perhaps because of a concern with scarce species or with the maintenance of the natural resource for future generations. Closely related to passive use is the concept of option values: people may not currently use the resource or have any concrete plans to do so, but nevertheless they may value retaining the resource to keep open the possibility of using it at some future date.[151]

The natural resources damages value that is lost to the citizenry is the monetary compensation needed to restore its members' welfare to their prespill level.[152] This principle is in line with the "make whole" approach to compensation for injury. The practical problem is establishing this value.

In economic terms, we can view the value of required compensation as a willingness-to-accept ("WTA") amount. Thus, WTA measures how much money is required to compensate an individual for the value of a loss if the objective is to restore that person's welfare to what it would have been in the absence of the harm. A closely related concept is willingness to pay ("WTP"), the amount that a person would be willing to pay to prevent the harm from occurring. The legal framing of compensation is in terms of the WTA amount. For minor effects on one's welfare, the WTP amount should equal the WTA amount.[153]

Notwithstanding their theoretical similarity and approximate equivalence, there are important gaps observed in practice between

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151. Option value is what an economist would label discounted expected consumer surplus.

152. The monetary compensation principle for natural resource damages is articulated in 43 C.F.R. § 11.83 (2010) and *Ohio v. U.S. Dep't of the Interior*, 880 F.2d 432, 464 (D.C. Cir. 1989).

153. In particular, the discrepancy arises due to income effects, as willingness-to-pay values involves a depletion of one's financial resources and willingness-to-accept amounts augment one's resources through compensation.

the values for WTA and WTP. In particular, WTA values often dwarf the values for WTP by much more than economic theory would have reasonably predicted.[154] Based on a review of the literature including both survey and experimental studies, the average discrepancy across studies between the mean WTA value and the mean WTP value is a ratio of 7.17.[155] However, the gap is much greater for public or nonmarket goods such as those involving environmental damages, as the mean ratio of WTA to WTP is 10.41 for such goods.[156] Unfamiliar goods that are not ordinary private goods that the person might purchase tend to generate high ratios.[157] Thus, even though WTA and WTP should be similar, they often differ by an order of magnitude for the types of commodities involved in natural resource damages cases.

This enormous discrepancy, though at odds with conventional economic theory, is consistent with a phenomenon well known in the behavioral decision literature as the endowment effect.[158] In particular, there is a surprising asymmetry between the WTA and WTP values that arises once people possess a good, even for easily replaced goods such as coffee mugs and pens that have been the objects of experimental studies. Such effects indicate the important role of reference points in affecting decisions.[159] Framing choices in terms of a loss from one's status quo position generates quite different and often implausibly large valuations when compared to valuing improvements from the current starting point.

## XI. CONCLUSION

The BP oil spill highlighted fundamental safety problems with deepwater drilling that led to a catastrophic accident.[160] Alas, we should not think of this accident as an aberrant occurrence, but rather as an outcome that must be expected on occasion given the incentives

154. For a review, see John K. Horowitz & Kenneth E. McConnell, *A Review of WTA/WTP Studies*, 44 J. ENVTL. ECON. & MGMT. 426 (2002).

155. *Id.* at 432 tbl.II.A.

156. *Id.* at 433 tbl.III.A.

157. *Id.* at 442.

158. Daniel Kahneman, Jack L. Knetsch & Richard H. Thaler, *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1325 (1990).

159. Alistair Munro & Robert Sugden, *On the Theory of Reference-Dependent Preferences*, 50 J. ECON. BEHAV. & ORG. 407 (2003).

160. The chief executive of BP, Robert Dudley, observed, "I think it would be a mistake to dismiss our experience of the last year simply as a 'black swan,' a one-in-a-million occurrence that carries no wider application for our industry as a whole." Clifford Krauss, *BP Chief Says Industry Must Change to Guard Against Spills*, N.Y. TIMES, Mar. 9, 2011, at B9, *available at* http://www.nytimes.com/2011/03/09/business/energy-environment/09bp.html.

operating with the current regulatory and liability regime. Examining those incentives, and creating a superior regime for the future, is the principal goal of this Article.

The task is critical. To be sure, in response to the spill, one would expect companies to become more diligent and government regulators to become more vigilant. However, with 3,754 deepwater wells already drilled and more pending, there will be a substantial number of additional opportunities for environmental disasters.[161] Although the BP spill was the largest U.S. spill in offshore waters, from 1996 to 2009 there were seventy-nine other reported loss-of-well-control accidents involving uncontrolled hydrocarbon flows.[162]

In our view, the policy changes undertaken to date are far from sufficient. The BP spill sends a clear message that our current liability structure is woefully inadequate. Had the spill not involved a major international oil company with exceptionally deep pockets and had the environmental harm not been much less than could have occurred, the BP oil spill catastrophe would have been much more devastating.

Our package of policy reforms summarized in Table 1 imposes strict liability on the oil-drilling company in addition to requiring proof of substantial financial resources to address potential harms. Under our scheme, operators must be of a sufficient scale, or otherwise purchase insurance or post bonds, to ensure that they could cover losses in almost all situations in which there is a spill. We pointed out, however, that losses from a spill have a fat-tailed distribution and that even with our reform proposal there is a small chance of a spill imposing costs well beyond such amounts. If the expected costs associated with such "excess losses" were minor relative to overall expected costs, this would not be a concern. However, given the fat-tailed nature of the losses, they may in fact comprise a significant portion. In other words, the very small percentage of extremely large spills may account for a meaningful proportion of overall expected costs. For example, the BP spill is an outlier in the upper tail of the distribution of losses from drilling operations in the United States over the course of the nation's history.

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161. This count is for wells drilled at depths of more than 1,000 feet. *See* CEQ REPORT, *supra* note 118, at 14 n.36 (summarizing the history of drilling oil and gas wells in the Gulf of Mexico); *see also Offshore Statistics by Water Depth*, BUREAU OF OCEAN ENERGY, MGMT. & ENFORCEMENT, U.S. DEP'T OF THE INTERIOR, http://www.gomr.boemre.gov/homepg/fastfacts/WaterDepth/WaterDepth.html (last visited Sept. 4, 2011) (providing statistics on offshore-drilling activity updated on a weekly basis).

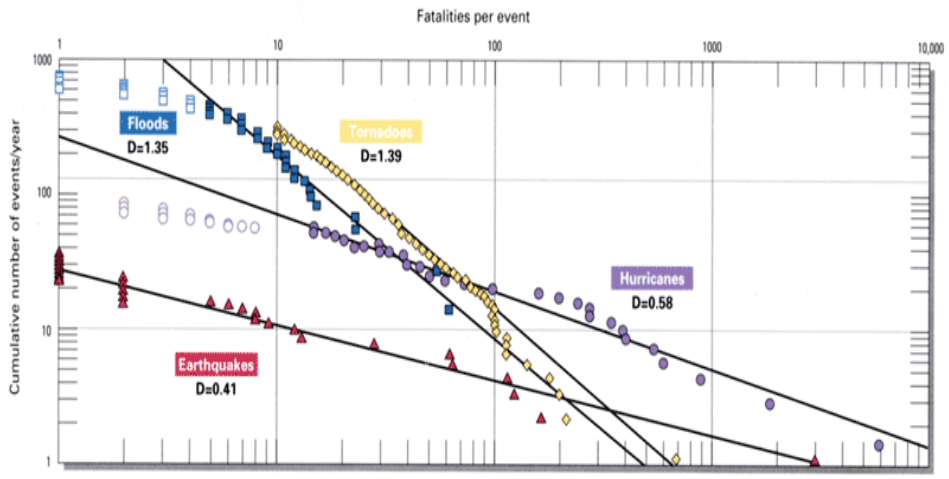
162. These flows include both underground and at-the-surface flows. *See* BP COMM'N REPORT, *supra* note 1, at 226.

The inefficiencies associated with excess spills—those above the firm's ability to pay for the damage—are twofold. First, losses that should be compensated will not be compensated. Second, incentives for safety will be insufficient because operators will recognize that they are not responsible for a significant portion of the expected costs they are imposing. Although not perfect, a second-best solution is to augment the substantial financial requirements with charges for the expected externality costs that cannot be covered with the company's resources.

Our package of policy reforms will rectify the major shortcomings of current arrangements by ensuring that firms undertaking activities with catastrophic risks can pay for the damage should there be an accident and will in fact be responsible for the full economic value of the costs their activities generate. This structure in turn will create incentives for companies to achieve an efficient level of safety. We rely on the role of a more meaningful retrospective liability approach rather than regulation alone, given the informational asymmetries and the specialized expertise that is required to effectively monitor the safety of deepwater drilling.

Although the BP *Deepwater Horizon* oil spill inspired its creation, our proposal can be applied generally to catastrophic environmental risks. Other contexts share the basic ingredients that led to our proposal for deepwater drilling. The incurred environmental risks may generate losses far in excess of the responsible party's ability to pay. Fat-tailed risks of catastrophic losses demand a quite different liability structure from the one that is appropriate for frequently occurring, modest-loss events, such as product manufacturing defects. One possibility would be to bolster the role of regulation, but the combination of informational asymmetries and lack of specialized technical expertise within government make this an ineffective remedy. Our two-tier liability proposal specifically recognizes the nature of catastrophic risks and will greatly bolster the incentives for safety.

**FIGURE 1: FAT TAILS FOR CATASTROPHIC EVENTS**




Source: U.S. Geological Service Fact Sheet, "Natural Disasters – Forecasting Economic and Life Losses," http://pubs.usgs.gov/fs/natural-disasters/index.html.

**TABLE 1: COMPARISON OF PROPOSAL TO CURRENT LIABILITY REGIME**

| Component | Viscusi-Zeckhauser Proposal | Current Policy |
|---|---|---|
| 1. Responsible party | Single responsible party. Contracts with other participants to receive compensation in case of an accident. | Joint and several liability. |
| 2. Strict liability | Yes. | Yes. |
| 3. Tax on noncompensable risk | Yes as part of tiered liability system. | No tax based on financial capacity but contributions to Oil Spill Liability Trust Fund. |
| 4. Financial capacity | Resources plus contracted compensation plus insurance sufficient to meet BP spill magnitude for deep water drilling, with capacity amount set generally based on potential damages in risk context. | $35 million–$150 million. |
| 5. Damages | No damages cap, no punitive damages, compensate only direct losses. | $75 million damages cap with exceptions, punitive damages possible, only direct losses compensable. |
| 6. Natural resource damages | Priority for restoration coupled with benefit-cost test. | Priority for restoration. |
| 7. Recipient of net resource value losses | Government. | Government. |
| 8. Regulation | Complement, recognizing limitation. | Prominent relative role. |
| 9. Benefit components | Focused, net benefits, including environmental harms. | Credits for energy independence and employment effects. |
| 10. Moratorium until implemented | Yes. | No. |