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

by

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Abstract

The BP Deepwater Horizon oil spill highlighted the glaring weakness in the current liability and regulatory regime for oil spills and for environmental catastrophes more broadly. This article proposes a new liability structure for deep sea oil drilling and for catastrophic risks generally. It delineates a two-tier system of liability. The first tier would impose strict liability up to the firm's financial resources plus insurance coverage. The second tier would be an annual tax equal to the expected costs in the coming year beyond this damages amount. A single firm will be identified as responsible for generating the risk. It would be required to demonstrate substantial ability to pay in the first tier before being permitted to engage in the risky activity. This structure provides for efficient deterrence for environmental catastrophes, since the responsible party is bearing in expectation the risks it is imposing. It also addresses the challenges posed by the fat-tailed distributions of catastrophic environmental risks and provides for more assured and adequate compensation of potential losses than current liability and regulatory arrangements.

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 11 workers and ultimately dumped an estimated 4.9 million barrels of oil into the Gulf of Mexico.[2] President Obama declared this event to be the worst environmental disaster in U.S. history.[3] It imposed financial costs in the tens of billions of dollars.[4]

Matters could have been much worse, both financially and environmentally. Had the spill had been generated by a medium-sized or even large firm, rather than giant BP, the consequences would have been far graver. Resource damages would have been left unabated, and financial losses would have been at best fractionally compensated. BP's unusually deep pockets made appropriate compensation feasible.

The environmental damage turned out to be less than many scenarios suggested. Indeed, the best-estimate projections of environmental harm were well above the damage that was actually inflicted.[5] Far greater ecological harms threatened, including severe long-term damage to prime beach areas along the Gulf Coast. Among the factors that reduced costs below expectations were the under anticipated capabilities of oil eating microbes that broke down much of the crude oil, and the Gulf currents that conveyed the oil away from the areas where it would

[1] NAT'L COMM'N ON THE BP DEEPWATER HORIZON OIL SPILL & OFFSHORE DRILLING, REPORT TO THE PRESIDENT, DEEPWATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING vi (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 173 ("Already, this oil spill is the worst environmental disaster America has ever faced.").
[4] *See 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.").
[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.").

have caused great damage.[6] Even though the BP spill was the greatest environmental disaster the nation has seen to date, there is the potential under the current liability and regulatory regime for human action to cause more devastating catastrophes. And these catastrophes would be compounded if the responsible firms have far fewer financial resources than BP, as virtually all do.

The BP Deepwater Horizon oil spill exposed glaring institutional failures in safety. All the three major companies involved in the spill had safety shortcomings, which together 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 potentially 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, it consists of a hodge podge of liability structures, damages limits, and ineffective regulatory efforts. We propose that this regime be jettisoned and replaced by a sounder structure, whose predominant risk-control mechanism is an effective liability system.

The inadequate performance of our governmental institutions for controlling drilling risks has 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

[6] *Id.*
[7] *Id.* 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.").

Offshore Drilling ("Commission") to address the spill.[8] Through the rest of 2010, the Commission issued reports criticizing the Obama 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 this is written, Japan is experiencing an environmental disaster of far graver consequence from another energy-related industry: the explosions, partial meltdowns, and radioactive releases at four of its nuclear plants. These events were triggered by a massive earthquake. To be sure, nature played a far more consequential role in that disaster than it did with the BP spill. It would be inappropriate to diagnose America's greatest environmental disaster but pay no attention to one far greater that occurred within the same twelve months in another highly developed nation. The analysis of that disaster, however, including the allocation of responsibility, will have to await another day.[11] But the principles discussed here should surely be examined in light of the Japanese experience, with similarities and differences identified, and their implications for desirable regulatory and liability structures explored. We draw one central lesson from these two disasters and many others studied: It is extremely difficult to predict the nature of or magnitude of catastrophic events. And the losses entailed, even within a class of disasters such as hurricanes or earthquakes, have fat-tailed distributions, implying potentially huge outlier events, as we shall discuss further below.

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

[8] Exec. Order No. 13,543, 75 Fed. Reg. 29,397 (May 21, 2010).
[9] *See, e.g.*, John M. Broder, *Report Slams Administration for Underestimating Gulf 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 250-91.
[11] 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. The Tepco Chairman Tsunehisa Katsumata made the following observation: "No matter how much money we have, it will not be enough." Yuka Hayashi, *Japan Confronts Liabilities for Crisis*, N.Y. TIMES, May 4, 2011, at A13.

framework that will encourage the parties involved in offshore drilling, or indeed any economic activity potentially producing catastrophic environmental consequences, to take appropriate actions. Our underlying assumption is that decisions relating to such activities are highly complex and constantly evolving and that the only way to get to desirable outcomes is to have parties face appropriate incentives. In a technologically advanced and advancing society, regulation alone will not be sufficient, since it will likely be directed to yesterday's problems. Moreover, liability schemes that might function well for traditional environmental externalities are not well equipped to deal with extreme potential outcomes. Indeed, 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 also include some tax charges for any extreme risks imposed on external parties that will not be addressed should the company's financial resources be exhausted. This article develops a ten-point proposal for overhauling the current liability and regulatory regime for deep-water drilling. The principles we advocate apply to many other contexts in which private entities are undertaking actions that could create potentially catastrophic environmental risks.

The generic problem we address is the following. Firms potentially could generate hazards that inflict damages that exceed their financial resources. Should the government deal with low probability-high loss situations by imposing a modest damages limit so that few firms will be daunted by the prospect of paying losses? Or should there be no limit to liability exposure? Either of these extremes would work poorly. The first would lead firm 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.[12] It replaces it 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 for other catastrophic risks. That is, with modest modifications it could be employed 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 the challenge of effectively controlling risks that impose damages on others in their most extreme form. Controlling risks is always difficult because of the problems 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, and pays 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 reasoned discourse and clear thinking in the political arena are challenged. Since accidents are low probability events, it is difficult to identify either victims or responsible parties in advance.

The BP spill, the event that inspires this volume, 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 quantity of oil and numbers of people affected, makes it stand out. Second,

[12] The Oil Pollution Act ("OPA") has a nominal damages cap of $75 million for firms that are not grossly negligent or otherwise reckless. *See* 33 U.S.C. § 2704(a)(3). 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*.

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 there is one responsible party, or at least one predominant responsible party. Third, the magnitude of the damages assessed would be sufficient to bankrupt almost all companies, though fortunately that was not true in the case of BP, which independent of culpability will be paying all or virtually all of the damages.

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.

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. The components of our reform proposal are as follows:

1. 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. This ensures that there is one party overseeing the whole process, a party that coordinates and monitors the actions of those beneath it. There is no separate liability for other firms involved in the drilling.[13] Thus, for example, there is no joint and several liability as under the current 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

[13] The Japanese nuclear disaster liability system provides an interesting contrast with U.S. liability systems. In the Japanese system, the plant operator bears almost all liability. *See* Nuclear Damage Compensation Law, Law No. No.147 of 1961, art. 3. Thus, for example, General Electric, which manufactured the Mark I reactor which has encountered a range of safety issues, will not bear significant financial responsibility. *See GE Unlikely to Face Liability in Japanese Nuclear Crisis*, BUS. INS., Apr. 1, 2011, http://www.businessinsurance.com/article/20110401/NEWS01/110409998.

negligence or other specified behavior of its corporate partners based on whatever contractual arrangements it makes with them.

2. 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 the 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.

3. Tax on noncompensable risk imposed. No corporation has sufficient resources to cover the most extreme potential losses from an accident. In case of a mega-catastrophe, either the government will pay significant amounts and/or losses will go uncompensated. The result is that the operator will essentially be judgment proof for extreme accidents. Absent other arrangements, excess risks will therefore be undertaken. 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.

4. Demonstration of financial capacity. Restrict deepwater oil drilling to firms that can demonstrate either adequate financial resources or 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.

5. Damages. There are three components to our damages proposal. A. Completely eliminate any cap on damages. (The cap is currently set at a paltry $75 million.[14]) B. Eliminate all punitive damages for oil spills. C. Only direct losses are compensable. The elimination of the damages cap couple with our tiered liability system will establish efficient incentives for safety. Because catastrophic oil spills can be readily monitored, additional punitive damages are not needed to establish the efficient level of care. Payments for financial and property damage losses are limited to losses directly caused by the spill. More distant economic ramifications of these losses are not compensable.

6. Natural resources 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.

7. 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 that are incurred. 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.

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

9. 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 employment effects beyond the assessed benefits for other less risky drilling

[14] *See* 33 U.S.C. § 2704(a)(3).

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.

10. Moratorium on all new deepwater drilling. Until these proposals (with modifications to be expected) are adopted, there should be a moratorium on all new deepwater drilling activities. Exemptions from the moratorium should be granted to a firm accepting strict liability, demonstrating adequate financial resources to pay for the costs of a major disaster, paying the tax for the expected damages beyond its financial capacity, and subjecting its proposed drilling operations to a safety review.

Although these proposals have been tailored to the oil drilling situation, they can be readily adapted to other contexts. Spills from oil tankers, such as the Exxon Valdez oil spill, represent an obvious extension. The hazards of nuclear reactors 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 there is the prospect of catastrophic losses 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.

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 be judging 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 to address environmental risks.[15] First, policies should be structured to maximize the net benefits to society, which is equivalent to maximizing the difference between the benefits and costs. Second, the implication of this objective is that the level of safety should be increased until the incremental benefits from boosting the level of safety just equal the incremental costs. In the usual situation, the cost of providing safety rises at an increasing rate as the level of safety is increased, 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 to be examined below, 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 well involved drilling in more than 5,000 feet of Gulf water followed by drilling more than 13,000 feet below the sea floor.[16] The mere magnitudes involved imply significant risk, but beyond that all such efforts involve new technologies that by definition have not been battle tested, hence involve risks despite the analytic studies, laboratory tests and field tests that may have been conducted. Because incremental costs tend to escalate rapidly as the level of the risk is reduced toward zero, it will usually be efficient from an economic standpoint

[15] 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).
[16] BP COMM'N REPORT, *supra* note 1, at viii.

for there to be some chance of adverse events, including potentially catastrophic environmental disasters.[17] 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 that 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 in and of itself for banning the activity. Similarly, the Japanese nuclear plant catastrophe does not imply that the world should abandon nuclear power, rather that we should have better systems in place to assure 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. 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, hence too reckless. Our policy proposals are targeted at achieving the appropriate balance between safety 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

[17] If the costs avoided are great, then it is perfectly rational to accept a small but positive risk of even a mega-catastrophe. 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 115-40 (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).

industry activities to meet our national goal of achieving energy independence.[18] Indeed, the energy independence mantra was used to justify "Project Independence" under the Nixon administration, which led to significant increase in offshore oil exploration, including additional leases off the Gulf coast.[19] Energy independence is an effective battle cry, used by both "drill baby drill" proponents and fierce energy conservationists. But is an unattainable goal in the foreseeable future, as all parties would admit if they examined the evidence.

"Independence" concerns are at best tangentially relevant to regulating the level of safety for deepwater drilling for several reasons. First, the price of petroleum products in the United States and other countries is driven by the world oil price and the subsequent refinery and distribution costs. U.S. production of oil represents a very small share of the world output and is not even a dominant share of U.S. consumption.[20] Except in situations involving cutoffs to the U.S. oil supply, such as oil embargoes and crises in major oil producing countries, whether the oil is domestic or foreign matters little. The national security benefits are derived from all U.S. oil production, not simply risky drilling, such as that associated with deepwater undertakings. 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 recognized the overall economic desirability of all U.S. oil production and did not place a differential premium on the forms of oil drilling that pose potentially catastrophic environmental risks. Our policy proposal 9 is that any credit for favorable national security effects should apply to all oil drilling, with no special premium accorded to that in deepwater.

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[18] BP COMM'N REPORT, *supra* note 1, at 56.
[19] *Id.* at 31.
[20] *See* U.S. Energy Information Administration ("EIA"), How Dependent Are We on Foreign Oil?, ENERGY IN BRIEF, Nov. 29, 2010, http://www.eia.doe.gov/energy_in_brief/foreign_oil_dependence.cfm (noting that the U.S. produced eleven percent of the world's petroleum and that petroleum imports made up fifty one percent of U.S. demand in 2009).

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, also pose the risk of catastrophic environmental consequences. All energy producing technologies should be treated the same in terms of credit for associated benefits, such as national security, or 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. Secondary economic losses are not counted in our proposal. But that is because secondary economic benefits also accrue when compensation is paid, or government spends money, as would happen with our proposal after a spill. Appropriate levels of safety should not be compromised in order to foster higher levels of employment. Nevertheless, a danger of excessively stringent regulations and liability rules is that they will discourage industries and activities that are economically efficient. 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.

Policy principle 9 also specifies 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 that petroleum products are associated with environmental pollution, importantly including contributing to 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.[21] Only a net tally, which also took account of taxes at end use, could tell us whether or not we should subsidize oil exploration, as the nation does at present, most importantly with generous depletion allowances.

Establishing the appropriate balance between the costs of providing safety against the sum of the benefits it provides plus the expected environmental benefits of more stringent safety standards, though conceptually simple, encounters severe difficulties in practice. The most significant is obtaining a meaningful assessment of the expected environmental costs of deepwater drilling and an assessment of how these costs will be reduced through more stringent control. 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 that it is straightforward to learn about both their likelihoods and magnitudes. Moreover, because the events are frequent and the stakes modest, having a period to learn about the actual level of the risks and the value of damages is not that costly. Situations in which the probabilities are well known are situations of risk.

[21] For a discussion of conventional pollutants that are linked to petroleum products, see W. Kip Viscusi, Wesley A. Magat, Alan Carlin & Mark K. Dreyfus, *Environmentally Responsible Energy Pricing*, 15 THE ENERGY J., April 1994, at 23-42. For linkage to global climate change, see Intergovernmental Penal on Climate Change, IPCC Fourth Assessment Report 2007, at 265 (2007).

Matters become quite different once we venture into the low probability-high consequence 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 are involved, making this a situation of uncertainty – one where probabilities are not known – rather than 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.[22] As one Shell geophysicist commented, "you just don't know what you don't know."[23]

One approach for dealing with dimly understood or, worse, hard-to-conjecture risks is to take advantage of information that may develop over time, 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.[24] Establishing greater corporate responsibility for liability will provide incentives for the oil drilling company to develop and utilize such ongoing informational inputs

[22] Richard Zeckhauser introduces this term in the context of the climate debate. *See* STRATEGY AND CHOICE (Richard J. Zeckhauser ed., 1991).
[23] BP COMM'N REPORT, *supra* note 1, at 32.
[24] *Id.* at 98, 105.

in making their safety decisions. The government should take measures to collect and facilitate sharing of such information among companies.

Behavioral Decision, Fat Tails, and the Separation of Probability and Size of Loss

Our discussion, and most analyses, of losses due to catastrophic environmental catastrophes assume that we will approach policy decisions using a rational framework. Yet a broad strand of research developed over the past three decades demonstrates that individuals have great difficulties assessing and evaluating low-probability, high-consequence events. They fall prey to errors both systematic and severe. Though the study of institutions, such as government agencies and corporations, in dealing with such decisions is less well developed, there is little evidence that their decisions come any closer to optimality.[25]

To illustrate, consider the availability heuristic.[26] It tells us that decision makers 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; it ranks as one of the largest earthquakes ever experienced in recorded history.[27] 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

[25] W. KIP VISCUSI, RATIONAL RISK POLICY (1998).
[26] *See, e.g.*, Amos Tversky & Daniel Kahneman, *Availability: A Heuristic for Judging Frequency and Probability*, 5 COGNITIVE PSYCHOL. 207-32 (1973).
[27] *See, e.g.*, U.S. Geological Survey, Largest Earthquakes in the World Since 1900, http://earthquake.usgs.gov/earthquakes/world/10_largest_world.php (last visited May 10, 2011) (ranking the Japanese quake as the fourth largest earthquake since 1990, behind earthquakes in Chile, the United States, and Indonesia).

lost from the radiation released.[28] But citizens, and hence 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.

Prospect Theory is a seminal article in the behavioral decision field.[29] It notes that individuals make decisions reflecting severe biases relative to prescriptive decision analysis both in valuing outcomes and weighing probabilities. In valuing outcomes, it hypothesizes that individuals are appropriately risk-averse in achieving gains, but, contrary to rational prescription are risk-preferring in the loss domain. Thus, for instance, they would rather take a 50% chance of losing $400 than lose $200 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.[30]

Prescriptive decision analysis tells us that probabilities should be weighted linearly; a 10% chance of a loss is twice as consequential as a 5% chance. Prospect Theory, and empirical studies documenting its predicted patterns of risk beliefs, shows that for actual decisions individuals are quite unresponsive to differences in probabilities. Thus, a 10% probability may count only 1.2 times as much as a 5% probability.[31] 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.

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[28] *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.").

[29] Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision under Risk*, XLVII ECONOMETRICA 263-91 (1979).

[30] 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.

[31] This result is true more generally when people lack full information and act as rational decision makers. *See* W. Kip Viscusi, *Sources of Inconsistency in Societal Responses to Health Risks*, 80 AM. ECON. REV. 257-61 (1990).

Untrained decision processes will both overestimate small risks and undervalue significant reductions in high-consequence but low probability risks.

Prescriptive decision analysis, as noted, separates out the consideration of consequences and probabilities. Essentially, they are the two different components of outcomes, and there are strong supporting normative principles for treating them independently.[32] 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 loss) and Chernobyl (extreme health losses).[33] The first is trivially small relative to the Japan situation, the latter many times worse.

Once one takes seriously assessing the magnitude of losses from a catastrophe, one confronts 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 in considering for example 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

[32] *See* HOWARD RAIFFA, DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICES UNDER UNCERTAINTY (1968).
[33] *See, e.g.*, Jenny Marder, *Japan's Nuclear Crisis: Does it Compare to Three Mile Island, Chernobyl?*, PBS NEWSHOUR, Mar. 14, 2011. *Compare* TMI REPORT, *supra* note X, *with* CHERNOBYL FORUM, CHERNOBYL'S LEGACY: HEALTH, ENVTL. & SOCIO-ECONOMIC IMPACTS & RECOMMENDATIONS TO THE GOV'TS OF BELARUS, THE RUSSIAN FED'N & UKRAINE 7-8 (2d ed. 2005), *available at* http://www.iaea.org/Publications/Booklets/Chernobyl/chernobyl.pdf.

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.[34] 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 100 is twice as high as is 10, even though 100 is an order of magnitude—*i.e.*, 10 times—greater than 10. The data indicate roughly linear relationships over two to three orders of magnitudes—that is factors of 100 to 1,000—in the number of fatalities.[35]

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 occurred was the Yellowstone fires in 1988, which burned about 1.6 million acres.[36] Before that, the most recent wildfire that burned over 1 million acres was seventy years ago, the 1918 Cloquet-Moose Lake fire in Minnesota that burned 1.2 million acres.[37] The largest North American oil spill was the 1910 spill Lakeview Gusher in California that poured out 9 million

[34] 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 $\log p(x) = \log c + d \log x$.
[35] U.S. Geological Survey, Fact Sheet: Natural Disasters—Forecasting Economic and Life Losses, http://pubs.usgs.gov/fs/natural-disasters/index.html (last visited May 11, 2011).
[36] *See* National Interagency Fire Center, Historically Significant Wildland Fires, http://www.nifc.gov/fireInfo/fireInfo_stats_histSigFires.html (last visited May 11, 2011). For a sense of the variation in monetary losses, see National Fire Protection Association, Deadliest/Large-Loss Fires: The 10 Largest Loss Wildland Fires in the U.S., http://www.nfpa.org/itemDetail.asp?categoryID=954&itemID=44745&URL=Research/Fire%20statistics/Deadliest/large-loss%20fires (last visited May 11, 2011).
[37] *Id.*

barrels of oil.[38] The 2010 BP Deepwater Horizon spill ranks second, with 4.9 million barrels.[39] The 1979 Ixtoc spill off the coast of Mexico generated 3.3 million barrels.[40] Terrorist attacks display similar variability. Prior to 9/11, the greatest loss ever was associated with the 1995 Oklahoma City bombing, when 168 people died.[41] Then on 9/11, nearly 3,000 people lost their lives.[42] Finally, the death tolls due to earthquakes are also variable. The deadliest earthquake since 1900 is the 1976 Tangshan, China earthquake that officially killed 255,000, although many estimate the death toll to be actually as high as 655,000.[43] The 2004 Sumatra earthquake ranks second with a death toll of 227,898.[44]

There are two implications of catastrophes being characterized by fat-tailed distributions. First, where disasters are concerned, the past may not be prologue to the future. A future disaster could easily be many times as bad. 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 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 that they be able to pay.

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[38] *See* World's Largest Oil Spills Map, http://geology.com/articles/largest-oil-spills-map/ (last visited May 11, 2011). These measures are in terms of barrels of oil. Should the loss be converted to dollars, we would expect even more variability.
[39] *Id.*
[40] *Id.*
[41] U.S. Department of Homeland Security, Federal Emergency Management Agency, Oklahoma City Bombing, 1995, http://www.fema.gov/emergency/usr/usrok95.shtm (last visited May 11, 2011).
[42] *See* 9/11 Attacks, Fact Box, http://topics.nytimes.com/topics/reference/timestopics/subjects/s/sept_11_2001/attacks/index.html (last visited May 11, 2011) (listing the number of dead as 2,992).
[43] U.S. Geological Survey, Earthquakes with 50,000 or More Deaths, http://earthquake.usgs.gov/earthquakes/world/most_destructive.php (last visited May 11, 2011).
[44] *Id.*

The failure to prepare for such unprecedented risks was manifested with respect to the 47 foot-high tsunami that 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 8 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."[45]

Insurance Principles, Compensation, and Nontransferable Losses

A central policy objective beyond generating an efficient level of safety 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 arising when the victims have property rights to the resource that has been lost. In that instance, it is widely viewed as fair and equitable that they be compensated. 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 level of financial well-being that prevailed before the harm occurred will generally be desirable. The "make whole" principle for setting damages for

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

financial loss, apart from its equity accomplishments, simultaneously achieves an optimal level of insurance for such losses.

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, one would not expect people to purchase insurance that would provide them 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, the most severe form of health loss. 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.[46] Serious injuries often impede a person's ability to increase individual welfare through financial expenditures. Because serious injuries reduce the degree to

[46] W. Kip Viscusi & Williams N. Evans, *Utility Functions that Depend on Health Status: Estimates and Economic Implications*, 80 AM. ECON. REV. 353-74 (1990).

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.[47]

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 don't hurt humans directly. Millions of Americans may feel that 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 for environmental losses rather than direct payments to the citizenry is well founded.[48] 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.

The Current Liability Structure: Retrospective Liability

There are two different law and economics approaches that 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, what could be

[47] 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).

[48] 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.

thought of as paying the expected value of the externality one is imposing.[49] 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.[50]

Under the conventional retrospective liability approach, payment for all the damages leads the injurer to internalize the costs and to 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. There are two principal requirements for this approach to be workable. 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 demonstrate the financial resources to pay for damages equivalent to those imposed by the

[49] 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 439-83 (George R. Feiwel ed., 1987).

[50] 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.

BP Deepwater Horizon oil spill. Another minimum benchmark for any operator might be chosen. What is critical is that it be substantial.

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. The second tier would address possible losses beyond this level. We propose that firms pay a tax to cover the potential expected damages amount beyond the level financial resources that the firm has demonstrated it has available to pay claims.

Both the Clean Water Act[51] and the Oil Pollution Act of 1990[52] ("OPA") include liability provisions pertaining to oil spills. 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.[53] The OPA provides for strict, joint and several liability for the damages caused by oil spills.[54] 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.[55] 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 "own or leases that

[51] 33 U.S.C. § 1321, § 311.
[52] *Id.* §§ 2701-61.
[53] *See* Comprehensive Environmental Response, Compensation and Liability Act ("CERLCA"), 42 U.S.C. § 9607; National Marine Sanctuaries Act, 16 U.S.C. § 1443; Trans-Alaska Pipeline Authorization Act, 43 U.S.C. § 1653.
[54] 33 U.S.C. § 2702(a).
[55] *Id.* § 2702(b).

property." Other financial losses are addressed under § 2702(b)(2)(C), which permits "any claimant" to recover "[d]amages equal to the loss of profits or impairment of earning capacity due to injury, destruction, or loss of real property, personal property, or natural resource." Damages for the loss or destruction of natural resources are addressed under § 2702(b)(2)(C).

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.[56] For oil spills resulting from offshore facilities as in the BP situation, the applicable cap on all damages paid is $75 million.[57] 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 are no longer binding in situations of gross negligence, willful misconduct, or violation of applicable Federal regulations pertaining to safety, construction, or operation.[58] 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.[59]

The OPA provides for three different measures of natural resource damages:

The measure of natural resource damages under § 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 these damages.[60]

[56] *Id.* § 2704(a).
[57] *Id.* § 2704(a)(3).
[58] *id.* § 2704 (c)(1).
[59] *See* W. Kip Viscusi, *Do Judges Do Better?*, *in* CASS SUNSTEIN ET AL., PUNITIVE DAMAGES: HOW JURIES DECIDE 188 (2002); Jeffrey J. Rachlinski, *A Positive Psychological Theory of Judging in Hindsight*, 65 U. CHI. L. REV. 571 (1998).
[60] 33 U.S.C. § 2706(d)(1).

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,[61] which provides for damages payments of up to $1 billion per oil spill incident. That larger amount was also dwarfed by the actual harm from the BP spill.[62]

The current damages regime for oil spills consequently follows the retrospective liability approach. The company causing the damage is responsible for both the financial harm and the environmental damage. Monetary payments to those who have suffered losses are appropriate for financial harm, whereas the favored remedy for environmental damage is restoration and remediation to bring the resource back to its pre-spill condition. Except in situations in which the company is guilty of specified infractions, such as regulatory violations and gross negligence, as mentioned, damages are capped at $75 million.[63] However, in the case of the BP Deepwater Horizon spill, BP voluntarily waived this cap but denied gross negligence.[64] 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."[65]

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,

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[61] *Id.* § 2712(a)(4).
[62] 26 U.S.C. § 9509(c)(2).
[63] 33 U.S.C. § 2704(a)(3).
[64] Statement of BP Exploration & Production Inc. re Applicability of Limit of Liability under Oil Pollution Act of 1990 at 1, In re Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on Apr. 20, 2010, MDL No. 2779 (E.D. La. Oct. 18, 2010), http://www.laed.uscourts.gov/OilSpill/Orders/BPStatement.pdf (last visited May 11, 2011).
[65] 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.

the prospects for retaining such a cap appeared dim given that President Obama had concluded that the company was guilty of "recklessness."[66] 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 that had been imposed. From BP's standpoint, traditional economic/legal considerations were swamped by overwhelming political forces.

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. Deepwater drilling involving multiple contractors whose actions cannot be readily monitored externally 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, and one with 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 transactions costs of a flurry of lawsuits, major oil spills from deepwater drilling are likely to be relatively infrequent events.[67] 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 have the power 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

[66] *Id.*

[67] 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.

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. That multiple parties may be at fault was borne out in the report by the Coast Guard, which placed substantial blame on Transocean Ltd., which operated the drilling rig.[68]

Because of the potential contribution to the accident of its drilling contractors, BP has filed several lawsuits in an effort to recoup some of the damages it incurred.[69] As one might expect based on the Coast Guard report, BP has sued Transocean Ltd.[70] Moreover, BP has filed a lawsuit against Cameron International Corp., which manufactured what BP termed a "dangerous" blowout preventer and, in BP's view, was negligent.[71] BP has also sued Halliburton, alleging misconduct and fraud.[72] 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 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 then to determine the difference between these in calculating the loss people have experienced as a result of the spill. For any given person to be

[68] *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; Russell Gold & Angel Gonzalez, *Spill Report Faults Transocean Rig*, WALL ST. J., Apr. 23-24, 2011.
[69] *See, e.g.*, Lawrence Hurley, *BP Sues 3 Companies Over Alleged Roles in Deepwater Horizon Spill*, GREENWIRE, Apr. 21, 2011.
[70] *See* Aude Lagorce, *BP Sues Halliburton, Transocean, Cameron*, MARKET WATCH, Apr. 21, 2011.
[71] *See* Russell Gold, *BP Sues Maker of Blowout Preventer*, WALL ST. J., Apr. 21, 2011.
[72] *See* Guy Chazan, *BP Sues Halliburton Over Gulf Disaster*, WALL ST. J., Apr. 21, 2011.

compensated such calculations may be difficult because of 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? If these suppliers are located in quite different parts of the country, should they also be compensated? More generally, given the ripple effects of all economic activity, where should the line be drawn? Our approach under policy proposal 5 is to make payment for the direct effects only, 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.

A potentially challenging issue is how to treat losses not caused by the spill but which were generated by misperceptions generated by the spill rather than being "due to" the spill.[73] 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

[73] 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 (2010), http://dash.harvard.edu/bitstream/handle/1/4595438/Report on Economic Loss Liability 11 22 10.pdf (last visited May 13, 2011).

> the Gulf of Mexico are more like an epidemic, one that we will be fighting for months and even years.[74]

Newspapers likewise ran stories suggesting major threats to tourism due to the spill.[75] 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, included unwarranted responses to inaccurate news coverage that implied that the beaches were far more tarnished than they were.[76] The BP spill led to a substantial drop in tourism at Gulf Coast beaches even for beaches that were not affected by the spill. 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 avoided by credible risk communication efforts.[77] Given the financial self-interest of the companies responsible for the spill, to be believed, such communication might best be handled by governmental entities.

Who Should Pay for the Damages?

As noted above, the current liability regime established by OPA provides for strict, joint and several liability. However, with a damages cap of $75 million except in situations such as gross negligence, the seemingly stringent liability regime that in effect treats oil spills in a manner similar to the treatment of hazardous substance sites under CERCLA is not nearly as

[74] BP COMM'N REPORT, *supra* note 1, at 173.
[75] 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.
[76] BP COMM'N REPORT, *supra* note 1, at 191.
[77] *Id.* at 278-79.

stringent as it might appear if implemented literally.[78] 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 striking 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, 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 is known by the company and what can be determined by outside observers, 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.

[78] 42 U.S.C. § 9601(32); United States v. Chem-Dyne Corp., 572 F. Supp. 802, 805 811 (S.D. Ohio 1983) (imposing strict, joint, and several liability unless responsible parties can prove the harm is divisible).

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 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.[79] 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. BP is the largest owner of tracts in the Gulf, as it owns more than 1,500 tracts in areas where the water is more than 1,500 feet and owns more than one-third of all the deepwater reserves.[80] It is also the fourth largest petroleum company in the world, with revenues of $297 billion in 2010[81] Halliburton is an energy products company with substantial oil drilling activities, with revenues in 2010 of $18.0 billion.[82] Transocean is the largest contractor of offshore oil rigs in the world, with revenues in 2009 of $11.6 billion.[83] The National Commission identified significant errors made by each of these three companies, where

[79] BP COMM'N REPORT, *supra* note 1, at 89-129.
[80] *Id.* at 47.
[81] *Id.* at 2. BP, FINANCIAL AND OPERATING INFORMATION 2006-2010 at 7 (2011), http://www.bp.com/liveassets/bp_internet/globalbp/STAGING/global_assets/downloads/F/FOI_2006_2010_full_book.pdf (last visited May 16, 2011).
[82] Halliburton, Financial Reports (2011), 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.
[83] BP COMM'N REPORT, *supra* note 1, at 2.

these errors contributed to the likelihood of the spill and the extent of the harm.[84] 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.[85] Imposing a strict liability standard with the oil drilling firm being responsible for all losses eliminates the daunting task of 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 OPA is to impose joint and several liability. If the oil firm's resources are not sufficient 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 does not establish much of a deterrent 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 feasible in practice because it will lead to the full amount of the damages being paid multiple times by each firm involved in the accident. Moreover, assuming full liability will discourage subcontractors from being involved in the drilling operation. And collusion among firms, who together would be paying much more than the actual costs should there be an accident, would actually lead to excess safety.

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[84] *Id.* at 115-22.

[85] BP, Deepwater Horizon Accident Investigation Report 3-6 (2010), http://www.bp.com/liveassets/bp_internet/globalbp_uk_english/incident_response/STAGING/local_assets/downloads_pdfs/Deepwater_Horizon_Accident_Investigation_Report.pdf (last visited Feb. 15, 2011). *See also* Nat'l Acad. of Eng'g & Nat'l Research Council, Interim Report on Causes of the Deepwater Horizon Oil Rig Blowout and Ways to Prevent Such Events, http://www.nationalacademies.org/includes/DH_Interim_Report_final.pdf (last visited Feb. 14, 2011). 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.

Our proposal for determining how payment should be made for an oil spill has four separate components. Our policy proposal 5A states 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 have made our policy proposal 4, which is that before being allowed to drill, the oil company must be able to demonstrate the financial resources or adequate insurance that is sufficient to pay for most possible harms. 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.[86] More typically, the amount is between $10 million and $35 million depending on the facility,[87] where the President under current law can increase the amount up to $150 million.[88] Existing financial resource requirements must be dramatically strengthened.

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

[86] BP COMM'N REPORT, *supra* note 1, at 283. Economic losses for the spill are estimated at tens of billions. *Id.* at vi.
[87] 33 U.S.C. § 2716(c)(1)(B).
[88] *Id.* § 2716(c)(1)(C).

advocates and has led to political opposition to raising the cap.[89] 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 the ultimate costs of their actions, these firms will not have an economic incentive to incorporate the costs of potential risky outcomes when making their safety decisions. Inadequate levels of care will result.[90]

Our policy proposals 1 and 2 replace the current OPA joint and several liability provision with full liability being imposed on the oil company that owns the lease. Thus, rather than requiring that all companies involved in the drilling operation demonstrate adequate financial resources 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 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 using an approach patterned after that employed by the Nuclear Regulatory Commission. But even if the

[89] There may, however, be possible insurance options that would enable smaller firms to operate. BP COMM'N REPORT, *supra* note 1, at 246. However, note that the possibility of obtaining insurance coverage may be reduced if all liability caps are removed.

[90] 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.

government is successful in devising a make shift 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 types of 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 their safety decisions would not be expected 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.[91] Our policy proposal 1 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 are responsible for damages and the level of these damages payments should a spill occur, depending on how the parties performed, etc. Thus, the oil firm and the drilling partners can agree to contractual arrangements that ensure that the oil firm is able to be compensated appropriately 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 caused by its activities will not reduce the oil company's liability.

[91] BP COMM'N REPORT, *supra* note 1, at 223.

Punitive Damages

Our proposed liability regime eliminates any productive role for punitive damages. Thus, under our proposal 5B 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"), our proposal number 5A 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.[92]

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.[93] 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 to be identifiable.

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. For environmental harms for

[92] 42 U.S.C. § 2210(s). 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 $12.975 billion.

[93] This result, which dates back to the work of Jeremy Bentham, is presented in A. Mitchell Polinsky and Steven Shavell, *Punitive Damages: An Economic Analysis*, 111 HARVARD LAW REVIEW 869 (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.

which money is not a suitable substitute, the firm is required to undertake all appropriate remediation efforts. For any shortfalls of or delays in the remediation, the firm is liable for the remaining natural resource damages. There are no gaps in the damages payment structure that need be addressed through punitive damages.

Missing from this discussion is a possible role of punitive damages from the standpoint of punishment, up and beyond its deterrent or compensatory role. Given the much more stringent liability system that we have proposed, firms will already be punished by much more than they are on average 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 harm that has been incurred 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.[94] Our proposal eliminates the risk of erroneous jury judgments, and establishes a liability structure that provides strong incentives for prudence and that secures damages payment for most accidents, and raises a tax fund that could be used for payments in case of catastrophic losses.

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 noncompensable risk component of our proposal adopts this framework. The building blocks for this analysis are different and much

[94] W. Kip Viscusi, *Corporate Risk Analysis: A Reckless Act?*, 52 STAN. L. REV. 547, 563 (2000).

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. The informational requirements of a prospective liability regime, and the potential for error, dwarf those 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.[95] 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 but rather determining the financial capability of the firm operating the well.

Government regulators will continue to have responsibility as well for establishing broad safety standards, as under the current regulatory regime. Note that to separate the regulatory oversight, management, and revenue functions, the organizational structure at the Department of the Interior was altered after the spill as 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.[96] Consistent with the conclusions of the Commission,

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[95] Many such schemes, such as the Pension Benefits Guarantee 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.

[96] COUNCIL ON ENVIRONMENTAL QUALITY (CEQ), 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), 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

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 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, the total financial incentives create by these penalties is modest. The U.S. Deptartment of the Interior levied only $919,000 penalties in 2009 and $1,595,000 in the first two quarters of 2010.[97]

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 levels to effectively undertake the required tasks.[98] Government regulators previously responsible for oversight fell short in terms of their technical expertise.[99] This deficiency is unlikely to be remedied in the future, as pay rates for those working on the rigs, including management positions, run well into six figures.[100] Some limited improvements in personnel can be achieved by raising salaries, but ultimately the federal pay scale at the top is not sufficient to attract the kinds of workers who are needed to undertake the oversight role

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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.

[97] For a list of penalties paid, see Bureau of Ocean Energy Management, Regulation, and Enforcement, OCS Civil/Criminal Penalties, http://www.boemre.gov/civilpenalties/ (last visited May 16, 2010).

[98] JOHN DONAHUE, THE WARPING OF GOVERNMENT WORK 89-91 (2008).

[99] BP COMM'N REPORT, *supra* note 1, at 57.

[100] *Id.* at 3.

effectively.[101] 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. It 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 waste water 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 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 has had a troubled record of safety violations including an oil refinery explosion that killed 15 workers in Texas, a major spill in Alaska due to a corroded pipeline, and a lengthy history of safety management problems.[102] That BP also had a major oil spill was not a one-time adverse event that tarnished an otherwise exemplary safety record.

[101] *Id.* at 79, 258.
[102] *Id.* at 2, 221.

Procedures for Compensatory Damages Payments

Much of the payment of financial compensation after the BP oil spill was and will be conducted through an administrative compensation scheme. After negotiations with President Obama, BP established a $20 billion fund for damages.[103] As of May 12, 2011, the fund had paid out $4.51 billion to individuals and businesses and $1.27 billion to government entities.[104] Payments to individuals and businesses are handled through the Gulf Coast Claims Facility,[105] while governmental claims are handled separately.[106] This fund approach provided payments to those who suffered financial loss at a far more expeditious pace than they would have experienced by filing individual lawsuits, though many claims are still being processed.

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 criteria for receiving payment involves demonstrating a financial loss from the BP spill.[107] The particular categories of loss covered parallel those under OPA, and include claims for "removal and clean up costs, damage to real or personal property, lost earnings of profits, loss of subsistence use of natural resources, or physical injury or death."[108] Nonfinancial harms, such as mental anguish and stress resulting from the spill, are not covered.[109] In addition, the

[103] BP COMM'N REPORT, *supra* note 1, at 185.
[104] BP, Claims and Government Payments, Gulf of Mexico Spill, Public Report—5/12/2011, http://responsedata.bp.com/files/PublicClaimsStatusTracking05122011.pdf (last visited May 16, 2011).
[105] Claims by individuals and businesses can be filed at http://www.gulfcoastclaimsfacility.com/index.
[106] Government claims are filed at http://www.bp.com/governmentclaim.
[107] "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." BP COMM'N REPORT, *supra* note 1, at 287.
[108] Gulf Coast Claims Facility, Frequently Asked Questions § 3.1, http://www.gulfcoastclaimsfacility.com/faq (last visited May 16, 2010). Compensation for injury and death is not included under OPA. 33 U.S.C. § 2702(b).
[109] *Id*, §12.4.

fund reimbursed governmental costs such as the costs incurred by the states of Louisiana and Florida for seafood testing.[110] 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, in our view this compensation fund approach performed reasonably well in terms of providing appropriate compensation according to the insurance principles advocated above.

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 losses 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 6, 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."[111] There is also potential harm to fish due to oiling of

[110] BP COMM'N REPORT, *supra* note 1, at 188.
[111] BP COMM'N REPORT, *supra* note 1, at 181.

seaweed, which imposes risks on mahi mahi, billfish, and cobia.[112] Other fish potentially harmed include the Bluefin tuna, the Gulf sturgeon, and several species of shark.[113] Offshore birds, such as Royal Terns and Gulls, likewise may have been affected if their feeding grounds became oiled, and open water birds and nearshore and marsh birds may also have been affected.[114] Some oil had reached 650 miles of Gulf coastal habitats, with 130 miles being categorized as moderately or heavily oiled.[115] The oil also poses longer terms risks to marine habitats, wetlands, corals, and other habitats.[116] 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.[117] These surveys were subjected to a variety of strident critiques, 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.[118]

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[112] RAY MABUS, AMERICA'S GULF COAST: A LONG TERM RECOVERY PLAN AFTER THE DEEPWATER HORIZON OIL SPILL 28-29 (2010), http://www.restorethegulf.gov/sites/default/files/documents/pdf/gulf-recovery-sep-2010.pdf (last visited May 16, 2011).
[113] *Id*.
[114] Damage Assessment Remediation & Restoration Program, Nat'l Oceanic & Atmospheric Admin. (NOAA), Affected Gulf Resources: NOAA Gulf Spill Restoration, http://www.gulfspillrestoration.noaa.gov/oil-spill/affected-gulf-resources/ (last visited May 16, 2011).
[115] BP COMM'N REPORT, *supra* note 1, at 175-76.
[116] MABUS, *supra* note 112, at 181.
[117] Richard Carson, et al., *Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill*, 25 ENVTL & RESOURCE ECON. 257, 259-60 (2003).
[118] Natural Resource Damage Assessment Under the Oil Pollution Act of 1990, 58 Fed. Reg. 4,601 (Jan. 15, 1993).

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 that must be incurred by the party responsible for the oil spill. Restoration efforts may involve cleaning up beaches and other efforts to restore the environment to the pre-spill condition. Many of these costs will be incurred directly by the company responsible for the spill, as in the case of Exxon's efforts to clean up the Prince William Sound area after EVOS.[119] Estimates of the restoration costs associated with the BP oil spill are in the range of $15 billion-$20 billion.[120] The third component of damages consists of the cost of damages assessment, which one would expect to be a comparatively minor cost component relative to other damages associated with oil spills of the magnitude of 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. Natural resource damages can be ameliorated by a variety of different types of actions.[121] 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.

Should the environment be less than 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 such compensation be paid to the government 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

[119] Exxon Valdez Oil Spill Trust Council, Questions and Answers, http://www.evostc.state.ak.us/facts/qanda.cfm (last visited May 16, 2011).
[120] BP COMM'N REPORT, *supra* note 1, at 279.
[121] 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).

for which monetary payments can substitute. Second, the nation owns the resources on the outer continental shelf so that payment to the government corresponds to compensating the resource owner.[122]

Let us consider the value of damages after the level of cleanup and restoration have already been determined and completed. What is the value of the damages that remain? How should the losses be conceptualized? 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 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, 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 2,000 square miles of wetlands since the 1930s.[123]

As is standard in economics 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.[124] Because of the role of discounting, even

[122] BP COMM'N REPORT, *supra* note 1, at 57.
[123] MABUS, *supra* note 112, at 26-27.
[124] Thus, if the interest rate is r then the present value of $1 in losses a 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.

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 that exceeds the rate of discount.[125]

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, though the initial harm will of course affect the baseline loss values. However, it is also essential to take into account how fast the natural resources will recover and to what extent. Thus, the valuation process must by necessity take into account and reductions in loss over time. If, for example, there are deaths to a bird population, 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, adding an additional dimension to the nature of the environmental damage being assessed. 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.[126] Commercial/productive services pertain to largely 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 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.

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

[126] For detailed discussion of the OPA process for resource compensation, see Jones, *supra* note 121, at 96.

Other services categories often involve non-market effects that make benefit assessment more difficult. Recreational and aesthetic damages pertain to the use of beaches, swimming, fishing, as well as 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 non-use. Even if people do not directly use the resource, they may nevertheless value it, perhaps because of a concern with scarce species or maintaining 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 the resource at some future date.[127]

The natural resources damages value that is lost to the citizenry is the monetary compensation needed to restore their welfare to what it would have been in the absence of the spill.[128] This principle is in line with the "make whole" approach to compensation for injury. The practical problem is establishing what this value should be.

In economic terms, the value of required compensation can be viewed as a willingness to accept (WTA) amount. Thus, 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 a person would be willing to pay to prevent the harm from occurring. The legal framing of

[127] Option value is what an economist would label discounted expected consumer surplus.
[128] The monetary compensation principle for natural resource damages is articulated in 43 C.F.R. § 11.83 (2010) and *Ohio v. U.S. Dept. of Interior*, 880 F.2d 432, 464 (D.C. Cir. 1989), rehearing denied, 897 F.2d 1151 (D.C. Cir. 1989).

compensation is in terms of the WTA amount. For minor effects on one's welfare, the WTP amount should equal the WTA amount.[129]

Notwithstanding their theoretical similarity and approximate equivalence, there are important gaps observed in practice between the values for WTA and WTP. In particular, WTA values often dwarf the values for WTP by much more than could be reasonably expected based on economic theory.[130] Based on a review of the literature including both survey and experimental studies, the average discrepancy between the mean WTA value across studies and the mean WTP value is a ratio of 7.17.[131] However, the gap is much greater for public or non-market goods such as those involving environmental damages, as the mean ratio of WTA to WTP is 10.41 for such goods.[132] Unfamiliar goods that are not ordinary private goods that the person might purchase tend to generate high ratios.[133] 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.[134] 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 object of experimental studies. Such effects indicate the important role of

[129] In particular, the discrepancy arises due to income effects, as willingness to pay values involve a depletion of one's financial resources and willingness to accept amounts augment one's resources through compensation.
[130] For a review, see John K. Horowitz & Kenneth E. McConnell, *A Review of WTA/WTP Studies*, 44 J. ENVTL. ECON. &MGMT. 426 (2002).
[131] *Id.* at 432 tbl.II.A.
[132] *Id.* at 433 tbl.III.A.
[133] *Id.* at 442.
[134] Daniel Kahneman, Jack Knetsch, & Richard Thaler, *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1324 (1990).

reference points in affecting decisions.[135] 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.

Conclusion

The BP oil spill highlighted fundamental safety problems with deepwater drilling that led to a catastrophic accident. [136] Alas, this accident should not be thought of as an aberrant occurrence, but rather an outcome that must be expected on occasion given the incentives operating with the current regulatory and liability regime. Examining those incentives, and creating a superior regime for the future, was the principal goal of this paper.

The task is critical. To be sure, in response to the spill, one would expect companies to become more diligent and government regulators to 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.[137] Although the BP spill was the largest U.S. spill in offshore waters, from 1996 to 2009, there were 79 other reported loss of well control accidents involving uncontrolled hydrocarbon flows.[138]

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

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

[136] 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.

[137] This count is for wells drilled at depths of more than 1,000 feet. *See* CEQ, CEQ REPORT, supra note 96; *see also* BOEM, Offshore Statistics by Water Depth, available at http://www.gomr.boemre.gov/homepg/fastfacts/WaterDepth/WaterDepth.html.

[138] These flows include both underground and at the surface flows. See the BP COMM'N REPORT, *supra* note 1, at 226-27.

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 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 surely accounts for the majority of losses from deepwater drilling in the United States over the course of the nation's history.

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.

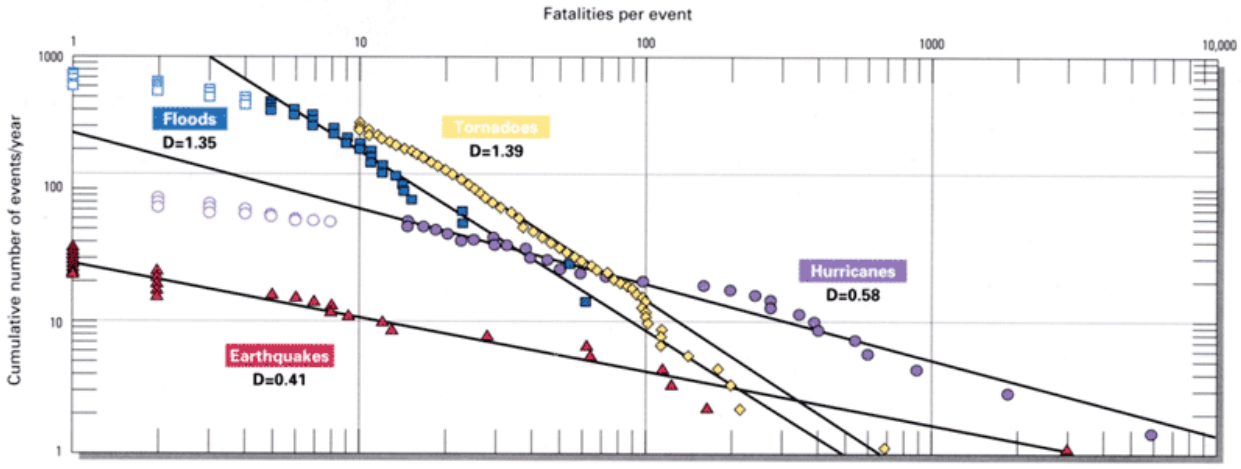
Our package of policy reforms will rectify the major shortcomings of current arrangements by ensuring that firms undertaking activities with catastrophic risks can pay for the

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 our proposal has been inspired by the BP Deepwater Horizon oil spill, it can be applied generally to catastrophic environmental risks. The basic ingredients that led to our proposal for deepwater drilling are shared by other contexts. The environmental risks being incurred 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 bolsters 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

	Viscusi-Zeckhauser Proposal	Current Policy
1. Responsible party.	Single responsible party.	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 or insurance for BP spill magnitude.	$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. Benefits.	Focused, net benefits, including environmental harms.	Credits for energy independence and employment effects.
10. Moratorium.	Yes	No