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IN THE AFTERMATH OF THE DISASTER: LIABILITY AND COMPENSATION MECHANISMS AS TOOLS TO REDUCE DISASTER RISKS

MICHAEL G. FAURE*

A variety of instruments can be used to compensate victims in the aftermath of a disaster. This article argues that it is important to structure ex post compensation mechanisms in such a way that they also provide incentives for disaster risk reduction. To that end, the article analyzes the ability of a variety of instruments to provide incentives for disaster risk reduction. Further, it argues that where an operator who contributed to the disaster risk can be identified, liability rules can be employed to provide incentives to reduce the risk of disaster. In the case of natural disasters, first-party insurance may be an appropriate tool to provide potential victims with incentives to reduce disaster risk.

In addition to analyzing the theoretical potential of various instruments to contribute to disaster risk reduction, this article provides many examples that show which instruments are used in practice. It also provides a critical analysis of international environmental agreements, arguing that the liability rules used in those agreements show particular features that may reduce their ability to contribute to disaster risk reduction. It therefore argues that there is substantial scope for policy change, more particularly in international environmental agreements. By making a smarter use of liability rules and having risk-dependent contributions to compensation mechanisms, the liability and compensation schemes in international environmental agreements could better contribute to disaster risk reduction than is currently the case.

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INTRODUCTION

There is a strong demand for compensation in the aftermath of a disaster. The pressure on politicians to provide some form of compensation is especially strong. International environmental law and domestic law both include a variety of liability and compensation mechanisms for victims.

Liability rules are frequently used in the case of manmade or technological disasters. In those cases, a tortfeasor can usually be identified and, to the extent that tortfeasor is solvent, held liable to compensate the victims. Because liability rules will usually not be available in cases of natural disasters, other compensation mechanisms—such as insurance and compensation funds—are used in those instances. Moreover, many international conventions employ hybrid forms of compensation.¹

This Article focuses on the extent to which these various liability and compensation schemes can reduce disaster risks. Economic analysis and environmental law conventions show that an *ex post* compensation mechanism may have positive or negative effects on the *ex ante* incentives to reduce disaster risks. Depending upon their specific design, liability rules may provide incentives to tortfeasors to invest in risk reduction mechanisms. However, those positive incentive effects are less likely in the case of government financed funds or compensation schemes.

This Article will therefore primarily explore the interrelationship between liability and compensation mechanisms, on the one hand, and their ability to reduce disaster risks on the other. A variety of available liability and compensation mechanisms will be reviewed—specifically liability rules, *ex post* government compensation, compensation funds, and insurance. Each of these mechanisms' ability to generate incentives for disaster reduction will be critically discussed. Moreover, examples of how these particular mechanisms are applied in international environmental law or in domestic law will be provided. The Article will argue that many of the international environmental agreements dealing with liability and compensation do not sufficiently contribute to disaster risk reduction. What is worse, some of those international conventions even create substantial perverse effects. As the Article will show, domestic law often provides better incentives for disaster risk reduction and better protection to victims.² Hence, it will also be shown that there is considerable scope for improving international conventions by learning from some examples of domestic law and from the economic approach to liability and compensation.

Following this introduction, Part II will sketch the starting points for the analysis. First, the Article will illustrate how liability and compensation mechanisms can reduce disaster risks in theory; next, it will discuss how incentives for risk mitigation can be provided. In addition, Part II will also outline which instruments of international environmental law will be further analyzed. In particular, this section will explain that the most prominent instruments regarding liability and compensation can be found in the nuclear accidents and marine oil pollution international conventions; these will therefore constitute the core of the

¹ For example, a first layer of compensation to be paid by the liable injurer and a second layer consisting of payment via a compensation scheme.

² I.e. higher amounts of compensation.

analysis. Having outlined the starting points in Part II, Part III will focus on liability rules and solvency guarantees. The potential, conditions, and limits of liability rules, as well as their prevalence in international environmental law, will be outlined and followed by a critical analysis. Part IV will focus on additional compensation mechanisms that take place either in a rather informal way (generosity as a form of charity) or through more formal payments, via compensation funds or governments stepping in and providing additional layers of compensation. Different forms of the latter can be found in international environmental agreements. Part V will focus on an instrument which is not explicitly present in international environmental law, but which plays an important role in domestic law by mitigating risks particularly related to natural disasters: First-party insurance for victims. This Part of the Article will explore the extent to which experience with models of first-party insurance compensation can provide interesting lessons for liability and compensation regimes in future instruments of international environmental law. Part VI will compare the different instruments that have been observed and discussed and consider how liability and compensation instruments in international environmental law have been increasingly improved. This Part will also argue that there is significant potential to improve the contents of the international conventions so as to more effectively contribute to disaster risk reduction. Part VII concludes the analysis.

I. STARTING POINTS AND BACKGROUND

A wide variety of legal rules, both in domestic as well as international law, focus on regulating the different phases of a disaster.³ Legal rules can focus on three different phases of a disaster: Prevention and precaution, relief efforts and recovery efforts.⁴ Mileti refers to these three different phases of disaster efforts as “preparedness, response and recovery.” This Article focuses exclusively on the efforts made in the aftermath of the disaster and, more specifically, on the instruments that are available to provide compensation to victims. The three phases of disaster efforts mutually influence each other. This is especially the case for compensation mechanisms, which may have a positive or negative influence on the incentives to invest *ex ante* in preventive efforts.⁵ The crucial question in this Article is therefore how instruments applied in the aftermath of the disaster, in particular liability and other compensation mechanisms, can be constructed in such a way as to provide optimal incentives *ex ante* for disaster mitigation. The question of which instrument may be optimal under which circumstances depends to some extent on the nature of the disaster, but also on the ability of the instrument to expose those who create the risk of disasters (e.g., operators of hazardous facilities) to the damage in case disaster strikes. International environmental law offers relatively few compensation mechanisms. Those that it does offer focus on nuclear

³ See generally DANIEL A. FARBER & MICHAEL G. FAURE, *DISASTER LAW* (Daniel A. Farber & Michael G. Faure eds., 2010).

⁴ See DENNIS S. MILETI, *DISASTERS BY DESIGN: A REASSESSMENT OF NATURAL HAZARDS IN THE UNITED STATES* 209, 215, 220, 229 (1999) (discussing the three different phases of disasters and corresponding legal rules).

⁵ See generally Louis Kaplow, *Incentives and Government Relief for Risk*, 4 *J. RISK & UNCERTAINTY* 167, 167–75 (1991) (discussing how *ex post* compensation by governments can negatively affect *ex ante* incentives for prevention).

accidents and marine pollution. Most instruments in international environmental law, however, focus on technological risks rather than on natural catastrophes. This Article will follow a law and economics approach to determine optimal instruments of compensation in the view of their effects on disaster risk reduction, since law and economics has paid a lot of attention to the question of how different instruments can provide incentives for prevention.

A. *Technological Versus Natural Disasters*

The question of which instruments can be adequately applied to provide ex post compensation to victims as well as ex ante incentives for disaster mitigation depends to some extent on the cause of the disaster. A distinction is usually made between technological disasters, also referred to as man-made disasters, and natural catastrophes.⁶ Examples of technological disasters are oil spills and nuclear accidents, as well as explosions in particular plants or fires in public buildings. By contrast, natural catastrophes include heavy rainfall, flooding, earthquakes, volcano eruptions, and tsunamis. Data show that while the insured losses resulting from man-made disasters seemed to remain constant in the period between 1970–2007, during that same period there was a substantial increase in the insured losses due to natural catastrophes.⁷ A third type of catastrophe usually dealt with separately is the catastrophe caused by terrorism. Such catastrophes are treated separately because on the one hand they are obviously man-made, but on the other hand they share a similarity with natural catastrophes: The injurer (the terrorist) typically can either not be found or is insolvent. As a result, liability rules cannot apply.

In some cases it may be difficult to adequately distinguish between man-made disasters and natural catastrophes. For example, heavy rainfall could sometimes lead to flooding because infrastructural works have changed rivers and, as a result, the natural carrying capacity of waters has decreased and governments may have even promoted building in flood prone areas. In those cases, man-made activity can in fact encourage devastating consequences of natural catastrophes.⁸ Another example of the hybrid nature of the distinction between technological and natural disasters relates to the fact that, just as private actions could trigger a natural disaster (e.g., drilling activities might trigger a mud flow), natural disasters could in turn trigger a technological disaster like in the case where a tsunami triggers a nuclear disaster, as was the case in Fukushima.⁹

⁶ See generally VERONIQUE BRUGGEMAN, COMPENSATING CATASTROPHE VICTIMS: A COMPARATIVE LAW AND ECONOMICS APPROACH (Kurt Deketelaere ed., 2010) (describing the distinction between natural catastrophes and technological disasters).

⁷ See Howard Kunreuther, *Catastrophe Insurance: Challenges for the U.S. and Asia*, in ASIAN CATASTROPHE INS. 5 (Charles Scawthorn & Kiyoshi Kobayashi eds., 2008).

⁸ See Phil O'Keefe, Ken Westgate & Ben Wisner, *Taking the Naturalness out of Natural Disasters*, 260 NATURE 566–67 (1976); see also Richard Zeckhauser, *The Economics of Catastrophes*, 12 J. RISK & UNCERTAINTY 134 (1996).

⁹ See Michael Faure, Liu Jing & Andri Wibisana, *Industrial Accidents, Natural Disasters and 'Act of God'*, 43 GEORGIA J. INT'L & COMP. L. ___ (2015) (forthcoming).

B. *Providing Incentives for Disaster Risk Mitigation*

One of the basic starting points of the economic approach to law¹⁰ is that people react to financial incentives.¹¹ For example, when the operator of a hazardous facility is exposed to the financial consequences of the potential disasters he may create, perhaps via liability rules, this will in turn give him ex ante incentives to invest in disaster mitigation.¹² Hence, an important starting point for analysis is that, to the extent possible, those who create particular disaster risks through their activities should be held liable to compensate the damage they cause. The ex post duty to compensate will provide ex ante incentives to invest in disaster mitigation. This general idea may be of utmost importance in the field of technological or so-called man-made disasters, where there is an operator (or, in terms of tort law, a tortfeasor or injurer) who can be held accountable for the consequences of the disaster.

The idea of providing incentives through exposure to financial consequences is not only important as far as potential risk creators are concerned. It may also be important to expose potential *victims* to the financial consequences of their decision. Exposing individuals to the risk with which they are confronted—of flooding, for example—will make them aware of their vulnerability to a natural hazard and may therefore have a positive impact on their behavior. This may in turn provide incentives for disaster mitigation to potential victims.¹³ Further, failing to alert potential victims to the consequences of their choices—such as location in a hazard prone area—may negatively affect where they choose to live and reduce incentives to proactively mitigate disaster risks. Adopting this strategy will strongly support first-party insurance solutions¹⁴ and weigh against charity payments to victims. The latter may lead to an underinvestment in disaster mitigation measures.¹⁵

C. *Risk Differentiation*

Exposing both potential risk creators and potential victims to the financial consequences of disasters is important in order to provide correct incentives for disaster mitigation to the stakeholders involved. However, it does not suffice to expose those who can take mitigation efforts; it is equally important that they are exposed to risk to the extent that they actually contributed through their behavior to

¹⁰ See ANDREW T. GUZMAN, *HOW INTERNATIONAL LAW WORKS: A RATIONAL CHOICE THEORY* (2008) (providing a comprehensive and coherent theory on how international law works and which mechanisms boost compliance with international obligations); see generally STEVEN SHAVELL, *FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW* 8, 177–206 (2004) (providing the first comprehensive monograph applying economic theory to accident law and more particularly to torts).

¹¹ See ROBERT COOTER & THOMAS ULEN, *LAW & ECONOMICS* 4 (5th ed., 2008).

¹² This is the basic idea behind the economic approach to liability rules. See SHAVELL, *supra* note 10, at 177–206.

¹³ See Michael Faure, *Towards Effective Compensation for Victims of Natural Catastrophes in Developing Countries*, in *REGULATING DISASTERS, CLIMATE CHANGE AND ENVIRONMENTAL HARM* 243, 248 (Michael Faure & Andri Wibisana eds., 2013).

¹⁴ See also George Priest, *The Government, the Market and the Problem of Catastrophic Loss*, 12 *J. RISK & UNCERTAINTY* 221–25 (1996) (arguing that private insurance is able, via the control of the moral hazard by insurers, to provide incentives for mitigation of disaster risks).

¹⁵ MILETI, *supra* note 4, at 137.

that risk. This suggests that the exposure to financial consequences should be related to risk contribution—in other words, risk differentiation should be applied.¹⁶ It further implies that risk creators contributing a larger amount of risk should be exposed to a larger extent of financial consequences. The degree to which a victim is exposed to risk should therefore be reflected in the price the victim pays for protection against damage resulting from the risk, e.g., through insurance. Risk differentiation is crucial because it positively affects incentives for prevention, risk reduction, and mitigation of damage.

Moreover, risk differentiation could also be defended on distributional grounds. A solidarity on the basis of which all taxpayers pay for those exposed to risk could result in a situation in which those who faced no risk and those who faced high risk are rewarded equally. The distributional problem can be made clear on the basis of the following example: Suppose that a particular individual purchases a high quality villa at a low cost in a flood prone area next to a river. If the individual could, when the flooding occurs, rely on compensation by government—and, necessarily, general taxpayers—a distributional problem might arise. The individual has, at least from an economic perspective, already been compensated for the loss by purchasing the house at a lower purchase price; he may not have taken out insurance and thus may not have paid insurance premiums or have taken the essential preventive measures, and can subsequently shift the risk to the collectivity.¹⁷

D. Different Instruments for Different Disasters

This Article will focus on the instruments that could be used in the aftermath of a disaster to compensate victims. In light of the aforementioned principles of risk differentiation,¹⁸ a variety of instruments will be reviewed and their relative strengths and weaknesses will be discussed based on their capacity to provide incentives for disaster risk reduction. First, this Part will consider liability rules that are basically applicable in the case of technological disasters when there is an identifiable tortfeasor (III). Next, additional compensation mechanisms will come into the picture. Those play on liability rules by providing an extra layer of compensation beyond the amounts due by the tortfeasor, but also on natural catastrophes (IV). Finally, first-party insurance—the compensation mechanism appropriate for compensating victims of natural disasters—will be presented (V).

While insurance can play a role as liability insurance which companies may have to take to cover their liability risks for technological disasters (III), potential victims could also insure against natural disasters via first-party insurance (V).

E. International Law Instruments

There is an impressive amount of international environmental agreements, many of which have the goal of reducing disaster risk. In order to limit the

¹⁶ Faure, *supra* note 13, at 247–48.

¹⁷ *Id.*

¹⁸ See Parts II(B) & (C).

analysis, this Article will focus on tools of international law that have explicit provisions with respect to liability and compensation. Hence, the article's focus specifically concerns instruments that are applied in the aftermath of a disaster to compensate victims.¹⁹ As will be made clear below,²⁰ we distinguish between international regimes that can be categorized into four different groups: International conventions related to civil aviation, nuclear liability, marine oil pollution, and other international conventions that contain provisions on liability and compensation.

It should be recalled, however, that important provisions can also be found in the work of the International Law Commission (ILC) concerning the codification of international law. Interesting documents in that respect are on the one hand the 2001 Articles on State Responsibility for Internationally Wrongful Acts (ARSIWA)²¹ and on the other hand the Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities of 1976. The latter points to the necessity of providing adequate and prompt compensation for transboundary damage, primarily by the operator, but otherwise by the source state. The degree to which those principles focus on transboundary damage will not be discussed, although a deeper examination of the relationship between ILC instruments and disaster risk reduction would undoubtedly be an interesting point of further research.

A variety of other legal instruments of international law may include some provisions regarding compensation for transboundary harm or may at least be indirectly relevant for the prevention of disaster with a transboundary character. In this respect, one can for example refer to the United Nations Convention on the Law of the Sea 1982 (UNCLOS),²² which only imposes a vague obligation upon all states to protect and preserve the marine environment, but contains no specific liability rules or compensation mechanisms.²³ The same is the case for the Energy Charter Treaty,²⁴ which was established in 1994 to develop international cooperation in the energy sector, including trade, transit, investments, and energy efficiency. Again, Article 19 of the ECT contains the duties of the contracting parties to strive to minimize harmful environmental impacts occurring within the energy sector, but it lacks specific liability or compensation mechanisms. Another example is the Convention on Environmental Impact Assessment in a Transboundary Context, also referred to as the ESPOO Convention.²⁵ Again, this

¹⁹ There is no global treaty on civil liability for transboundary pollution or damage. See Alan E. Boyle, *Globalising Environmental Liability: The Interplay of National and International Law*, 17 J. ENVTL. L. 3, 4 (2005).

²⁰ See Part III(B).

²¹ See JAMES CRAWFORD, *STATE RESPONSIBILITY: THE GENERAL PART* 3, 41 (2013). On the liability rules in this respect, see also Boyle, *supra* note 19, at 9–16 (discussing various approaches to civil liability for environmental harm in a transboundary context).

²² United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 3 [hereinafter UNCLOS]. See Mehdi Piri & Michael Faure, *The Effectiveness of Cross-Border Pipeline Safety and Environmental Regulations (under International Law)*, 40 N.C. J. INT'L. & COM. REG. 86, 86–94 (2014).

²³ Hui Wang, *Transboundary Vessel-Source Marine Pollution: International Legal Framework and its Application to China*, in *CHINA AND INTERNATIONAL ENVIRONMENTAL LIABILITY: LEGAL REMEDIES FOR TRANSBOUNDARY POLLUTION* 64, 68–71 (Michael Faure & Song Ying eds., 2008).

²⁴ The Energy Charter Treaty, Dec. 17, 1993, 2080 U.N.T.S. 95 [hereinafter Energy Charter].

²⁵ Convention on Environmental Impact Assessment in a Transboundary Context, Feb. 5, 1991, 30 I.L.M. 800 (1991) [hereinafter ESPOO]. This Convention prescribes, inter alia, in Article 2(1) that

Convention sets up obligations of contracting parties to assess environmentally adverse impacts of certain hazardous activities and to consult affected states prior to decision-making,²⁶ but fails to offer specific liability rules or compensation mechanisms. For that reason, those international environmental agreements—and others like them—remain undiscussed here, although they can undoubtedly contribute to an important extent to disaster risk mitigation.

Finally, we could also mention the importance of principles of international environmental law that could either affect states' responsibilities or play an indirect role in domestic litigation concerning transboundary harm.²⁷ We therefore recognize that those principles may have an impact by shaping the scope of liability rules and consequently affecting the incentives of risk creators. However, they are beyond the scope of this discussion since the importance of environmental principles is only indirectly related to the scope of the operator's liability.

II. LIABILITY RULES AND SOLVENCY GUARANTEES

Liability rules can undoubtedly be considered instruments that can fulfill the goals of exposing operators to the costs related to the harmful consequences of disasters. In that way, the imposition of liability *ex post* could provide *ex ante* incentives for disaster mitigation. However, in order for liability rules to fulfill this preventive effect, particular conditions must be met. Moreover, liability rules may also contain limits (A). As previously mentioned,²⁸ liability rules found in particular international environmental agreements show interesting similarities (B). Nonetheless, the way in which liability rules are shaped in international environmental agreements is often problematic given the starting point of providing efficient incentives for disaster mitigation. An analysis will reveal that, in many cases, rules of domestic law (e.g., in the United States) serve the goal of providing incentives for disaster mitigation better than the liability rules contained in international environmental agreements (C).

the party shall, either individually or jointly, take all appropriate and effective measures to prevent, reduce and control significant adverse transboundary environmental impact from proposed activities. The following Articles ensure that the party of origin must undertake an environmental impact assessment prior to a decision to authorize or undertake a proposed activity (Article 2(3)). See PHILIPPE SANDS & JACQUELINE PEEL, *PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW* 610–13 (3d ed., 2012) (discussing the obligations of parties under the ESPOO Convention).

²⁶ See NEIL CRAIK, *THE INTERNATIONAL LAW OF ENVIRONMENTAL IMPACT ASSESSMENT: PROCESS, SUBSTANCE AND INTEGRATION* 101 (2008) (providing details concerning the obligations of adverse parties as imposed by UNCLOS).

²⁷ See generally André Nollkaemper, *Cluster-Litigation in Cases of Transboundary Environmental Harm*, in *CHINA AND INTERNATIONAL ENVIRONMENTAL LIABILITY*, *supra* note 23, at 11–37 (arguing also at page 31 that it is rare for principles of international responsibility to be applied in domestic courts as well).

²⁸ See Part II(E).

A. Potential, Conditions, and Limits

1. Potential

The economic approach to liability rules reveals that they have the major advantage of providing incentives for hazard mitigation.²⁹ For more traditional tort lawyers, the main goal of tort law would be to compensate accident victims, and not to primarily provide deterrence.³⁰ By exposing them to the costs of their activities via liability rules, parties will be given appropriate incentives for taking optimal care to prevent accidents. Since it is the level of care that minimizes the costs of prevention and the expected damage costs, taking optimal care would reduce the total social costs of accidents.³¹ This basic insight can apply to the damage resulting from disasters as well: The exposure of the risk taker to liability provides incentives for disaster mitigation.³²

In 1961, Guido Calabresi stressed the deterrent effect of liability rules.³³ He suggested they would force a potential tortfeasor to take efficient care. The effect of a liability rule is that the social costs of the accident are allocated to the source of the risk that created the accident. Put more simply: The costs of the potential tortfeasor's activity will confront the enterprise causing the particular risk, which will, in turn, incentivize prevention. Moreover, the tortfeasor—the one who creates the risk—pays compensation. As a result, a perfect diversification of risk can take place.

Some have been critical of the assumption that tort law could have any deterrent effect and would therefore influence the behavior of individuals.³⁴ However, most of these doubts only relate to the behavior of individuals, and not of enterprises. Enterprises' decisions regarding how much to invest in disaster risk prevention may be the result of a conscious cost-benefit calculus more so than in the case of individuals. There is, moreover, increasing empirical evidence of the deterrent effect of liability rules.³⁵

Finally, it is important that in the economic approach prevention is considered to be the primary goal of liability rules. Victim compensation as such is

²⁹ See the basic approach in Steven Shavell, *Strict Liability Versus Negligence*, 9 J. LEGAL STUD. 1 (1980).

³⁰ See Gary T. Schwartz, *Reality in the Economic Analysis of Tort Law: Does Tort Law Really Deter?*, 42 UCLA L. REV. 377, 381–82 (1994) (arguing that there would be little empirical evidence that people actually change their behavior as a result of an exposure to liability and criticizing the economic approach to tort law).

³¹ See STEVEN SHAVELL, *ECONOMIC ANALYSIS OF ACCIDENT LAW* 5–32 (1987).

³² See Faure, *supra* note 13, 249–50.

³³ See Guido Calabresi, *Some Thoughts on Risk Distribution and the Law of Torts*, 70(4) YALE L.J. 499 (1961); GUIDO CALABRESI, *THE COSTS OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS* 24–28 (1970) (arguing that the goal of accident law is to reduce the total social cost of accidents which can be reached through either general or specific deterrence of potential wrongdoers).

³⁴ See Richard L. Abel, *A Critique of Torts*, 37 UCLA L. REV. 685 (1990) (criticizing the fact that tort law has turned to the language of economics, replacing moral judgment with concern for the efficient allocation of resources); see also Gregory C. Keating, *Reasonableness and Rationality in Negligence Theory*, 48 STAN. L. REV. 311 (1996) (arguing that the concept of reasonableness fits the doctrine and rhetoric of due care law better than the rationality concept defended by law and economics).

³⁵ See Ben C.J. van Velthoven, *Empirics of Tort*, in *TORT LAW AND ECONOMICS* 453 (Michael Faure ed., 2d ed. 2009).

not. Rather, the exposure of the risk taker to liability is considered to have the advantage of providing incentives for optimal prevention. Compensation is hence a means rather than a goal.

2. Conditions

Although it was just discussed how exposing risk creators to liability rules may provide efficient incentives for disaster mitigation, it was also stressed that this effect will not be reached automatically and unconditionally. A careful design of liability rules is necessary in order to enable them to provide incentives for disaster risk mitigation.

a. Strict Liability Versus Negligence

A basic question, often addressed in the literature,³⁶ is whether the operator—the tortfeasor in a liability context—should be exposed to a strict liability or a negligence rule. A distinction is usually made between the case where only one party, the injurer, can influence the accident risk—this is referred to as a unilateral accident situation—and the situation where both the injurer and the victim can influence the accident risk; the latter is referred to as a bilateral accident situation.³⁷ The goal of tort law should be to provide parties that can influence the accident risk with incentives in order to reduce the total sum of accident costs. Those costs consist, on one hand, of the costs of prevention and, on the other hand, of the costs of the accident (the damage). Efficient care levels can be found where the marginal costs of care equal the marginal benefits in reduction of the expected loss.³⁸

In a unilateral accident case, where only the injurer can influence the accident risk, both negligence and strict liability will provide incentives to follow an efficient care level. On the condition that the due care required in the legal system is equal to the efficient care, the injurer will take the efficient care level. The simple explanation is that the injurer will be found liable under the negligence rule if he spends less than the due care level required in the legal system. Hence, for the injurer following the due care level is a mechanism to reduce his expected costs. The negligence rule can therefore in principle give a tortfeasor an incentive to spend on care to reach the optimal standard. However, in order for the negligence rule to work optimally, the legal system must define the due care level as the efficient care level.

Additionally, a strict liability rule will lead to optimal incentives for care taking for the polluter, since taking efficient care will minimize the expected accident costs which the potential polluter has to bear under a strict liability

³⁶ The seminal article is by Shavell, *supra* note 29. See generally Hans-Bernd Schäfer & Frank Müller-Langer, *Strict Liability Versus Negligence*, in *TORT LAW AND ECONOMICS*, *supra* note 35, at 3–45 (providing a recent overview of the economic literature with respect to the choice between strict liability and negligence).

³⁷ *Id.*

³⁸ See William Landes & Richard Posner, *Tort Law as a Regulatory Regime for Catastrophic Personal Injuries*, 13 *J. LEGAL STUD.* 417 (1984).

system.³⁹ Therefore, the literature generally accepts that both a negligence rule and a strict liability rule will provide a potential polluter with incentives to take the efficient care level. However, this is only valid in a unilateral accident setting, in an accident wherein only the injurer can influence the accident risk.

In a bilateral accident situation the potential victim also needs to be provided with incentives for mitigation. In that case a contributory negligence defense should be added to the strict liability rule. Under a negligence regime, victims will always have an incentive to take efficient care as well, since they will—in principle—not be compensated by the injurer, who will take efficient care to avoid liability under a negligence rule.

In the joint care or bilateral case, strict liability with contributory negligence and a negligence rule—with or without contributory negligence—will incite parties to adopt efficient levels of care. However, the accident risk cannot be completely minimized by increasing the levels of care. Accident losses also depend on the extent to which parties participate in the activity that might cause the damage (e.g., the miles driven). Therefore, reducing the activity level will also reduce the accident risk.⁴⁰ The activity level can be interpreted as any control variable not taken into account in setting the optimal level of care. Under a negligence rule, an injurer has no incentive to adopt an optimal level of activity. This cannot be remedied, because judges cannot easily calculate the optimal activity level into the due care standard.⁴¹ A strict liability rule has the advantage that the injurer will automatically adopt an optimal activity level. This is also a means to minimize his costs. If the victim's activity has no influence on the accident risk, strict liability might have a slight advantage, because it might also lead to an optimal activity level of the injurer. Nevertheless, in a joint care case this advantage is cancelled out by the fact that the victim will not adopt an optimal activity level. This is due to the impossibility of calculating the activity level into the due care standard when considering contributory negligence.⁴²

What is the importance of the activity level for the choice between negligence and strict liability? In a unilateral accident model, wherein only the behavior of the injurer influences the accident risk, strict liability seems to be the preferred rule since it is the only liability rule which will lead both to efficient care and to an optimal activity level. In a bilateral case the answer is more balanced.

Since changes in activity level are not calculated into the due care standard, strict liability with a defense of contributory negligence will encourage activity level changes on the part of the injurer. On the other hand, a negligence rule will encourage activity level changes of the victim. Therefore, several authors suggest that in bilateral cases strict liability will be a superior device if giving injurers an incentive to change their activity level is more important than giving victims a similar incentive.⁴³ This implies that if the injurer's activity is very dangerous and

³⁹ A. MITCHELL POLINSKY, *INTRODUCTION TO LAW AND ECONOMICS* 44–47 (1983); SHAVELL, *supra* note 31, at 8.

⁴⁰ Peter A. Diamond, *Single Activity Accidents*, 3 J. LEGAL STUD. 107, 109–11 (1974); Polinsky, *supra* note 39, at 44; Shavell, *supra* note 29.

⁴¹ It is difficult to determine both the optimal and the actual activity level. See, e.g., Polinsky, *supra* note 39, at 47; Shavell, *supra* note 29, at 2.

⁴² William Landes & Richard Posner, *The Positive Economic Theory of Tort Law*, 15 GA. L. REV. 875 (1981); SHAVELL, *supra* note 31, at 23–24.

⁴³ Landes & Posner, *supra* note 42, at 877; Shavell, *supra* note 29, at 7, 19.

creates a high accident risk, even if optimal care is taken, it will be more desirable to control the injurer's activity than it is to control the victim's.

Even though a clear-cut test is thus difficult to provide, Landes and Posner describe several factors that may lead to a preference for a strict liability rule. These elements are: (1) high expected accident costs; (2) the impossibility that more care by the injurer would reduce the accident risk; (3) the impracticability of constraining the victim's activity in favor of the injurer's; and (4) the desirability of reducing the risk by an activity level change of the injurer.⁴⁴

Since tortfeasors such as petrochemical plant operators are undoubtedly much more influential than victims with respect to technological accident risks that could lead to man-made disasters, there are strong arguments in favor of applying a strict liability rule to such ultra-hazardous activities. The strong appeal of the strict liability rule (of course combined with a comparative negligence defense to account for the victim's influence on the risk as well)⁴⁵ is that it advantageously shifts all social costs of the accident to the operator. Thus, the operator will appropriately weigh costs and benefits concerning optimal preventive measures and activity levels.⁴⁶ For this reason, it is no surprise that the literature generally advocates strict liability both for environmental harm⁴⁷ and for technological disasters.⁴⁸

b. Solvency Guarantees

Unfortunately, strict liability may only be efficient if the insolvency problem can be cured. Insolvency should be seen here as a situation where the amount of the damage is higher than the tortfeasor's wealth. This scenario is very likely in case of catastrophes. The literature has even indicated that, if an insolvency problem persists, strict liability may more easily lead to underdeterrence than negligence.⁴⁹ This is because strict liability leads to underdeterrence as soon as the total amount of the damage is lower than the injurer's wealth. Under a negligence regime, the tortfeasor still has an incentive to spend on care as long as the costs of due care required in the legal system are less than his wealth. Spending

⁴⁴ Landes & Posner, *supra* note 42, at 907; for a more recent overview of the literature see Hans-Bernd Schäfer & Frank Müller-Langer, *Strict Liability Versus Negligence*, in TORT LAW & ECONOMICS, *supra* note 35, at 36, at 3–45.

⁴⁵ The literature makes a distinction between a contributory negligence defense (where the plaintiff would be completely barred from compensation if he would be at fault) and a comparative negligence defense (where the victim's claim on compensation would only be reduced to the proportion in which he contributed to the loss as well). Both defenses are generally considered sufficient to provide incentives for appropriate victim care. For an overview of the literature see Mireia Artigot i Golobardes & Fernando Gómez Pomar, *Contributory and Comparative Negligence in the Law and Economics Literature*, in TORT LAW AND ECONOMICS, *supra* note 35, at 46.

⁴⁶ Shavell, *supra* note 29.

⁴⁷ For a summary of the literature see Michael Faure, *Environmental Liability*, in TORT LAW AND ECONOMICS, *supra* note 35, at 252–53 (summarizing the literature defending a strict liability rule for environmental pollution).

⁴⁸ See Michael Faure, *Financial Compensation for Victims of Catastrophes: A Law and Economics Perspective*, 29 L. & POL'Y 339, 342–43 (2007); BRUGGEMAN, *supra* note 6, at 38–39.

⁴⁹ Michael Faure & David Grimeaud, *Financial Assurance Issues of Environmental Liability*, in DETERRENCE, INSURABILITY AND COMPENSATION IN ENVIRONMENTAL LIABILITY: FUTURE DEVELOPMENTS IN THE EUROPEAN UNION 7, 35–36 (Michael Faure ed., 2003); Landes & Posner, *supra* note 38, at 418.

on due care will in that case still be attractive for the injurer since it implies that he will not be held liable.⁵⁰

When strict liability is introduced, it should thus be accompanied by some guarantee against insolvency. This is, moreover, a more general point made in economic literature: Liability rules only work efficiently, in terms of both deterrence and compensation, if solvency of the tortfeasor can be guaranteed. Otherwise, a so-called “judgment proof” problem will arise whereby liability rules may generally fail to lead to a deterrent effect.⁵¹ There is, therefore, a strong economic argument in favor of imposing a duty to purchase financial coverage (e.g., compulsory liability insurance) for disasters simply because the magnitude of the damage caused by a disaster can greatly outweigh the assets of an individual tortfeasor.⁵²

c. No Limits

In sum, although strict liability can, in principle, be efficient for technological disasters, due to a potential insolvency problem it should be accompanied with solvency guarantees since it could otherwise lead to underdeterrence. Precisely for that reason there should likewise be no limit on the liability of the potential tortfeasor. A so called “financial cap,” which limits the tortfeasor’s liability to a particular amount, will have the same effect as insolvency, i.e., it will lead to underdeterrence and thus negatively affect incentives for prevention.

An obvious disadvantage of a system involving financial caps is the serious impairment of the victim’s right to full compensation. However, if the cap is indeed set at a much lower amount than the expected damage, this would not only violate the victim’s right to compensation, but would also prevent the full internalization of the externality mentioned above. From an economic point of view, a limitation on compensation therefore poses a serious problem, since the risky activity will not be internalized.

Indeed, if one believes that exposure to liability has a deterrent effect, limiting the amount of compensation owed to victims poses yet another problem. There is a direct linear relationship between the magnitude of the accident risk and the amount spent on care by the potential wrongdoer. Therefore, if the liability is limited to a certain amount, the potential injurer will assess the accident’s magnitude in proportion to that limited amount. Hence, he will only spend on care to avoid causing an accident with a magnitude equal to his limited amount of liability, and he will not spend the care necessary to reduce the total accident costs. Obviously, the amount of care spent by the potential injurer will be lower, causing a problem of underdeterrence. The amount of optimal care reflected in the optimal standard—that is to say the care necessary to efficiently reduce the total accident costs—will exceed the amount the potential injurer will spend to avoid an accident

⁵⁰ Faure & Grimeaud, *supra* note 49.

⁵¹ Steven Shavell, *The Judgment Proof Problem*, 6 INT’L REV. L. & ECON. 45 (1986).

⁵² See Howard C. Kunreuther & Paul K. Freeman, *Insurability, Environmental Risks and the Law*, in THE LAW AND ECONOMICS OF THE ENVIRONMENT 302 (2001).

equal to the statutory limited amount.⁵³ Thus, as a result of the cap too little care is taken.⁵⁴

Moreover, another effect of imposing a financial limit on liability (in addition to victim undercompensation and operator underdeterrence) is that it would constitute an indirect subsidization of the industry that enjoys a particular limit on liability.⁵⁵

d. Attribution

Another point that remains important in the design of efficient liability rules is that liability should be attributed in such a way that all parties that contributed to the risk should be held liable to the extent that their actions actually affected the accident risk. When several tortfeasors have acted together, a joint and several liability rule may provide incentives to the joint tortfeasors for mutual monitoring.⁵⁶ In any case, liability of other actors who contributed equally to the loss should not be excluded by, for example, exclusively channeling the liability to one selected tortfeasor, e.g., the licensee of a particular plant. Doing so would negatively affect the incentives of others who could have equally contributed to the loss.⁵⁷

However, inefficiencies may arise in case of insolvency of one of the actors, since recourse may become impossible.⁵⁸ Joint and several liability is debated since an injurer could, in principle, also be held liable for a part of the damage not caused by his activity, thus potentially increasing his liability exposure.⁵⁹

The application of joint and several liability is a general rule in all cases where more than one tortfeasor is involved. Many legal systems adopt a joint and several liability rule where more than one party (e.g., an operator and a subcontractor) has contributed to the accident risk.⁶⁰ Joint and several liability has,

⁵³ See Michael Faure, *Economic Models of Compensation for Damage Caused by Nuclear Accidents: Some Lessons for the Revision of the Paris and Vienna Conventions*, 2 EUR. J.L. & ECON. 27–28 (1995).

⁵⁴ The reason for the underdeterrence is obviously the same as for the underdeterrence that results from the insolvency of the injurer. Underdeterrence arises because the injurer is not exposed to full liability, either as a result of his insolvency or as a result of a cap.

⁵⁵ See Marcus Radetzki & Marian Radetzki, *Private Arrangements to Cover Large-Scale Liabilities Caused by Nuclear and Other Industrial Catastrophes*, 25 GENEVA PAPERS ON RISK & INS. 180 (2000) (arguing that the top layer of compensation provided by the governments in fact constitutes a subsidy to nuclear power generation).

⁵⁶ See Tom Tietenberg, *Indivisible Toxic Torts: The Economics of Joint and Several Liability*, 65 LAND ECON. 305, (1989) (discussing this incentive mechanism).

⁵⁷ MICHAEL FAURE & TON HARTLIEF, *INSURANCE AND EXPANDING SYSTEMIC RISKS* 127–28 (2003).

⁵⁸ See Lewis A. Kornhauser & Richard Revesz, *Sharing Damages Among Multiple Tortfeasors*, 98 YALE L.J. 831 (1989) (providing an analysis of joint and several liability under full solvency); Lewis A. & Richard Revesz, *Apportioning Damages Among Potentially Insolvent Actors*, 19 J. LEGAL STUD. 617 (1990) (analyzing liability in case of insolvency).

⁵⁹ For this reason, joint and several liability in case of environmental harm is opposed by Lucas Bergkamp, *The Proper Scope of Joint and Several Liability*, 14 TIJDSCHRIFT VOOR MILIEUAANSPRAKELIJKHEID 153–56 (2000).

⁶⁰ See W.V. Horton Rogers, *Comparative Report on Multiple Tortfeasors*, in UNIFICATION OF TORT LAW: MULTIPLE TORTFEASORS 271, 276–79 (W.V. Horton Rogers ed., 2004).

however, been criticized from an insurance perspective, based on the argument that it increases the necessity to purchase insurance coverage for all parties involved.⁶¹

e. Summary

To summarize, liability rules can be used to provide incentives for disaster mitigation, but particular conditions must be met:

- A strict liability rather than a negligence rule should apply;
- solvency guarantees should exist;
- no statutory limit (a so-called cap) should be imposed on the operator's liability; and
- liability should be attributed to all actors who can influence the risk of a catastrophe.⁶²

Under these conditions liability rules can have the desirable effect of incorporating the social costs of technological risks into the prices of the activity concerned and to provide incentives to operators for disaster risk reduction. The liability rules only provide incentives to take optimal care,⁶³ which can thus reduce the chilling effects that could follow from what the literature considers “crushing” liability. For example, the latter could occur when operators would also be held liable for harm that was not caused by their own activity.⁶⁴ However, the mere fact that the application of a liability rule will lead to increased prices of particular products or services (resulting from higher investments in preventive efforts) is from a social welfare perspective nothing but desirable. Efficient operators—those taking optimal care to reduce disaster risks—will be able to produce at lower prices than inefficient ones, who would not take optimal preventive measures and would thus be confronted with higher liability risks and higher insurance premiums. That is precisely the desirable result of the application of liability rules: Efficient operators will be rewarded with lower liability risks and, therefore, lower prices.

3. *Limits of Liability Rules*

a. Priority of Regulation

Although a strict liability rule could in theory provide incentives for disaster risk mitigation—provided that solvency guarantees are in place and that liability is effectively attributed to all those who contributed to the risk—in practice there can be many reasons why liability rules may generally not have a deterrent

⁶¹ See FAURE & HARTLIEF, *supra* note 57, at 127.

⁶² For a more detailed discussion of those conditions, see Faure & Grimeaud, *supra* note 49, at 18–50.

⁶³ Recall, this is the care where the marginal costs of accident prevention equal the marginal benefits reduction of the expected damage.

⁶⁴ Inter alia as a result of a shift in the burden of proving causation. FAURE & HARTLIEF, *supra* note 57, at 126–27. On the dangers of such a crushing liability more particularly, see Michael J. Trebilcock, *The Social Insurance-Deterrence Dilemma of a Modern North-American Tort Law: A Canadian Perspective on the Liability Insurance Crisis*, 24 SAN DIEGO L. REV. 929, 958–60 (1987) (arguing that the attempt to pursue deterrence objectives and compensation objectives—traditionally in social insurance—through this tort system leads to a destabilization of the tort system and to a lacking availability and affordability of liability insurance).

effect. Shavell's well-known work on the choice between liability rules and safety regulation identifies these limits of liability rules.⁶⁵ Shavell indicates that: (1) When information on preventive technology would be greater with government than with private parties and (2) when insolvency problems would arise and/or (3) for a number of reasons a liability suit would never be brought, regulation can be a more effective instrument to control externalities—like damage to critical infrastructure—than private law instruments such as liability rules.⁶⁶

Turning to each of those criteria, it seems that these potential weaknesses of liability rules are all relevant to the potential damage resulting from technological disasters. Private parties may in some cases lack adequate information on preventive technology, whereas governments can use economies of scale and thus invest more efficiently in prevention. Moreover, regulation could pass on information regarding optimal preventive technologies to the parties in the market. The insolvency problem will obviously arise in all cases where smaller operators may also cause high damage whose potential magnitude may outweigh their personal assets. In addition, corporations' limited liability may support the externalization of harm onto third parties and society in general.⁶⁷ To the extent that solvency guarantees would be unavailable or unable to cure the underdeterrence that follows from insolvency, this may likewise be an argument in favor of ex ante safety regulation.

There can also be a number of reasons why victims never bring tort suits despite in theory meeting all the conditions. First, tortfeasors cannot be identified in some cases; second, there can be a long period between the accident and the damage (referred to as latency); third, problems of proof may arise as well as problems related to uncertainty over causation. Fourth, victims may face large hurdles such as going to court and effectively litigating. Legal aid, contingency fees, or other instruments to lower the barriers to access to justice are often insufficiently developed.⁶⁸ Precisely given these hurdles, using liability rules may also have a rather ad hoc character as far as compensating victims of catastrophes. In other words: Some victims may receive generous compensation if they are successful in the "tort law lottery," whereas others may receive no compensation whatsoever.⁶⁹ Compensation via liability rules therefore has no structural nature and may also come at odds with the equality principle.

b. Public Authority Liability?

At first blush it may be obvious that an important limit of tort liability in providing incentives for disaster mitigation is that liability rules can only work in the case of technological disasters where a liable tortfeasor can be identified and

⁶⁵ See Steven Shavell, *Liability for Harm Versus Regulation of Safety*, 13 J. LEGAL STUD. 357, 363 (1984).

⁶⁶ For a detailed development of those criteria, see *id.* at 359–64.

⁶⁷ For that reason the limited liability of corporate entities has been seriously criticized by Henry Hansmann & Reinier Kraakman, *Toward Unlimited Shareholder Liability for Corporate Torts*, 100 YALE L.J. 1879 (1991) especially when involuntary creditors (like tort victims) are involved.

⁶⁸ For difficulties concerning access to justice see the contributions in MARK TUIL & LOUIS VISSCHER, *NEW TRENDS IN FINANCING CIVIL LITIGATION IN EUROPE: A LEGAL, EMPIRICAL AND ECONOMIC ANALYSIS* (2010).

⁶⁹ See Van Velthoven, *supra* note 35, at 461–71 (showing that in fact the tort system is highly selective and only leads to compensation for a relatively small number of accident victims).

where the damage can be directly attributed to manmade causes. No liable tortfeasor can be found, for example, when an earthquake, a flooding, or a volcanic eruption occurs. The only possibility to apply tort law to those natural disasters is to argue that public authorities were at fault, e.g., by failing to prevent the disaster or to take adequate measures to mitigate the damage. This raises the question of the adequacy of public authority liability.

It is possible to theoretically imagine situations where public authorities would be at fault in case of a natural disaster. In fact, some scholars have held that there are no natural disasters, but only natural events that turn into disasters as a result of the intervention of men.⁷⁰ Indeed, there are many ways, particularly through the design of critical infrastructure, to ex ante reduce the probability of damage or mitigate the seriousness of the consequences.⁷¹ Precautionary measures to reduce the likelihood of disasters can be taken by individuals but, especially where large-scale measures are concerned, by governments as well. Many disasters can be prevented, and a lack of precautionary measures is often the real reason why natural events have catastrophic consequences.⁷² A failure to prevent the disaster or to take adequate measures to mitigate the damage can hence in some cases be attributed to a government. It could for example be held that the government failed to give adequate warning, e.g., in case of a flooding, or it could be questioned why governments provide building permits allowing house construction in flood prone areas or on the slopes of active volcanoes.

Critical questions concerning the role of public authorities are often asked after many natural disasters cause substantial damage. For example, in the case of Hurricane Katrina, Shughart showed that no effective precautionary measures had been taken before Katrina was announced because of bureaucratic myopia, bureaucratic inertia, and corruption.⁷³ As a consequence, the question of governmental responsibility was raised in the wake of Katrina.⁷⁴ However, none of those lawsuits were successful.⁷⁵

One reason why lawsuits against public authorities are often not brought in cases of natural disasters is that governments generously intervene with public aid. For example, in the case of Katrina, a report of the U.S. Senate refers to a total

⁷⁰ See Phil O'Keefe, Ken Westgate & Ben Wisner, *Taking the Naturalness out of Natural Disasters*, 260 *NATURE* 566 (1976); Zeckhauser, *supra* note 8.

⁷¹ See Herman B. Leonard & Arnold M. Howitt, *Acting in Time Against Disaster: A Comprehensive Risk Management Framework*, in *LEARNING FROM CATASTROPHES: STRATEGIES FOR REACTION AND RESPONSE* 18 (Howard Kunreuther & Michael Useem eds., 2010).

⁷² O'Keefe et al., *supra* note 70.

⁷³ See William F. Shughart II, *Katrinanomics: The Politics and Economics of Disaster Relief*, 127 *PUB. CHOICE* 31, 33–41 (2006).

⁷⁴ See Jonathan Walters & Donald Kettl, *The Katrina Breakdown*, in *ON RISK AND DISASTER: LESSONS FROM HURRICANE KATRINA* 255–61 (Ronald J. Daniels, Donald F. Kettle & Howard Kunreuther eds., 2006). See generally Vicki Bier, *Hurricane Katrina as a Bureaucratic Nightmare*, in *ON RISK AND DISASTER: LESSONS FROM HURRICANE KATRINA* 243–54 (Ronald J. Daniels, Donald F. Kettle & Howard Kunreuther eds., 2006) [hereinafter *ON RISK AND DISASTER*] (discussing the failures of planning and response in relation to Katrina).

⁷⁵ See Mark Schleifstein, *Federal Judge Dismisses Most of Remaining Katrina Damage Lawsuits*, *NOLA.com* (Dec. 27, 2013, 5:03 PM), http://www.nola.com/environment/index.ssf/2013/12/federal_judge_dismisses_most_o.html; see also JEREMY I. LEVITT & MATTHEW C. WHITAKER, *HURRICANE KATRINA: AMERICA'S UNNATURAL DISASTER* 207 (2009); *Judge Ends Katrina Flooding Lawsuits Against Feds*, *USA TODAY* (Dec. 28, 2013, 5:57 PM), <http://www.usatoday.com/story/news/nation/2013/12/28/judge-ends-katrina-flooding-lawsuits-against-feds/4233217/>.

amount of USD 88 billion that the U.S. Federal Government has committed as of March 8, 2006 to the response, recovery and rebuilding efforts.⁷⁶

There is also a serious potential for public authority liability since public choice analysis shows that politicians tend to underinvest in precautionary efforts because these do not lead to substantial political gains during the term of office of the particular politician.⁷⁷ This not only plays out in the case of Katrina, as mentioned before, but more generally with all necessary precautionary efforts to mitigate damage. For example, scholars have held with respect to hurricanes that “a number of important potential precautionary strategies that are designed to minimize the expected costs or consequences associated with a natural disaster—but not the risk of its occurrence, which we are assuming to be exogenous—have many of the characteristics of public goods and if left purely to private markets are likely to be underdemanded and undersupplied as a result of collective action problems.”⁷⁸

Public authority liability could obviously also arise in the transboundary context, where the question of state responsibility could be raised, in case of breach of an international obligation, pursuant to the ARSIWA, or the question of state liability could arise based on the ILC principles on the allocation of loss. However, in practice one rarely sees cases of public authority liability for the simple reason that governments have a strong tendency to provide ex post compensation, in part because this generates high political rewards. The tendency of governments to provide this ex post compensation may to some extent even be triggered by the fear of public authority liability, thus avoiding the imposition of blame on governments.

c. Summary

Although we argued that liability rules—more particularly strict liability with solvency guarantees—can provide incentives for disaster risk mitigation, in practice the impact of liability rules may not be that large. Due to high barriers to entry, the liability regime may turn out to be merely an ad hoc system available to only a small percentage of accident victims. The primary role in preventing disasters will thus most likely be played by safety regulations, often also resulting from international environmental agreements directly aiming at disaster risk mitigation. As a result of many problems, such as causation, latency, proof, access to justice, among others, in practice liability rules often only play a limited or supplementary effect in preventing technological disasters.

Moreover, liability rules can basically only apply in cases of technological disasters where a liable tortfeasor can be identified. In the case of natural disasters, the only actor who could be held liable would be a public authority, but suits against public authorities, either based on domestic law or on rules of state responsibility or liability, are rare. This leads to the conclusion that the scope of liability rules in providing prevention and compensation will remain limited both

⁷⁶ Report of the Senate Committee on Homeland Security and Governmental Affairs, *Hurricane Katrina: A Nation Still Unprepared*, Executive Summary, May 2006, at 17, available at <http://www.disastersrus.org/katrina>.

⁷⁷ See Ben Depoorter, *Horizontal Political Externalities: The Supply and Demand of Disaster Management*, 56 DUKE L.J. 101, 110–14 (2006).

⁷⁸ Ronald J. Daniels & Michael J. Trebilcock, *Rationales and Instruments for Government Intervention in Natural Disasters*, in *ON RISK AND DISASTER*, *supra* note 74, at 91–92.

for technological as well as for natural disasters. As a result, alternative rules will have to be called upon. For prevention purposes these rules may be ex ante government regulation, whereby compensation can be provided through alternative compensation mechanisms⁷⁹ or insurance.⁸⁰ In both cases it is obviously important to also determine how those mechanisms affect the ex ante incentives for disaster risk mitigation.

B. *Liability Rules in International Environmental Agreements*⁸¹

1. *Civil Aviation*

With the development of civil aviation, people started to realize the potential damage caused by aircrafts to the people and property on board, as well as to third parties on the ground. The Convention for the Unification of Certain Rules relating to International Carriage by Air was concluded in Warsaw in 1929 and applies to damage to international carriage of persons, baggage and cargo. Damage to third parties on the ground has a different characteristic, in that usually an ex ante contract cannot be reached between the potential injurers and victims. A separate liability regime was therefore established in 1952: The Rome Convention. This convention was later revised by the 1978 Protocol to Amend the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface (1978 Protocol). Another attempt to further revise the convention resulted in the 2009 Convention on Compensation for Damage Caused by Aircraft to Third Parties. However, this new convention has not come into force yet.

The 1952 Rome Convention establishes strict liability by attributing liability to aircraft operators.⁸² The Convention defines the term “operator” as the person who was making use of the aircraft at the time the damage was caused, provided that an individual who cedes the right to use the aircraft but directly or indirectly retains control of its navigation shall be considered the aircraft’s operator.⁸³ With the exception of deliberate acts or omissions, Article 9 of the Rome Convention constitutes the only basis of liability for operators.⁸⁴ However, this Convention does not expressly exclude liability of other parties, and it does not prejudice the right of recourse against other parties.⁸⁵

⁷⁹ See *infra* Part IV.

⁸⁰ See *infra* Part V.

⁸¹ It is of course not possible within the scope of this Article to discuss all conventions in which some references to civil liability or compensation would have been made. We therefore selected some conventions of particular importance and interest. For a further analysis see JULIO BARBOZA, *THE ENVIRONMENT, RISK AND LIABILITY IN INTERNATIONAL LAW* 32–43 (2011); Jutta Brunnée, *Of Sense and Sensibility: Reflections on International Liability Regimes as Tools for Environmental Protection*, 53 INT’L COM. L. Q. 351 (2004); SANDS & PEEL, *supra* note 25, at 700–72.

⁸² Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface art. 1(1), Oct. 7, 1952, 310 U.N.T.S. 243 [hereinafter Rome Convention] (“Any person who suffers damage on the service shall, upon proof only that the damage was caused by an aircraft in flight or by any person or thing falling therefrom, be entitled to compensation as provided by this Convention.”).

⁸³ *Id.* art. 2(a).

⁸⁴ *Id.* art. 9.

⁸⁵ *Id.* art. 10.

The Rome Convention establishes liability caps according to the weight of the aircraft.⁸⁶ In addition, it also establishes a mandatory financial security system. Any Contracting Parties may require the aircraft operator to maintain insurance coverage for damage up to the liability limitation in its territory.⁸⁷

The liability regime for international carriage of persons, baggage, or cargo was established in 1929 in Warsaw, but substantial revisions were made from the 1950s to the 1970s. Under the auspices of the International Civil Aviation Organization, a new convention was concluded to modernize and consolidate the Warsaw Convention and related instruments in Montreal in 1999: The Convention for the Unification of Certain Rules for International Carriage by Air.⁸⁸ According to its preamble, the Montreal Convention has two aims: To ensure the protection of an equitable compensation for consumers of international carriage by air and to promote the development of international air transport operation. It applies to international carriage of persons, baggage, or cargo performed by aircraft. To satisfy the “international” requirement, the places of departure and destination must either be in different State Parties, or in the same State Party but with an agreed stopping place in another State.⁸⁹

The Montreal Convention establishes three types of liability: Liability for death and injury of passengers, damage to baggage, and damage to cargo.⁹⁰

If a passenger dies or suffers bodily injury “on board the aircraft or in the course . . . of embarking or disembarking,” strict liability will apply.⁹¹ In case of destruction, loss, or damage to baggage, the basis of liability depends on the baggage’s checking status. Strict liability applies for checked baggage. For unchecked baggage and personal items, the carrier is only held liable if its servants or agents can be found at fault.⁹²

The Montreal Convention also applies to delays in the carriage. Liability caps are established respectively for those types of damage. According to Article 25 of the Montreal Convention, a higher liability cap or no liability cap is also allowed if the carriage contract so stipulates.⁹³ A mandatory insurance framework is established under Article 50 of the Montreal Convention: “State Parties shall require their carriers to maintain adequate insurance covering their liability . . .”⁹⁴

⁸⁶ See *id.* art. 11 (defining the extent of liability in relation to the aircraft weight).

⁸⁷ *Id.* art. 15(1).

⁸⁸ Convention for the Unification of Certain Rules for International Carriage by Air, May 28, 1999, T.I.A.S. No. 13038 [hereinafter Montreal Convention], available at <http://www.state.gov/documents/organization/122935.pdf>.

⁸⁹ *Id.* art. 1.

⁹⁰ *Id.* arts. 17–18; see *id.* pmbl (“Recognizing the importance of ensuring protection of the interests of consumers in international carriage by air and the need for equitable compensation based on the principle of restitution.”).

⁹¹ *Id.* art. 17(1).

⁹² *Id.* art. 17(2).

⁹³ *Id.* art. 25.

⁹⁴ *Id.* art. 50.

2. Nuclear Liability

Two separate international compensation regimes were established in the 1960s, and both were substantially revised after the Chernobyl accident of 1986.⁹⁵

The Convention on Third Party Liability in the Field of Nuclear Energy of July 29, 1960 (Paris Convention)⁹⁶ and the Supplementary Convention to the Paris Convention on Third Party Liability in the Field of Nuclear Energy of January 31, 1963 (Brussels Supplementary Convention)⁹⁷ were developed under the auspices of the OECD Nuclear Energy Agency (NEA). The second regime was developed under the aegis of the International Atomic Energy Agency (IAEA): The Vienna Convention on Civil Liability for Nuclear Damage of May 21, 1963 (Vienna Convention).⁹⁸ These two regimes are usually referred to as the first generation of nuclear liability conventions.⁹⁹

The 1986 Chernobyl accident triggered both intensive discussion about those limitations and an eventual revision process of the existing regimes. The so-called second generation of nuclear liability conventions was established thereafter. Those conventions include the Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (Joint Protocol),¹⁰⁰ the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage (Protocol to the Vienna Convention),¹⁰¹ the Convention on Supplementary Compensation for Nuclear Damage (CSC),¹⁰² the Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy (Protocol to the Paris Convention),¹⁰³ and the Protocol to Amend the Convention of January 31, 1963 Supplementary to the Convention of July 29, 1960 on Third Party Liability in the Field of Nuclear Energy (Protocol to the Brussels Supplementary Convention).¹⁰⁴

⁹⁵ See *infra* Part III(B)(2).

⁹⁶ Convention on Third Party Liability in the Field of Nuclear Energy, Jan. 28, 1964, 956 U.N.T.S. 251 [hereinafter Paris Convention].

⁹⁷ Convention Supplementary to the Convention on Third Party Liability in the Field of Nuclear Energy, Jan. 31, 1963, 1041 U.N.T.S. 358 [hereinafter Brussels Supplementary Convention]. This Convention was amended by the Additional Protocol of January 28, 1964 and by the Protocol of November 16, 1982. See Paris Convention, *supra* note 96, Annex I; Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy, Nov. 16, 1982, 1519 U.N.T.S. 329.

⁹⁸ Vienna Convention on Civil Liability for Nuclear Damage, May 21, 1963, 1063 U.N.T.S. 265 [hereinafter Vienna Convention].

⁹⁹ See Michael G. Faure & Tom Vanden Borre, *Compensating Nuclear Damage: A Comparative Economic Analysis of the U.S. and International Liability Schemes*, 33 WM. & MARY ENV'T L. & POL'Y REV. 219, 220–32 (2008).

¹⁰⁰ Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention, Sept. 21, 1988 [hereinafter Joint Protocol], available at <https://www.iaea.org/sites/default/files/infocirc402.pdf>.

¹⁰¹ Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, Sept. 12, 1997 [hereinafter Protocol to the Vienna Convention], available at <https://www.iaea.org/sites/default/files/infocirc566.pdf>.

¹⁰² Convention on Supplementary Compensation for Nuclear Damage, Sept. 12, 1997 [hereinafter CSC], available at <https://www.iaea.org/sites/default/files/infocirc567.pdf>.

¹⁰³ Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy, Feb. 12, 2004 [hereinafter Protocol to the Paris Convention], available at https://www.oecd-nea.org/law/paris_convention.pdf. This 2004 protocol has not yet entered into force.

¹⁰⁴ Protocol to Amend the Convention of 31 January 1963 Supplementary to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy, Feb. 12, 2004 [hereinafter Protocol to the Brussels Supplementary Convention], available at https://www.oecd-nea.org/law/brussels_supplementary_convention.pdf.

The Paris Convention establishes a system of absolute liability.¹⁰⁵ According to this system, the operator is liable for damage caused by a nuclear incident in a nuclear installation or involving nuclear substances coming from such installations.¹⁰⁶ Similar stipulations regarding absolute liability and exonerations can also be found under the Vienna Convention.¹⁰⁷ The conventions of the second generation have not changed the principle that strict liability applies to the operator of a nuclear power plant. However, an important change took place as far as the operator's available defenses are concerned: Natural disasters are no longer an applicable defense.¹⁰⁸

Under the Paris Convention, liability is channeled to operators. No one else is liable for the damage caused by a nuclear incident.¹⁰⁹ The "operator" is defined as "the person designated or recognized by the competent public authority as the operator of that installation."¹¹⁰ The Vienna Convention also has similar provisions.¹¹¹

Under the Paris Convention and the Vienna Convention, the operator's liability is limited both in amount and in time. The Paris Convention sets the maximum liability of the operator at 15 million SDRs but allows the Contracting Party to establish a greater or lesser amount by legislation considering the capacity of insurance and financial security. The Contracting Party can also require a lower amount of liability according to the nature of the installation. The lower amount should be no less than 5 million SDRs.¹¹² By contrast, the Vienna Convention sets the cap of liability at no less than USD 5 million.¹¹³

The liability limitation has, however, been changed under the second-generation nuclear conventions. The Protocol to the Paris Convention increases the limit for nuclear operators to no less than EUR 700 million. The Contracting Party can reduce the liability to no less than EUR 70 million for an incident originating from a nuclear installation, or no less than EUR 80 million for the carriage of nuclear substances according to the reduced risks.¹¹⁴ The Convention even allows for the adoption of unlimited liability by the Contracting Parties, as long as the financial security required is no less than the amount mentioned above.¹¹⁵

Seeking financial security coverage for the operator's liability is important for the international regimes on nuclear liability. Both conventions require the operator to have and maintain insurance or other financial security up to its liability cap.¹¹⁶ In addition, it should be mentioned that the Brussels Supplementary

¹⁰⁵ Paris Convention, *supra* note 96, Exposé des Motifs, point 14; *see also* SANDS & PEEL, *supra* note 25, at 738–45.

¹⁰⁶ Paris Convention, *supra* note 96, art. 3.

¹⁰⁷ Vienna Convention, *supra* note 98, arts. I(1)(k), IV(1) & IV(3).

¹⁰⁸ *See* Protocol to the Paris Convention, *supra* note 103, art. 9; Protocol to the Vienna Convention, *supra* note 101, art. 4(3).

¹⁰⁹ Paris Convention, *supra* note 96, art. 4(a)–4(b).

¹¹⁰ *Id.* art. 1(a)(vi).

¹¹¹ Vienna Convention, *supra* note 98, arts. II(5), X; *see also* JING LIU, COMPENSATING ECOLOGICAL DAMAGE: COMPARATIVE AND ECONOMIC OBSERVATIONS 212–13 (2013).

¹¹² Paris Convention, *supra* note 96, art. 7(b).

¹¹³ Vienna Convention, *supra* note 98, art. V(1).

¹¹⁴ Protocol to the Paris Convention, *supra* note 103, art. 7(a)&(b).

¹¹⁵ *Id.* art. 10(b).

¹¹⁶ Paris Convention, *supra* note 96, art. 10; Vienna Convention, *supra* note 98, art. VII.

Convention added two additional layers of compensation via public funds. They will be discussed below when discussing additional compensation mechanisms.¹¹⁷

3. *Marine Oil Pollution*

The international oil pollution compensation system consists of two important conventions that are interrelated. The first is the International Convention on Civil Liability for Oil Pollution Damage (CLC),¹¹⁸ and the second is the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (Fund Convention).¹¹⁹

The CLC adopts strict liability.¹²⁰ Hot debates took place during the negotiation of the convention with regard to whom the liability should rest on. Under the influence of the international regimes for nuclear liability, no doubts have been expressed on the reasonability of the channeling of liability. The debates focused on whether the shipowner or the oil industry should bear the liability. In the end, a compromise was made: Liability under the CLC fell on the shoulders of the shipowner. In return, the oil industry also needed to contribute to compensation through a compensation fund. At the conference on the passage of the 1969 CLC, parties agreed that an international compensation fund would be established in the near future.¹²¹

From what was just mentioned as far as the creation of the 1969 CLC and the 1971 Fund Convention is concerned, it is clear that the 1969 CLC channeled liability to the tanker owner. The ship-owner is defined as “the person or persons registered as the owner of the ship or, in the absence of registration, the person or persons owning the ship.”¹²² However, the 1969 CLC preempts other legislation: No other claims are eligible other than those under the Convention. It shows explicitly that no claims are made against the servants or agents of the owner.¹²³

The liability established under the 1969 CLC was capped at FF 210 million or FF 2,000 for each ton of the ship’s tonnage. Several serious oil spills that happened after the adoption of the 1969 CLC and the Fund Convention—for example, the *Amoco Cadiz* in 1978 and the *Tanio* in 1980—triggered the revisions

¹¹⁷ See *infra* Part III.

¹¹⁸ The original CLC was adopted in 1969, and it was revised in 1992. International Convention on Civil Liability for Oil Pollution Damage, Nov. 29, 1969, 973 U.N.T.S. 3 [hereinafter 1969 CLC]; Protocol to Amend the International Convention on Civil Liability for Oil Pollution Damage, Nov. 27, 1992, 1956 U.N.T.S. 255 [hereinafter 1992 CLC].

¹¹⁹ The original Fund Convention was adopted in 1971, and it was revised in 1992. Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Nov. 27, 1992, 1953 U.N.T.S. 330 [hereinafter 1992 Fund Convention]; International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Dec. 18, 1971, 1110 U.N.T.S. 5767 [hereinafter the 1971 Fund Convention]. See Hui Wang, *Shifts in Governance in the International Regime of Marine Oil Pollution Compensation: A Legal History Perspective*, in *SHIFTS IN COMPENSATION FOR ENVIRONMENTAL DAMAGE* 197, 212–19 (Michael Faure & Albert Verheij eds., 2007); see also HUI WANG, *CIVIL LIABILITY FOR MARINE OIL POLLUTION DAMAGE: A COMPARATIVE AND ECONOMIC STUDY OF THE INTERNATIONAL, U.S. AND CHINESE COMPENSATION REGIME* 53–130 (2011) [hereinafter WANG, *CIVIL LIABILITY*].

¹²⁰ 1969 CLC, *supra* note 118, art. III; see also SANDS & PEEL, *supra* note 25, at 746–47.

¹²¹ See SANDS & PEEL, *supra* note 25, at 745–55.

¹²² 1969 CLC, *supra* note 118, art. I(3).

¹²³ *Id.* art. III.

to the original conventions. The first protocols to revise the conventions were drafted in 1984. Since the United States did not ratify the protocols, they could not come into force. Nevertheless, the changes in the 1984 protocols were largely incorporated in the 1992 conventions.¹²⁴

In 1992, two protocols were adopted to revise the original conventions: The 1992 CLC and the 1992 Fund Convention. The 1992 CLC increased the liability limit to 4.51 million SDRs or 89.77 million SDRs, depending on the size of the ships. As a compromise for increasing the liability limit, the criteria preventing shipowners from limiting their liability were further constricted: Damage must result from their willful misconduct.¹²⁵

The 1969 CLC requires the owner of a ship that is registered in a Contracting State and carries more than 2,000 tons of oil in bulk as cargo to maintain insurance or other financial security up to his liability limits. In addition to insurance, financial security can also be in the form of a bank guarantee or certificate delivered by an international compensation fund.¹²⁶ The 1992 CLC retained this requirement.¹²⁷

4. *Other Relevant Treaties*

a. HNS Convention

Since the CLC only covers oil pollution damage, a separate convention was drafted to address liability and compensation for damage connected to the carriage of hazardous and noxious substances by sea: The HNS Convention.¹²⁸ This convention governs personal injuries, environmental damage, economic losses, and the costs of preventive measures which resulted from the carriage of hazardous and noxious substances by vessels.¹²⁹ The HNS Convention imposes a strict liability regime on the owner of the ship. According to Article 1, the shipowner is “the person or persons registered as the owner of the ship or, in the absence of registration, the person or persons owning the ship.”¹³⁰

The shipowner’s liability under the HNS Convention is again capped. According to a calculation scheme provided in Article 9 of the Convention, the shipowner is entitled to limit his liability depending on the tonnage of the ship and on the form of the transported substances (bulk HNS or packaged HNS).¹³¹ If the amount of the damage exceeds the owner’s liability cap, the HNS Fund will step in.

Moreover, according to Article 12 of the HNS Convention, the owner of a ship carrying hazardous and noxious substances is required to take insurance or to maintain other acceptable financial securities to cover sums fixed by applying the

¹²⁴ For details on this evolution see Wang, *supra* note 119, at 131–88 (describing the evolution of the international regime, the failure of the 1984 Protocols and the adoption of the 1992 Conventions).

¹²⁵ 1992 CLC, *supra* note 118, art. V(1) & V(2).

¹²⁶ 1969 CLC, *supra* note 118, art. VII.

¹²⁷ 1992 CLC, *supra* note 118, art. VII.

¹²⁸ International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, May 3, 1996, 35 I.L.M. 1415 [hereinafter HNS Convention]; see also WANG, CIVIL LIABILITY, *supra* note 119, at 38–39.

¹²⁹ HNS Convention, *supra* note 128, art. 1.

¹³⁰ *Id.*

¹³¹ *Id.* art. 9.

limits of liability.¹³² Since the HNS Convention is structured in the same way as the conventions on marine pollution discussed above, it will not be analyzed in further detail.

b. Transboundary Civil Liability Protocol

In execution of the relevant provisions of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the Convention on the Transboundary Effects of Industrial Accidents, both signed in 1992, a transboundary civil liability protocol was adopted on May 21, 2003.¹³³ However, this protocol is not yet in force.¹³⁴ The preamble to the Transboundary Civil Liability Protocol refers to the “polluter pays” principle as the basis for the liability regime.¹³⁵ Based on the “polluter pays” principle, operators are strictly liable for the damage caused by industrial accidents.¹³⁶ Furthermore, fault-based liability might also apply to other persons such as servants or agents of the operator if they cause or contribute to damage through their “wrongful[,] intentional, reckless or negligent acts or omissions.”¹³⁷

The concept of “operator” has been defined in Article 1(e) of the 1992 Convention on the Transboundary Effects of Industrial Accidents as “any natural or legal person, including public authorities, in charge of an activity, e.g., supervising, planning to carry out or carrying out an activity.”¹³⁸ The protocol includes financial limits to the amount of compensation. Operators must accordingly ensure that they have financial security covering at least the minimum limits specified in Annex II of the Protocol, namely, 2.5 million units of account for Category A hazardous activities and 10 million units of account for both Categories B and C.¹³⁹

c. Space Liability

The 1971 Convention on the International Liability for Damage Caused by Space Objects (Space Liability Convention) provides that “[a] launching State shall be absolutely liable to pay compensation for damage caused by its space object on

¹³² *Id.* art. 12.

¹³³ See Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes and to the 1992 Convention on the Transboundary Effects of Industrial Accidents, May 21, 2003 [hereinafter Transboundary Civil Liability Protocol], available at http://www.unece.org/fileadmin/DAM/env/civil-liability/documents/protocol_e.pdf; Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Mar. 17, 1992, 1936 U.N.T.S. 268; Convention on the Transboundary Effects of Industrial Accidents, Mar. 17, 1992, 2105 U.N.T.S. 457 [hereinafter Industrial Accidents Convention].

¹³⁴ The Protocol was signed by twenty-four parties in 2003, but only one (Hungary, on June 25, 2004) made the step to ratification, acceptance, approval, or accession. See Transboundary Civil Liability Protocol, *supra* note 133.

¹³⁵ *Id.* pmbl.

¹³⁶ *Id.* art. 4(1). For a list of industrial hazardous activities, see Industrial Accidents Convention, *supra* note 133, Annex I.

¹³⁷ Transboundary Civil Liability Protocol, *supra* note 133, art. 5.

¹³⁸ Industrial Accidents Convention, *supra* note 133, art. 1(e).

¹³⁹ Transboundary Civil Liability Protocol, *supra* note 133, arts. 4, 9, 11. For a definition of these categories, see *id.* Annexes I–II.

the surface of the earth or to aircraft”¹⁴⁰ Furthermore, a launching State shall also be liable for damage due to its faults in space. The convention imposes *absolute liability*, which refers to “a liability system without any defense or exclusion.” The Space Liability Convention refers to the concept of “launching States,” as defined in Article I(c): “(i) [A] state which launches or procures the launching of a space object; (ii) a State from whose territory or facility a space object is launched.”¹⁴¹ The term “launching” also includes attempted launching.¹⁴²

In the preamble to the Convention, the need is recognized to ensure “prompt payment . . . of a full and equitable measure of compensation to victims” of damage caused by space objects.¹⁴³ The term “damage” is defined in Article I of the Convention and refers to “loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organisations.”¹⁴⁴

C. Analysis

Having briefly sketched the liability regimes adopted by international environmental agreements, we will now proceed (1) to a comparison of the liability regimes described in Subpart 1; and (2) to a critical analysis of those regimes in light of the conditions for designing optimal liability rules explored above in Subpart 2.¹⁴⁵ This will lead to the conclusion that the liability regimes incorporated in the international conventions show important limits, at least from the perspective of the optimal design. Interestingly, some domestic liability regimes, particularly in the United States, seem better able to provide incentives for disaster risk mitigation. That is why the United States did not join the international conventions with respect to marine oil pollution and nuclear liability, but rather drafted its own separate regime. Analyzing those regimes can provide interesting lessons for a better design of international conventions, discussed in Subpart 3.

1. Liability Regimes Compared

Surprisingly, the liability regimes in the international conventions just discussed show some striking similarities. For example, all conventions introduce strict liability. There are a few nuances in the sense that some conventions adopt a liability regime that is even stricter than the others. For example, the nuclear liability conventions refer to “absolute liability,” as does the Space Liability Convention. Indeed, the latter seems to be “absolute” in the sense that it does not allow any defenses whatsoever. A second feature common to all conventions is a requirement for some form of mandatory financial security. An overview of the conventions reveals that the imposition of a duty to provide financial security in order to meet the strict liability threshold appears to be the state of the art at the

¹⁴⁰ Convention on the International Liability for Damage Caused by Space Objects art. II, Mar. 29, 1972, 961 U.N.T.S. 187 [hereinafter Space Liability Convention].

¹⁴¹ *Id.* art. I(c).

¹⁴² *Id.* art. I(b).

¹⁴³ *Id.* pmb1.

¹⁴⁴ *Id.* art. I

¹⁴⁵ See discussion *supra* Part II(A)(2).

international level. Moreover, the liability regimes discussed demonstrate that operators can have a broad set of options to provide proof of their solvency. Proving solvency should therefore not necessarily be limited to insurance. For example, the Rome Convention and the Transboundary Civil Liability Protocol refer to a variety of financial security mechanisms such as cash deposits, bank guarantees, and guarantees by the Contracting State.¹⁴⁶ These examples would be valuable tools to cover liability should one consider introducing a duty to provide financial security.

Liability was limited in six of the seven international conventions discussed above. The only convention that does not apply liability limitation is the Space Liability Convention. A liability cap can be limited in different ways; in some cases the convention itself establishes the cap (like in the marine pollution convention, the HNS Convention, and the conventions related to aviation), but the caps are dependent upon the nature and amount of either the cargo transported or the tonnage of the ship. In other cases, the conventions provide the scope for liability limitation, but the precise amount of the cap can be set through domestic law (that is more particularly the case in the conventions on nuclear liability).

Channeling liability to the operator is yet another of the conventions' interesting features. Again, although the formulation can be different, liability channeling can be found in all seven conventions that have provisions regarding liability. The difference in the way the channeling works relates more to whether liability of other agents is still possible in principle or whether it is totally excluded. For example, in the marine pollution conventions, others besides the ship owner are in principle excluded from liability, whereas in the aviation conventions the liability is channeled to the operator/air carrier, but the possibility of holding others liable as well is not completely excluded.

If one were to summarize these findings, one would notice that four important features appear in those international conventions: (1) strict liability, (2) compulsory financial guarantees, (3) a financial limit on the liability, and (4) a channeling of the liability. A fifth feature, present in some conventions—in fact only in the nuclear liability, marine pollution, and HNS Conventions—is the presence of an additional layer of compensation.¹⁴⁷

2. *Critical Analysis*

It is interesting to note how those four characteristics of liability provisions in international environmental agreements compare to the theoretical starting points for the optimal design of a liability regime explored earlier in the article.¹⁴⁸ The first element, the introduction of strict liability, is clearly in line with the theoretical starting points. All activities regulated by the international conventions (nuclear liability, aviation, marine pollution) can certainly be considered ultra-hazardous activities, which clearly correspond with the economic criteria that favor choosing a

¹⁴⁶ See Rome Convention, *supra* note 82, at 15(4); Transboundary Civil Liability Protocol, *supra* note 133, at 11(1).

¹⁴⁷ Since that layer is not paid by the operator, it cannot be considered to belong to the liability rules discussed in this point. See *infra* Part IV.

¹⁴⁸ See *supra* Part III(A)(2).

strict liability rule.¹⁴⁹ Those ultra-hazardous activities are cases where the influence of the operator is much more important than the influence of the victim.¹⁵⁰

Likewise, the introduction of financial guarantees is also clearly in line with the theoretical starting points.¹⁵¹ Without guarantees, strict liability itself would be meaningless. A specific feature of catastrophes is precisely their ability to lead to damage that can easily outweigh the capacity of an individual operator. Financial security mechanisms are hence necessary to avoid operators externalizing risk to society as a result of their insolvency.¹⁵² Through insurance, ex ante incentives for disaster risk mitigation could be provided via the control of moral hazard by the insurance company.¹⁵³

The third characteristic, the limitation of liability in six of the seven international conventions, is more problematic. Indeed, most international conventions appear to pay an important price for the strict liability of the operator: A financial cap is imposed on his liability.¹⁵⁴ The literature with respect to the nuclear and marine pollution conventions is very critical with respect to the financial cap on liability.¹⁵⁵ The criticism is directed on one hand to the fact that the operator will only have incentives to prevent an accident up to the amount of the limited liability. A financial cap could therefore reduce the incentives for prevention. On the other hand, to the extent that the actual damage could be substantially larger than the capped liability, victims would remain uncompensated. This leads to a third type of criticism, arguing that a financial cap on liability allows operators to de facto externalize harm to society. In fact, from an economic perspective a financial cap constitutes a subsidy to an industry, which may be problematic in itself.

Channeling liability to the operator—the fourth feature of the liability regime in the international conventions—is undoubtedly equally problematic from the point of view of deterrence. The simple reason is that channeling liability to the operator prevents holding liable others who could equally contribute to the risk of a disaster. That would consequently reduce their incentives for disaster risk mitigation. Such liability channeling is therefore highly criticized in the literature.¹⁵⁶

¹⁴⁹ See *supra* Part III(A)(2)(a).

¹⁵⁰ To the extent that the victim may also have an influence on the accident risk, a defense of contributory negligence should be added to take account of the victim's behavior. See Golobardes & Pomar, *supra* note 45, at 48. All of the discussed conventions do, in different wordings, take into account the fact that the victim's fault can lead to a reduction or exclusion of the compensation.

¹⁵¹ See discussion *supra* Part III(A)(2)(b).

¹⁵² See BARBOZA, *supra* note 81, at 39–40 (expanding on the obligation to contract insurance).

¹⁵³ Omri Ben-Shahar & Kyle D. Logue, *Outsourcing Regulation: How Insurance Reduces Moral Hazard*, 111 MICH. L. REV. 197, 197–248 (2012) (explaining how, through the use of insurance, companies can impose conditions upon operators relating, e.g., to the safe operation of plants).

¹⁵⁴ In the literature this liability cap is defended as an instrument “to enable a hazardous industry to continue functioning. Unlimited liability would prevent insurance coverage of risks and place excessive costs on the industry.” BARBOZA, *supra* note 81, at 36.

¹⁵⁵ See Tom Vanden Borre, *Shifts in Governance in Compensation for Nuclear Damage, 20 Years after Chernobyl*, in *SHIFTS IN COMPENSATION FOR ENVIRONMENTAL DAMAGE*, *supra* note 119, at 261–311 (criticism with respect to the financial caps in nuclear liability); Michael Faure & Hui Wang, *Financial Caps for Oil Pollution Damage: A Historical Mistake?*, 32 MARINE POL'Y 592 (2008) (critical analysis on the financial caps in the international regime with respect to marine oil pollution).

¹⁵⁶ See Tom Vanden Borre, *Nuclear Liability: An Anachronism in EU Energy Policy?*, in *EUROPEAN ENERGY LAW REPORT VII* 177, 192 (Martha M. Roggenkamp & Ulf Hammer eds., 2010).

In summary, the liability regimes in the international conventions introduce strict liability and compulsory financial guarantees. However, these conventions problematically limit liability and, moreover, channel liability to the operator. Both of these features are especially problematic when taken in combination. Liability limitations not only provide operators insufficient incentives for disaster risk mitigation, but may also cause victims to remain uncompensated. Moreover, channeling liability to the operator excludes the possibility for victims to bring a lawsuit against anyone other than the operator to whom liability was channeled. That not only highlights the potential undercompensation of victims, but also the lack of deterrent effect. Channeling *de facto* excludes anyone other than the operator from liability and thus does not provide incentives to others, like suppliers or other stakeholders involved in creating the risk. As a result, channeling can increase the danger of a disaster resulting from a technological risk.

The question obviously arises as to the extent to which these features of liability regimes will effectively lead to undercompensation and underdeterrence. This may to an important extent depend on the specific design features of the regime. For example, channeling is most problematic when it is exclusive (meaning that victims are not allowed to bring suits against anyone other than the channeled operator) and when it is absolute (in the sense of not allowing recourse against other stakeholders that equally contributed to the risk). As far as the financial cap is concerned, it may be clear that capping liability is most problematic where the financial cap is set at a much lower amount than the expected damage resulting from the disaster, which is arguably the case with nuclear liability in the international conventions.¹⁵⁷ If, to the contrary, limited liability may still be able to provide adequate compensation, and hence deterrence for most of the accidents, meaning that the total damage will likely not often be higher than the amount of the cap, capping liability is certainly less problematic. This situation is arguably the case in the marine pollution regime. Finally, the problematic nature of the liability regimes in the conventions also depends upon another feature yet to be discussed¹⁵⁸—whether additional compensation mechanisms are available and how they are financed. If a substantial amount of compensation were available in situations where the operator's liability is capped, the regime would not necessarily lead to undercompensation. Moreover, depending on how the second layer is financed, either by stakeholders equally exposed to the risk or by the government, the second layer of compensation could still provide additional incentives for disaster risk mitigation. Hence, it is only possible to pass a final judgment on the effectiveness of the liability regimes in the multilateral environmental treaties when additional compensation regimes have also been analyzed.

3. *Alternatives*

We just showed that the liability regimes found in the international environmental agreements all display a similar pattern of strict liability, compulsory financial guarantees, financial caps, and liability channeling. It is no accident that the conventions show similar features. These features originated from the nuclear liability conventions in the 1960s and were introduced at the time because they

¹⁵⁷ See discussion in further detail *infra* Part IV(C)(1)(a) on whether this is actually the case.

¹⁵⁸ See *infra* Part IV.

clearly served the interests of industry.¹⁵⁹ The fact that those features were present in the nuclear liability conventions was subsequently also used as a justification to include them in the conventions with respect to marine oil pollution when these were created.¹⁶⁰ “Path dependency” apparently influences the fact that future conventions dealing with liability followed a similar pattern. However, that is surely not the only way in which a liability regime for catastrophic risk could be created. Domestic law provides interesting examples of different liability regimes that do not show the same problematic features we discovered in the international conventions and that may hence come closer to the optimal liability regime design aimed at disaster risk mitigation. A few alternatives from domestic law will be presented in order to show that alternatives are not only possible, but also already in place in several legal systems.

a. U.S. Price-Anderson Act

In the United States, nuclear liability is governed by the Price-Anderson Act, which was adopted in 1957.¹⁶¹ One specific feature of the Price-Anderson Act is that it has been regularly revised at approximately ten years intervals.¹⁶² Thanks to those revisions the Act has been able to adapt to changing circumstances much better than the international regime.

The initial Price-Anderson Act, just like the international compensation regime, wanted to spread the risk of nuclear activities between the private industry on the one hand, and the nation that benefits from the development of nuclear energy on the other. The nuclear operator needed to buy all the insurance coverage presently available, which at the time was USD 60 million. As will be explained below, initially government funds were made available to cover sums above that amount, but in 1975 the financing of the second layer shifted from public to private funding.¹⁶³

Today the Price-Anderson Act has the practical effect of imposing strict liability for nuclear incidents. This is realized via the extraordinary nuclear occurrence (ENO), introduced in the Price-Anderson Act in 1966,¹⁶⁴ in case of a nuclear accident, the Nuclear Regulatory Commission is given the power to determine whether or not there is an extraordinary nuclear occurrence.¹⁶⁵ If that is

¹⁵⁹ For a historical account, see Vanden Borre, *supra* note 155, at 261–66 (providing a critical historical overview of the creation of the nuclear liability conventions).

¹⁶⁰ For such a historical account, see Wang, *supra* note 119, at 197–241 (providing an overview of the various instruments in the regime for compensation of marine oil pollution and sketching the evolution of the conventions).

¹⁶¹ For further details on the Price-Anderson Act, see Vanden Borre, *supra* note 155, at 261–311.

¹⁶² Revisions took place in 1966, 1975, 1988, and 2005.

¹⁶³ See *infra* Part IV(C)(2)(b).

¹⁶⁴ See TOM VANDEN BORRE, EFFICIËNTE PREVENTIE EN COMPENSATIE VAN CATASTROFERISICO'S—HET VOORBEELD VAN SCHADE DOOR KERNONGEVALLLEN 644–47 (2001) (providing further detail on the Price-Anderson Act).

¹⁶⁵ This is defined as:

[A]ny event causing a discharge or dispersal of source, special nuclear, or byproduct material from its intended place of confinement in amounts offsite, or causing radiation levels offsite which the Nuclear Regulatory Commission determines to be substantial, and which the Commission determines has resulted or will probably result in substantial damages to persons offsite or property offsite.

See Faure & Vanden Borre, *supra* note 99, at 241; LIU, *supra* note 111, at 233–34.

the case, the nuclear operator will not be able to invoke certain defenses that are available under federal law or state tort law.¹⁶⁶

There are a few differences between the Price-Anderson Act and the international regime. First, the liability of the power plant operator under the Act has been increased to USD 375 million.¹⁶⁷ That is substantially more than the amounts currently available for operator liability in the international regime. The Paris Convention sets the financial cap between USD 5 million and USD 15 million special drawing rights.¹⁶⁸ According to the Vienna Convention, the liability cap should be no less than USD 5 million.¹⁶⁹ After the 1986 Chernobyl accident the financial limit was increased so that the limit for nuclear operators would be no less than EUR 700 million.¹⁷⁰ Moreover, according to a Protocol to the Vienna Convention, the liability limit would be increased to no less than USD 300 million or no less than 150 million SDR provided the installation state makes public funds available to cover the amount between the limitation and USD 300 million.¹⁷¹ However, these additional protocols which would substantially raise the operator's amount of financial liability have not yet entered into force.¹⁷² Today the liability limit under the U.S. Price-Anderson Act is hence still substantially higher than the operator liability under the international conventions.

A second important difference will be highlighted below: Whereas the international conventions rely on a second tier of compensation (beyond the liability limit of the operator) stemming largely from public funding (by the operator's state and by all contracting states), the U.S. Price-Anderson Act relies on a system of private funding to provide an additional layer of compensation.

The third important difference is that the U.S. Price-Anderson Act did not incorporate the highly criticized liability channeling system, whereby any stakeholders other than the operator are not subject to liability. This is related to the fact that nuclear liability insurance under the Price-Anderson Act provides a system of so-called "omnibus"-coverage. This means that, per the Act, liability insurance provides cover for "anyone who may be liable"¹⁷³ for "public liability." The Act defines "public liability" as "any legal liability arising out of or resulting from a nuclear incident or precautionary evacuation . . ."¹⁷⁴ The only exceptions to that definition pertain to "claims arising out of an act of war," worker's compensation claims, and claims for damage to on-site property at a licensed nuclear facility.¹⁷⁵ As a result of this provision, everyone who can be held liable

¹⁶⁶ See Dan M. Berkovitz, *Price-Anderson Act: Model Compensation Legislation?—The Sixty-Three Million Dollar Question*, 13 HARV. ENVTL. L. REV. 1, 12–13 (1989); Omer F. Brown, *Nuclear Liability Coverage Developments in the United States of America*, in NUCLEAR INTER JURA 4, 5–6 (1993).

¹⁶⁷ In July 2013, the Nuclear Regulatory Commission (NRC) adapted the liability amounts to inflation. As of September 10, 2013, a limit in the first tier (liability of the operator) of USD 375 million hence applies.

¹⁶⁸ Paris Convention art. VII(b).

¹⁶⁹ Vienna Convention art. V(1). For further details see LIU, *supra* note 111, at 212.

¹⁷⁰ Protocol to the Paris Convention art. X(b).

¹⁷¹ Protocol to the Vienna Convention art. V(1). For further details see LIU, *supra* note 111, at 214–17.

¹⁷² See the discussions *supra* Part III(B)(2).

¹⁷³ 42 U.S.C. § 2014(t) (2015) (defining "person indemnified").

¹⁷⁴ *Id.* § 2014(w).

¹⁷⁵ The U.S. Nuclear Insurers (ANI) Facility Form nuclear liability policy provides it will pay on behalf of the named insured all sums which the insured shall become legally obligated to pay as

for the damage from a nuclear accident (including the supplier) can benefit from the liability insurance coverage of the nuclear operator. The mechanics of this system were demonstrated following the Three Mile Island accident, where a single law firm represented all defendants—the nuclear operator as well as the designer and constructor of the nuclear power plant.¹⁷⁶ Thus, unlike the international compensation regime, the Price-Anderson Act has a system of economic rather than legal channeling.¹⁷⁷

It is interesting to note that the United States played a decisive role in the initiation and drafting of the specific text of the international nuclear liability conventions.¹⁷⁸ The U.S. interest in an international liability convention was due to the United States' essential monopoly on nuclear knowledge and technology in the 1950s. The developing Western-European economy was interested in acquiring the U.S. technology and nuclear material. U.S. suppliers protected themselves through so-called "hold-harmless" clauses. Under such clauses, the European nuclear operator who would have purchased nuclear material from a U.S. supplier would hold the U.S. supplier harmless for all claims that might arise.¹⁷⁹ However, there was uncertainty with respect to the ability of those clauses to provide sufficient protection to the U.S. suppliers.

Consequently, the U.S. "Atomic Industrial Forum" conducted two studies on the possible liability claims of nuclear accident victims against U.S. suppliers. The first study was the "Preliminary Report on Financial Protection against Atomic Hazards."¹⁸⁰ The second study was titled "International Problems of Financial Protection against Nuclear Risk."¹⁸¹ The preliminary report basically dealt with the liability regime for domestic accidents. It concluded that the interests of both the industry and the public could be met by limiting the nuclear operator's liability to the amount of coverage available on the insurance market and by providing public funds for damage not covered by the operator or his insurer. Concerns regarding potential transboundary nuclear accidents were addressed in the Harvard Report. The Harvard Report suggested principles like liability channeling, strict liability, liability limitation, etc. that were later included in the international conventions. According to the drafters of the Report, those principles were an

covered damages because of bodily injury or property damage, or as covered environmental cleanup costs because of environmental damage. See http://www.amnucins.com/?page_id=173.

¹⁷⁶ Omer F. Brown, *Recent Developments from the Perspective of the United States, in CONTEMPORARY DEVELOPMENTS IN NUCLEAR ENERGY LAW: HARMONISING LEGISLATION IN CEEC/NIS 479, 481* (Natalie L.J.T. Horbach ed., 1999).

¹⁷⁷ Under a system of legal channeling of liability, a claim against other persons is legally impossible, precisely because of the fact that liability is exclusively concentrated on one person. Economic channeling means that the rules of ordinary tort law remain applicable, but that the economic burden of such liability lies with one person only. Other persons than those to which liability is economically channeled can therefore be held legally liable, in the sense that they can reclaim the amounts paid from the one who is economically liable. This is exactly the case under the Price-Anderson Act: Suppliers can also be held liable, but their liability is covered by the omnibus coverage of the nuclear operator. For more details, see Tom Vanden Borre, *Channeling of Liability: A Few Juridical and Economic Views on an Inadequate Legal Construction, in CONTEMPORARY DEVELOPMENTS IN NUCLEAR ENERGY LAW, supra* note 176, at 13–39.

¹⁷⁸ For a detailed analysis see Vanden Borre, *supra* note 155, 262–66 (highlighting how two reports from the United States argued in favor of an international liability regime).

¹⁷⁹ *Id.*

¹⁸⁰ ARTHUR W. MURPHY & ATOMIC INDUS. FORUM, PRELIMINARY REPORT ON FINANCIAL PROTECTION AGAINST ATOMIC HAZARDS (1956) [hereinafter "the Preliminary Report"].

¹⁸¹ HARVARD LAW SCH. & ATOMIC INDUS. FORUM, INTERNATIONAL PROBLEMS OF FINANCIAL PROTECTION AGAINST NUCLEAR RISK (1959) [hereinafter "the Harvard Report"].

effective tool to protect U.S. “Atomic Suppliers” since channeling liability to the European power plant operators would preclude any liability claims against U.S. suppliers.¹⁸² The draft of what later became the 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy was even literally annexed to the Harvard Report.

It is therefore striking that, on the one hand, the United States has insisted on introducing legal liability channeling in the nuclear liability conventions, but on the other hand, U.S. domestic nuclear liability law—the Price-Anderson Act—provides for a system of economic channeling. The United States has hence used its power to influence the nuclear liability conventions with the sole purpose of protecting its own companies, who are world leaders in the supply of goods and services to the nuclear industry.¹⁸³

b. Unlimited Liability

The legislation of several E.U. Member States, moreover, shows that it is possible to apply both strict liability and unlimited liability to the activities of nuclear power plant operators. The European Commission provides an interesting overview of a nuclear power plant operator’s liability in E.U. Member States.¹⁸⁴

Amounts in million €					
	<i>Convention</i>	<i>Liability of the operator of a nuclear power plant</i>	<i>Limit of the financial security</i>	<i>Additional state compensation (if any)</i>	<i>Additional compensation (from international arrangements)</i>
Austria	PC (not ratified)	Unlimited	446.6	-	-
Belgium	PC	1,200	1,200	-	142.22
Bulgaria	VC	49.1	49.1	-	-
Croatia	VC	43.9	43.9	-	-
Cyprus	-	Unlimited	-	-	-
Czech Republic	VC	232	232	-	-
Denmark	PC	Unlimited	700	-	142.22
Estonia	VC	Unlimited	-	-	-
Finland	PC	Unlimited	700	-	142.22
France	PC	91.5	91.5	99.3	142.22
Germany	PC	Unlimited	2500	2,500	142.22
Greece	PC	16.3	-	-	-
Hungary	VC	109	109	217.9	-
Ireland	-	Unlimited	-	-	-

¹⁸² *Id.* at 59.

¹⁸³ Vanden Borre, *supra* note 155, at 262–63.

¹⁸⁴ European Commission, *Public Consultation on Insurance and Compensation of Damages Caused by Accidents of Nuclear Power Plants*, NUCLEAR ENERGY AGENCY, <http://www.nea.fr> (last visited March 17, 2015).

Italy	PC	5.4	5.4	185.2	142.22
Latvia	VC	114.2	5.7	113.2	-
Lithuania	VC	154	154	-	-
Luxemburg	PC (not ratified)	Unlimited	-		
Malta	-	Unlimited			
Netherlands	PC	1,200	1,200	1930	142.22
Poland	VC	345	345	-	-
Portugal	PC	16.3	-	-	-
Romania	VC	345	345	163.5	-
Slovakia	VC	75	75	-	-
Slovenia	PC	700	-	27.2	142.22
Spain	PC	1,200	1,200	-	142.22
Sweden	PC	Unlimited	1,200	-	142.22
UK	PC	156.7	156.7	34.2	142.22

Table 1: Liability of a nuclear power plant operator and compensation amounts in E.U. Member States.¹⁸⁵

A few E.U. Member States impose unlimited liability upon operators, but some of those (like Austria) do not have nuclear power plants. Nonetheless, others who do have nuclear power plants still impose unlimited liability. A striking example is Germany, even though the country is currently undertaking a phase-out of nuclear energy. Germany is a party to the Paris Convention and to the Brussels Supplementary Convention and therefore requires financial security to cover the operator's liability up to EUR 2.5 billion.¹⁸⁶ As the table shows, this is the highest amount of financial security required amongst the European Member States. Therefore, in principle Germany provides for unlimited liability, but in practice it only imposes a duty to provide financial guarantees up to a maximum of EUR 2.5 billion. This constitutes yet another example of domestic law providing wider-reaching liability, and thus better incentives for disaster risk mitigation, than the international regime.

c. U.S. Oil Pollution Act

The relationship between the United States and the marine oil pollution conventions is to some extent comparable to the role the United States played with respect to the international nuclear liability conventions.¹⁸⁷ The United States was involved in the enactment of the International Convention on Civil Liability for Oil Pollution Damage 1969 (CLC) and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1971 (Fund Convention). However, the United States did not join the international conventions. After new major incidents demonstrated the inadequacy of the 1969–

¹⁸⁵ *Id.* For more details, see that table which also differentiates in case there are different liability amounts, e.g., for research reactors or other specified nuclear activities. Our focus only lies with liability for nuclear damage caused by a nuclear power plant. No data for Malta and Cyprus were available. The amount of EUR 142.22 million of additional compensation corresponds to the third tier of 125 million SDRs under the Brussels Supplementary Convention.

¹⁸⁶ See LIU, *supra* note 111, at 299–301.

¹⁸⁷ See Michael G. Faure, *Transboundary Pollution*, in INTERNATIONAL ENVIRONMENTAL LAW: THE PRACTITIONER'S GUIDE TO THE LAWS OF THE PLANET 235, 247–48 (Roger R. Martella Jr. & Brett Grosko eds., 2014).

1971 regime,¹⁸⁸ it was decided to draft protocols aimed, inter alia, at increasing the limits of liability and compensation and creating a new fund.¹⁸⁹ One of the legal conditions for the enactment of the 1984 Protocols was ratification by the United States and Japan since those were the two largest receivers of oil transported by ship. However, the United States did not ratify the 1984 Protocols, as a result of which they never entered into force. Moreover, since the United States was confronted with the Exxon Valdez incident in 1989, it decided to draft its own Oil Pollution Act, which came into effect in 1990. Hence, the International Maritime Organization continued international negotiations without the United States, as the enactment of the Oil Pollution Act 1990 had made clear that the United States would no longer join the international regime. The changes made by the 1984 Protocols were eventually largely implemented by the 1992 Protocols.¹⁹⁰

The most important reason why the United States did not join the international conventions was related to their belief that liability limits in the conventions were too low. Moreover, they rejected the principle of channeling liability to ship owners. Adherence to the conventions would also preempt state laws which had unlimited liability.¹⁹¹ In response to the 1989 Exxon Valdez accident, the U.S. Congress quickly passed the Oil Pollution Act 1990 (hereafter OPA). The OPA shares a few similarities with the international regime, such as strict liability, limited liability, and a compulsory financial guarantee. However, there are substantial differences as well: Liability is not channeled; under OPA the liability limits are much higher and, as will be explained below, allow potentially responsible parties to lose their right to limit liability. Moreover, the OPA does not preempt state laws, which means that states can still impose additional liability or financial responsibility.¹⁹² It is important to mention that in the United States thirty of the fifty states have a coastline and, in fact, all of these states but six have legislation on vessels liability.¹⁹³

Some states, such as Alaska, California, North Carolina, and Rhode Island, impose strict and unlimited civil liability for cleanup costs, natural resource damage, and private losses caused by oil pollution, including pure economic losses. In some other states, unlimited liability is only established for certain categories of damage, such as in Washington, for cleanup costs and damages to persons or property; Maryland, for cleanup costs, damage to real and personal property and natural resources damages; Massachusetts, for natural resources damages; and Florida, for natural resource damages, damage to real and personal property, and losses consequential upon property damage.¹⁹⁴

In addition to being exposed to potentially unlimited liability under state law, the limits under OPA also involve conditions. OPA establishes limits on oil pollution liability for different types of facilities. A cap is established for the total

¹⁸⁸ See WU CHAO, *POLLUTION FROM THE CARRIAGE OF OIL BY SEA: LIABILITY AND COMPENSATION* 129–36 (1996).

¹⁸⁹ Wang, *supra* note 119, at 145–48.

¹⁹⁰ *Id.* at 145.

¹⁹¹ See Hui Wang & Michael Faure, *Civil Liability and Compensation for Marine Pollution – Methods to be Learned for Offshore Oil Spills*, 8 OIL, GAS & ENERGY L. 1, 3 (2010).

¹⁹² 33 U.S.C. § 2718. (1990).

¹⁹³ See Robert Force, Martin Davies & Joshua S. Force, *Deepwater Horizon: Removal Costs, Civil Damages, Crimes, Civil Penalties, and State Remedies in Oil Spill Cases*, 85 TUL. L. REV. 889, 978–79 (2011).

¹⁹⁴ *See id.* at 979.

sum of removal costs and damages. The cap is the greater of a per incident cap and a per gross ton cap.¹⁹⁵ In 2006, the Coast Guard and Maritime Transportation Act (CGMTA) increased the cap.¹⁹⁶ The Coast Guard and Maritime Transportation Act (CGMTA) also established different caps for single hull and double hull tankers.¹⁹⁷ Moreover, in 2009 the Coast Guard made a further increase to the cap.¹⁹⁸ The result can be summarized in the following table:

Vessel	OPA 90 liability limits	2006 (2009) liability limits
Single hull tanker > 3000GT	\$1200/GT or \$10,000,000	\$3000 (3200)/GT or \$22,000,000 (23,496,000)
Single hull tanker ≤ 3000 GT	\$1200/GT or \$2,000,000	\$3000 (3200)/GT or \$6,000,000 (6,408,000)
Double hull tanker > 3000GT	\$1200/GT or \$10,000,000	\$1900 (2100)/GT or \$16,000,000 (17,088,000)
Double hull tanker ≤ 3000 GT	\$1200/GT or \$2,000,000	\$1900 (2100)/GT or \$4,000,000 (4,272,000)
Any vessel other than a tanker	\$600/GT or \$500,000	\$950 (1000)/GT or \$800,000 (854,400)

Table 2: Comparison of liability limits under OPA 90 and the Coast Guard and Maritime Transportation Act of 2006.

In 2009, the Coast Guard made its first consumer-price index (CPI) adjustment to the liability limits, increased the limits for double-hull tankers from 1900 to 2000 USD per gross ton, and increased single-hull tankers from 3000 to 3200 USD per gross ton.¹⁹⁹

In spite of those caps, a responsible party can lose its right to limitation if the incident was proximately caused by “gross negligence or willful misconduct,” or “the violation of an applicable Federal safety, construction, or operating regulation.”²⁰⁰ A responsible party may also face unlimited liability if it fails to report an incident, provide requested cooperation in connection with removal activities, or comply with an order of the President.²⁰¹ Hence, under the OPA, the amount of the financial cap is related to the preventive measures taken by the operator, and the limits are easily breakable.

Furthermore, unlike the international regime established through the CLC, OPA does not channel liability to one particular party but provides for joint and several liability.²⁰² OPA identified as responsible parties the ship owner, the operator, and the demise charterer.²⁰³ All those features imply that OPA is better

¹⁹⁵ 33 U.S.C. § 2704 (a) (1990).

¹⁹⁶ Coast Guard and Maritime Transportation Act of 2006, Pub. L. No. 109-241, 120 Stat. 516 (2006), § 603.

¹⁹⁷ *Id.*

¹⁹⁸ See Consumer Price Index Adjustments of Oil Pollution Act of 1990 Limits of Liability—Vessels and Deepwater Ports, 74 Fed. Reg. 31357 (July 1, 2009).

¹⁹⁹ See *id.* at 31360.

²⁰⁰ 33 U.S.C. § 2704(c)(1)(A)–(B) (1990).

²⁰¹ 33 U.S.C. § 2704 (c)(2) (1990).

²⁰² See WANG, CIVIL LIABILITY, *supra* note 119, at 209.

²⁰³ 33 U.S.C. 2701(32)(A) (1990).

aligned with the economic principles of liability²⁰⁴ and hence provides better incentives for disaster risk mitigation.

III. ADDITIONAL COMPENSATION MECHANISMS

As we outlined above, liability rules have a lot of potential to provide compensation to disaster victims and, when appropriately designed, can even provide adequate incentives for disaster risk mitigation. However, it was equally shown that liability rules have substantial limits as well. One problem is that their application is mostly limited to technological (man-made) disasters, which leaves victims of natural disasters uncompensated. Moreover, the design of the liability rules in international conventions is, as we showed, somewhat flawed due to its inclusion of channeling and low liability limits, as a result of which the positive incentive effects for operators will often not be attained.

In reality one can therefore observe a variety of alternative compensation mechanisms²⁰⁵ which all usually aim at some form of recovery after a disaster. Those additional compensation mechanisms are in some cases unstructured and ad hoc (e.g., governments or other actors providing relief to victims); in other cases they involve structural compensation funds. Some mechanisms can be found in domestic law; others have a basis in international environmental agreements, usually in the conventions we discussed earlier that also introduce liability rules. The fund then constitutes an additional layer of compensation, supplementing the operators' liability.

In all those cases where additional compensation is provided, the crucial question again arises as to how those compensation mechanisms affect stakeholder incentives to take disaster risk mitigation measures. The incentives at stake in technological disasters are usually those of the operators. By contrast, the incentives that could be affected by ex post payments when natural disasters occur mostly belong to potential victims.

We first provide an inventory of the different models of additional compensation, showing their potential advantages and dangers. Next, we present examples of additional compensation mechanisms in international environmental agreements (A). Finally, we provide a critical analysis of these mechanisms (B).

A. Potential and Models

1. Potential

a. Technological Disasters

The main potential of additional compensation mechanisms lies in their ability to go beyond the limits of liability and insurance. One problem with seeking compensation for catastrophic risks via traditional liability rules is that the capacity of the operator and of traditional insurance markets may be limited, as a result of which operators may not be able to fully compensate the catastrophic risk they are

²⁰⁴ *Supra* Part II(C).

²⁰⁵ *See infra* Part V.

causing.²⁰⁶ Providing an additional compensation mechanism could advantageously generate higher capacity to deal with damage resulting from catastrophic risks. If additional capacity, for example of the state or of a pool of operators,²⁰⁷ were enacted, risk spreading would generate higher capacity to deal with the catastrophic risk. Ultimately, an additional compensation mechanism could thus provide greater coverage, guaranteeing better compensation for victims.

A second potential advantage of using additional compensation mechanisms involves the ability to prevent operators from externalizing harm. It is well-known²⁰⁸ that the deterrent effect of liability rules starts diminishing the moment the amount of the damage is substantially higher than the wealth of an operator.²⁰⁹ Mandating solvency guarantees would solve that problem.²¹⁰ Nevertheless, that solution would still leave another problem unresolved: Capacity must also be available in order to provide security to the operator. To the extent that the additional compensation mechanism would charge risk-related premiums (and in that sense function as an insurer), the contributions to the additional compensation mechanism would provide operators incentives for disaster risk mitigation. Yet a crucial condition for the effectiveness of the additional compensation mechanism in providing incentives for disaster risk mitigation requires that contributions be related to the risk posed by the operator, as outlined above.²¹¹ Incentives for prevention could only be generated via risk-related contributions. If, to the contrary, contributions were not risk-related (e.g., did involve a general tax), the additional compensation mechanism could even produce negative incentives, since safer operators would then de facto cross-subsidize riskier ones. This negative effect on incentives for disaster risk mitigation would certainly apply when the additional compensation mechanism could no longer be financed by the operators that create the risk but, for example, by the government. In that scenario, the additional compensation mechanism would constitute a subsidy to operators and would allow them to externalize the disaster risk to society. Based on that hypothesis, the additional compensation mechanism would even increase the disaster risk in lieu of providing incentives for disaster risk mitigation.

b. Natural Catastrophes

In the case of natural catastrophes no operator can be made liable for the consequences of the catastrophe. Hence the goal of an additional compensation mechanism is not related to providing incentives for operators. Rather, its primary goal is to generate financial capacity for recovery in the form of infrastructure reconstruction and victim compensation. Again, in the case of natural catastrophes,

²⁰⁶ See FAURE & HARTLIEF, *supra* note 57, at 88–90.

²⁰⁷ In the hypothesis that a risk pooling agreement between operators would be used.

²⁰⁸ And already discussed above. See *supra* Part III(A)(2).

²⁰⁹ See Shavell, *supra* note 51, at 45–58 (arguing that when the magnitude of the damage is higher than the operator's wealth a "judgment proof problem" will emerge, leading to underdeterrence of operators).

²¹⁰ See Peter J. Jost, *Limited Liability and the Requirement to Purchase Insurance*, 16 INT'L REV. L. & ECON. 259, 259–76 (1996).

²¹¹ See Part II(B).

a compensation mechanism²¹² could have positive effects on society. Leaving victims of catastrophes without any relief would probably be incompatible with the concept of the welfare state, at least as it is conceived in most E.U. Member States.²¹³ A disaster can potentially lead to a total disruption of society, and ex post recovery can therefore fulfill an important function by, for example, restoring infrastructure and, to the extent possible, bringing life after the disaster back to normality. There is also a strong belief that providing relief in the immediate aftermath of a disaster is one of the principal functions of government.²¹⁴

Another potential rationale for ex post recovery would be that, although ex post payments in the case of a natural catastrophe cannot affect the incentives of potential tortfeasors, they might affect the incentives of government. The prospect of large-scale payments in the aftermath of a disaster might encourage the government to take cost-benefit justified precautions long before disasters strike.²¹⁵ This argument may be of particular strength in the case of terrorism. The goal of terrorist attacks is often to disrupt society. Providing ex post relief may then help to restore public trust. Moreover, terrorists may adopt adaptive strategies to which governments can potentially react better than individuals. Additionally, in the case of terrorist attacks there is little one can expect from civilians as far as preventive measures are concerned. The same is obviously true of large-scale infrastructural works which would be necessary to prevent catastrophes (e.g., building dykes against tsunamis). These are typically public goods that are not provided through private action and may therefore require government intervention.

A related argument in favor of government intervention is that government has the capacity to diversify the risks over the entire population and to allocate past losses to future generations, thereby creating a form of cross-time diversification, which the market could not achieve.²¹⁶ Likewise, the argument can be made that, as far as the terrorism risk is concerned, the risk of terrorist attacks is partly in the government's control and the government may have more information on ongoing terrorist groups' activities through intelligence services.²¹⁷ Hence, in some cases the government may be in the best position to prevent disasters. Government intervention would from this perspective provide incentives to politicians to invest in preventive measures. A few examples that come to mind are the building of dykes against the risk of a tsunami, taking measures to prohibit building residences on the slopes of volcanoes (like Mount Merapi in Indonesia), or effective zoning and planning decisions to avoid locating residences in flood-prone areas.

²¹² Which in this case should not be referred to as an "additional" compensation mechanism since it is not "additional" to anything else like liability.

²¹³ See Reimund Schwarze & Gert Wagner, *In the Aftermath of Dresden: New Directions in German Flood Insurance*, 29 GENEVA PAPERS ON RISK & INS. 154, 154–68 (2004) (arguing that a general mandatory insurance against natural catastrophes whereby the state steps in as final insurer should be introduced in Germany).

²¹⁴ See Priest, *supra* note 14, at 235.

²¹⁵ Saul Levmore & Kyle D. Logue, *Insuring Against Terrorism—and Crime*, 102 MICH. L. REV. 268, 310 (2003).

²¹⁶ For a strong version of this argument see generally Howard Kunreuther & Erwann Michel-Kerjan, *Challenges for Terrorism Risk Insurance in the United States*, 18 J. ECON. PERSP. 201 (2004).

²¹⁷ Howard Kunreuther & Erwann Michel-Kerjan, *Insurability of (Mega-) Terrorism Risk: Challenges and Perspectives*, in TERRORISM RISK INSURANCE IN OECD COUNTRIES 107, 107–48 (2005) (calling for government participation in any terrorism insurance program to be based on public-private partnerships. See especially page 126: "Government can have more information on ongoing terrorist groups' activities through intelligence services.").

Moreover, one could also make the argument that government can in principle compensate without limits. If the damage were to exceed the current budgetary possibilities of the government, the aforementioned cross-diversification over time and future generations could in principle take place.

2. Models

Compensation mechanisms can take different shapes and forms. In the case of technological disasters, it usually consists of providing an extra layer of compensation in addition to the liability scheme (combined with liability insurance). In the case of natural catastrophes, the compensation mechanism usually consists of government intervention that can either be structured as an ad hoc charity or as a more structured compensation fund.

a. Extra Layer Compensation

An additional compensation mechanism, which is often put in place in case of technological disasters,²¹⁸ is an extra layer of compensation. This extra layer is in addition to the principal liability of an operator who has created the catastrophic risk. Such an additional layer can typically be found in combination with a financial cap on the liability of the operator. Since the operators' liability is limited, the damage could in principle exceed the operators' liability. The extra layer of compensation is then meant to compensate for the amount of damage that goes beyond the amount of the operators' liability. In that sense the compensation mechanism is indeed "additional" and only intervenes when the amount of the operator's limited liability would be insufficient to cover the damage. This additional layer is usually limited and the financing can either be via the government²¹⁹ or through operators.²²⁰

As the description of the liability regimes in the international liability conventions made clear,²²¹ the nuclear and marine pollution conventions commonly provide for an additional layer of compensation.²²² However, the Draft Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities, drafted by the International Law Commission, also referred to the need for creating a prompt and adequate compensation mechanism.

b. Nuclear Liability Conventions

The aim of the 1963 Brussels Supplementary Convention is to supplement the compensation system provided in the Paris Convention "with a view to

²¹⁸ And, as we shall see, also via international environmental agreements. See *infra* Part IV B.

²¹⁹ Like in the case of the international conventions with respect to nuclear liability, as we will show in Part IV(B)(1)(a).

²²⁰ As in the case of the international conventions with respect to marine pollution liability, addressed in Part IV(B)(1)(b).

²²¹ See *supra* Part III(B).

²²² Regarding those compensation mechanisms see BARBOZA, *supra* note 81, at 37–39.

increasing the amount of compensation for damage which might result from the use of nuclear energy for peaceful purposes.”²²³

According to Article 3 of the Brussels Supplementary Convention, the Contracting Parties undertake that compensation in respect of damage caused by a nuclear accident shall be provided up to the amount of 300 million SDRs per incident (EUR 341.85 million or USD 432.474 million). Such compensation shall be provided:

Up to an amount of at least 5 million SDRs (EUR 5.70 million or USD 7.64 million), out of funds provided by insurance or other financial security, such amount to be established by the legislation of the Contracting Party in whose territory the nuclear installation of the operator liable is situated;

A second tier consisting of the difference between SDR 175 million and the amount required under the first tier (thus maximum 170 million SDRs or EUR 193.72 million or USD 259.70 million), out of public funds to be made available by the Contracting Party in whose territory the nuclear installation of the operator liable is situated;

A third tier of 125 million SDRs (EUR 142.44 million or USD 190.96 million), out of public funds to be made available by the Contracting Parties according to a formula for contributions which is based on the GNP and the thermal capacity of the reactors.

The 1963 Brussels Supplementary Convention thus introduces two additional tiers of compensation for covering nuclear damage on top of the first tier of private funds (liability) provided for by the Paris Convention. Indeed, the first tier of the Brussels Supplementary Convention is the insurance coverage of the nuclear operator as established under the Paris Convention. On top of that amount, the Brussels Supplementary Convention provides for two additional tiers of public funds: One “national” public fund to be made available by the Installation State and one international solidarity fund to be made available by all Contracting Parties.

However, the Installation State can escape from its obligation to make national public funds available. Under the Brussels Supplementary Convention, each Contracting Party has certain freedoms. It can establish the maximum liability of the operator, pursuant to the Paris Convention, at 300 million SDRs, and provide that such liability shall be covered by the insurance of the nuclear operator (in that case the Installation State has met its obligation under the Convention and must not provide for national public funding in the second layer). However, the Contracting Party can also set the maximum liability of the operator at an amount at least equal to the insurance of the nuclear operator and provide that, in excess of such amount and up to 300 million SDRs, public funds shall be made available by some means other than as cover for the liability of the operator.²²⁴

As we already mentioned above, important changes occurred in the international regime after the Chernobyl accident. We mentioned that first tier liability (the liability of the operator of the nuclear power plant) shall increase to EUR 700 million. Moreover, according to the Protocol to the Brussels Supplementary Convention, the Contracting Parties will undertake that

²²³ Considerations to the Brussels Supplementary Convention, *supra* note 97.

²²⁴ For more details, see Vanden Borre, *supra* note 155, at 302–08.

compensation in respect of nuclear damage shall be provided up to an amount of EUR 1.5 billion per nuclear incident. This will be divided as follows:

Up to an amount of at least EUR 700 million: Funds provided by insurance or other financial security or out of public funds provided pursuant to Art. 10(c) of the Paris Convention;

Between this amount and EUR 1,200 million: Public funds to be made available by the Contracting Party in whose territory the nuclear installation of the operator liable is situated;

Between EUR 1.2 billion and EUR 1.5 billion, out of public funds to be made available by all the Contracting Parties according to the formula for contributions.

Finally, the Convention on Supplementary Compensation for Nuclear Damage (CSC), adopted on September 12, 1997, is a new and independent legal instrument, which means that a State does not need to be a party to the Vienna or Paris conventions in order to become a party to the CSC.²²⁵

According to Article III.1.A of the CSC, the Installation State shall ensure the availability of at least 300 million SDRs (EUR 341.85 million or USD 458.29 million). This provision provides for an obligation of the Installation State to ensure that 300 million SDRs are available; the Installation State is free to choose how this amount is funded (private insurance, regional agreement, etc.). A State meets its obligation under Art. III.1.A of the CSC when it imposes liability on the operator for the entire amount. So, as such, this Article does not oblige a State to make public funds available. However, according to Art. II.1.B of the CSC, the Contracting Parties shall, beyond the amount available under the first tier, make public funds available.²²⁶

If one were to summarize the situation, one could hold that in addition to the individual liability (with financial caps) of the nuclear operator there are two additional types of funding mechanisms: There is an obligation of an Installation State to make certain amounts of money available; it can do so either by providing for public funding, or by making the nuclear operator liable for the total amount—this is the second tier of the Brussels Supplementary Convention and the first tier under the CSC.

Finally, there is a system that can be called an international solidarity fund, funded by all Contracting Parties.²²⁷ This public funding can as such not be shifted—this is the case for the third tier of the Brussels Supplementary Convention and for the second tier under the CSC.

The total amounts available in the nuclear liability regime can be summarized in the following table:

²²⁵ CSC, *supra* note 102.

²²⁶ According to the following formula:

The amount which shall be the product of the installed nuclear capacity of that Contracting Party multiplied by 300 SDRs per unit of installed capacity; and the amount is determined by applying the ratio between the United Nations rate of assessment for that Contracting Party as assessed for the year preceding the year in which the nuclear incident occurs, and the total of such rates for all Contracting Parties to 10% of the sum of the amounts calculated for all Contracting Parties.

²²⁷ Brussels Supplementary Convention, *supra* note 97, arts. III(a)–III(b); LIU, *supra* note 111, at 214; SANDS & PEEL, *supra* note 25, at 740.

Amount in million €			
What convention?	Who pays?	First generation	Second generation
Paris Convention	Nuclear operator	57	700
Brussels Supplementary Convention	Installation State (or Nuclear operator)	193.7	500
	Collective State Fund	142.4	300
Total NEA-regime		341.8	1,500
Vienna Convention	Nuclear operator	4.2	170.9
	Collective State Fund	-	170.9
Total Vienna Convention		4.2	341.8
Convention on Supplementary Compensation	Operator/installation State		341.8
	Collective State Fund		341.8
Total CSC			683.7

Table 3: Available amounts of compensation under the international nuclear liability conventions.²²⁸

The table above highlights that the nuclear liability regime of the second generation increases the differences between the Paris and Vienna Convention with regard to the liability amount of the nuclear operator (or, in a system of unlimited liability the amount up to which the operator is required to have financial security) and with regard to the total compensation available. Under the revised Paris and Brussels Supplementary Convention, a total amount of EUR 1.5 billion will be available (of which EUR 700 million is financed by the operator) whereas the total amount of the initial Paris and Brussels Supplementary Convention was EUR 356 million. The total amount available under the Vienna Convention is equal to the amount set by the 1963 Brussels Supplementary Convention.

Table 3 also demonstrates that under the nuclear compensation scheme of the second generation, public funding is either newly created or kept at the same level as in 1963 in relative terms.²²⁹ In absolute terms, there is considerably more public funding in the second generation conventions: Under the 2004 Brussels Supplementary Convention, the public intervention has more than doubled²³⁰ and under the IAEA regime, no public intervention existed under the conventions of the first generation.

It is important to underline that out of the four new nuclear liability instruments that resulted from the revision exercise, only two have entered into

²²⁸ See Faure & Vanden Borre, *supra* note 99, at 239 (providing the amounts of compensation in USD according to the exchange rate in 2008).

²²⁹ See Vanden Borre, *supra* note 155, at 303–04.

²³⁰ In the second tier of the Installation State the amount rose from EUR 202 million to EUR 500 million; in the third tier, the Collective State Fund went from approximately EUR 150 million to EUR 300 million.

force so far. The Protocol to the Vienna Convention entered into force on October 4, 2003; the CSC entered into force on April 15, 2015.

c. Marine Oil Pollution

As mentioned above, the establishment of a compensation fund was decided upon at the 1969 conference, which led to the conclusion of the CLC 1969.²³¹ Two years after the adoption of the 1969 CLC, the 1971 Fund Convention was enacted. The 1971 Fund Convention has two aims: To provide compensation when the protections provided under the 1969 CLC are inadequate; and to relieve ship owners from additional financial burdens.²³²

The 1971 Fund Convention plays two roles: Compensating the victims, and indemnifying ship owners. First, it supplements the compensation provided by the 1969 CLC in the following situations: Where no liability can be established under the 1969 CLC; and where an owner and his financial guarantors are financially incapable of compensation and the damage exceeds the owner's liability. To encourage preventive measures, the costs raised from the voluntary activities of the owners are also treated as pollution damage.²³³ The Fund has no obligation to pay if it can prove that the damage at issue resulted from an act of war, hostilities, civil war or insurrection; or the oil from a warship or a state owned or operated ship; or if the claimant is unable to prove that the damage resulted from a ship-related incident. The Fund may also raise the defense of contributory negligence.²³⁴ The compensation available from the 1971 Fund, however, is not unlimited: The total amount available from the 1969 CLC and the 1971 Fund Convention is capped at FF 450 million. Similarly, the amount payable for the damage caused by a natural disaster of an exceptional, inevitable, and irresistible character is capped at FF 450 million. However, the Assembly of the Fund has the right to increase the amount to FF 900 million. If claims exceed the amount payable from the fund, payment should be reduced proportionally for each claimant.²³⁵

In addition to providing complementary compensation to victims, the 1971 Fund also indemnifies ship owners. Indemnification is available for quantities between (1) an amount in excess of FF 1,500 for each ton of the ship's tonnage, or FF 125 million, whichever is less; and (2) an amount not in excess of FF 2,000 per ton of said tonnage, or FF 210 million, whichever is less. However, indemnification is not available for damage caused by the willful misconduct of the ship owners.²³⁶ Claims for compensation or indemnification should be made within three years of the occurrence of the damage and within six years of the occurrence of the incident.²³⁷

The Fund is financed by big oil importers in contracting states. The eligible importers need to make initial contributions as the working capital of the

²³¹ See Part III(B)(3).

²³² See 1971 Fund Convention, *supra* note 119, art. 2(1).

²³³ *Id.* art. 4(1).

²³⁴ *Id.* arts. 4(2)–(3).

²³⁵ *Id.* arts. 4(4)–(6).

²³⁶ *Id.* art. 5(1).

²³⁷ *Id.* art. 6(1).

fund, as well as annual contributions to cover administrative expenses and claims.²³⁸ The calculation of contributions is based on a fixed sum for each ton of contributing oil received.²³⁹ Each Contracting State has the duty of ensuring that each eligible contributing importer appears on a list and to communicate this information to the Fund.²⁴⁰ Moreover, a Contracting State may, by means of a simple declaration, assume the burden of making contributions on behalf of importers within its territory.²⁴¹

The original CLC and Fund Conventions proved to be insufficient to cover the potentially catastrophic damage of oil pollution. In 1992, a new compensation fund was established. The 1992 Fund Convention removed the Fund's burden of alleviating the liability of ship owners. Therefore, the only function of the 1992 Fund became that of providing additional protection to the victims of oil pollution. The conditions for the application of the 1992 Fund are the same as those of the 1971 Fund.²⁴² Moreover, the available compensation increased to 203 million SDRs.²⁴³

The 1992 Fund is also financed by the oil industry through annual contributions. Furthermore, the calculation of the contributions is also based on the amount of oil received.

Though the compensation limits under the 1992 Fund Convention increased considerably, the amount was dwarfed shortly afterwards by various catastrophic oil pollution cases.²⁴⁴ Against this backdrop, a Supplementary Fund was established in the 2003 Protocol.²⁴⁵ The Supplementary Fund provides an additional layer of compensation for oil pollution victims under the 1992 CLC and the 1992 Fund Convention. In other words, a condition to receive a payment from the Supplementary Fund is that the victim be entitled to compensation under the 1992 CLC and the 1992 Fund Convention, and unable to obtain full and adequate compensation from them.²⁴⁶ The Supplementary Fund Convention increased the aggregate amount of compensation from the previous level of 203 million SDRs, to 750 million SDRs.²⁴⁷

The amount of compensation available under the international marine pollution regime can be summarized as follows:

²³⁸ WU, *supra* note 188, at 98.

²³⁹ See 1971 Fund Convention, *supra* note 119, arts. 11(1) & 12(2).

²⁴⁰ *Id.* art. 15(1).

²⁴¹ *Id.* art. 14(1).

²⁴² See 1992 Fund Convention, *supra* note 119, art. 4.

²⁴³ *Id.*

²⁴⁴ The 1997 Nakhodka accident near Japan and the 1999 Erika disaster in France are two examples.

²⁴⁵ See generally Protocol to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1992), May 16, 2003, IMO Doc. LEG/CONF.14/20 [hereinafter "Supplementary Fund Protocol"].

²⁴⁶ *Id.* art. 4.

²⁴⁷ *Id.* art. 4(2).

Tonnage of Ship (GT)	CLC 1969 (Euro)	CLC 1992 (Euro)	2000 Protocol (Euro)	
Ships ≤ 5000	153 per ton	3.45 million	5.19million	
5,000 < Ships < 140,000	153 per ton	3.45 million + 483/additional ton	5.19million + 726/additional ton	
Ships ≥ 140,000	16.1 million	68.6 million	103.2million	
	1971 Fund (Euro)	1992 Fund (Euro)	2000 Protocol (Euro)	2003 Supplementary Fund (Euro)
Overall limit ²⁴⁸	69 million	155.2 million	233 million	862 million

Table 4: Compensation for pollution damage under the international regime.²⁴⁹

d. Ad Hoc Charity

A second possibility is that of awarding ex post compensation to catastrophe victims. This could be done by means of private charity, but is usually done by the government. The motivations behind these interventions may vary. In some cases, it is argued that public funds should be used to provide partial compensation to victims out of a sense of solidarity.²⁵⁰ In other cases—this may be an especially strong argument in case of terrorist attacks—the government may be better situated to take preventive measures.²⁵¹ Alternatively, if these preventive measures are not taken, direct compensation through public funds can provide a means for the government to fulfill its responsibilities.²⁵²

A typical feature of ad hoc charity is that, in principle, the victim has no right to compensation. The ad hoc nature implies that the government has the discretion to decide whether to provide the compensation or not. Further, how much to provide to each individual victim can also be decided on an ad hoc basis.

Ad hoc charity²⁵³ is not primarily found in international environmental agreements, but rather in the actions of domestic governments. The reason why politicians often compensate the victims of a catastrophe is that they suffer from a so-called hold-up problem.²⁵⁴ It is politically impossible to deny assistance “once there are identified victims and their stories are featured on the evening news.”²⁵⁵

²⁴⁸ The overall limit is the maximum compensation payable by the Fund for any incident, and it includes the compensation made by the ship owner or his insurer under the CLC.

²⁴⁹ The original unit of calculation in the Conventions is SDR as defined by the International Monetary Fund (IMF). For the convenience of comparison, all the units are converted to Euros, as per the exchange rate on February 22, 2013, 1 SDR = EUR 1.1498.

²⁵⁰ See Jef Van Langendonck, *International Social Insurance for Natural Disasters?*, in *SHIFTS IN COMPENSATION BETWEEN PRIVATE AND PUBLIC SYSTEMS* 183, 192–93 (Willem H. Van Boom & Michael Faure eds., 2007).

²⁵¹ *Id.*

²⁵² For further details, see Veronique Bruggeman, Michael Faure & Tobias Heldt, *Insurance Against Catastrophe: Government Stimulation of Insurance Markets for Catastrophic Events*, 23 *DUKE ENVTL. L. & POL'Y F.* 185, 190–91 (2012).

²⁵³ As well as structural compensation funds.

²⁵⁴ See generally Kip W. Viscusi, *The Hold-Up Problem: Why It Is Urgent to Rethink the Economics of Disaster Insurance Protection*, in *THE IRRATIONAL ECONOMIST: MAKING DECISIONS IN A DANGEROUS WORLD* 146 (Erwann-Michel Kerjan & Paul Slovic eds., 2010).

²⁵⁵ *Id.*

In other words, the pressure to provide relief to victims *ex post* is exceedingly strong and leads to the so-called “Samaritan’s dilemma”: The government grants *ex post* compensation, even if this is likely to have negative *ex ante* effects on incentives.²⁵⁶

These types of *ex post* charity compensation can be found in many jurisdictions. Several examples can be provided by developed countries. In Europe, such payments took place in Germany after the Elbe flooding of 2002, where EUR 6.1 billion were made available to victims of flooding.²⁵⁷ Similarly, in Italy, EUR 3.5–4 billion are spent on average each year to indemnify victims of damage caused by catastrophic events.²⁵⁸

In the United States, the importance of charity payments became especially clear after hurricane Katrina made landfall near the Louisiana-Mississippi border on the morning of August 29, 2005. This catastrophe went on to become the most expensive natural disaster in U.S. history, as well as one of the deadliest.²⁵⁹ Total costs for Katrina were (as of February 2006) estimated to be USD 96 billion—300,000 homes were destroyed or rendered uninhabitable, and 1,330 people died. Comparatively, Katrina was far more costly than the total estimated damage of the 9/11 terrorist attacks, reported to be approximately USD 18 billion.²⁶⁰

In the United States, local authorities can provide victim relief based on the Stafford Act.²⁶¹ An individual or household can receive a maximum of USD 26,200 of Individual and Household Programme (IHP) assistance through the Federal Emergency Management Agency (FEMA), financed in part by the federal government and in part by the state through a cost-sharing agreement. The Stafford Act determines the federal assistance as well as the financial assistance provided by FEMA, which can include direct payments, grounds, loans and insurance. Overall, funding is capped at USD 5 million. In the event of an emergency, and in particular when the President has declared an event a major disaster, no financial limits apply and states can request federal assistance.²⁶² To the extent feasible and practicable, preference must be given to organizations, firms, and individuals from the area affected by the disaster or emergency when federal contracts are concluded for debris, clearance, distribution of supplies, or reconstruction.²⁶³ Congress dedicated

²⁵⁶ See Stephen Coate, *Altruism, the Samaritan’s Dilemma, and Government Transfer Policy*, 85 AM. ECON. REV. 46, 46–57 (1995) (arguing that the reliance on private charity by the poor has adverse efficiency effects).

²⁵⁷ Ulrich Magnus, *Germany*, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES: A COMPARATIVE LEGAL APPROACH 119, 140–41 (Michael Faure & Ton Hartlief eds., 2006).

²⁵⁸ Alberto Monti & Filippo A. Chiaves, *Italy*, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES: A COMPARATIVE LEGAL APPROACH, *supra* note 257, at 169.

²⁵⁹ H.R. REP. NO. 109-377, at 7 (2006) [hereinafter A FAILURE OF INITIATIVE], available at http://katrina.house.gov/full_katrina_report.htm (last visited Dec. 25, 2015).

²⁶⁰ FRANCES F. TOWNSEND, THE WHITE HOUSE, THE FEDERAL RESPONSE TO HURRICANE KATRINA: LESSONS LEARNED 7 (2006) [hereinafter LESSONS LEARNED].

²⁶¹ See generally Robert T. Stafford Disaster Relief and Emergency Assistance Act, Pub. L. No. 100-707 (1988). The Robert T. Stafford Disaster Relief and Emergency Assistance Act, signed into law November 23, 1988, amended the Disaster Relief Act of 1974. This Act constitutes the statutory authority for most federal disaster response activities in the United States, more particularly the programs of the Federal Emergency Management Agency (FEMA).

²⁶² OFFICE OF INSPECTOR GEN., OFFICE OF INSPECTIONS & SPECIAL REV., DEP’T OF HOMELAND SECURITY, OIG-06-32, A PERFORMANCE REVIEW OF FEMA’S DISASTER MANAGEMENT ACTIVITIES IN RESPONSE TO HURRICANE KATRINA 13–17 (2006) [hereinafter “A PERFORMANCE REVIEW”]; LESSONS LEARNED, *supra* note 260.

²⁶³ A FAILURE OF INITIATIVE, *supra* note 259, at 33.

USD 62.3 billion to relief and recovery after Katrina.²⁶⁴ According to the Bipartisan committee report “A Failure of Initiative”, USD 63 billion were allocated to “disaster relief.” By November 30, 2005, USD 19.3 billion had been spent.²⁶⁵ The report shows that the money went, among other things, to personal needs not met by insurance, temporary housing (including vouchers for hotels/motel rooms and mobile homes), debris removal, damage inspections, hazard mitigation, etc. A later Senate report refers to a total amount of USD 88 billion committed by the Federal Government, as of March 8, 2006, “to the response, recovery and rebuilding efforts.”²⁶⁶ An even later (August 2006) report of the Congressional Research Service mentions a total amount of supplemental disaster appropriations of USD 81.6 billion, largely consisting of relief and reconstruction. As mentioned above, direct compensation to victims was limited to the amounts of immediate relief for households. Recovery (other than reconstruction) took place via the National Flood Insurance Program. Projected payments to policyholders in Louisiana were estimated at USD 17 billion²⁶⁷ for those who were insured, an amount that also corresponds to estimates made by insurance experts.²⁶⁸

Japan offers generous support funds, reconstruction funds, and financial aid for disaster victims (especially earthquakes). Following the recent Fukushima incident of March 2011, a corporation was created to compensate victims.²⁶⁹ To ensure full compensation, the Japanese government decided to issue 2 trillion yen (USD 26 billion) in government bonds to help Tepco (Tokyo Electric Power Company), the operator, pay compensation. Further, the government is considering approving a supplementary budget of 3 trillion yen (USD 38 billion).²⁷⁰ In this case there was generous intervention by the government of Japan, even though the nuclear accident at Fukushima was clearly a technological, and not a natural, disaster.²⁷¹

Although their financial capacity is often more limited, governments in developing countries also offer charity. For example, in Indonesia government compensation for disasters amounted to USD 1.27 billion in 2006.²⁷² However, compensation payments to victims based on charity do not only come from

²⁶⁴ A PERFORMANCE REVIEW, *supra* note 262, at 112.

²⁶⁵ A FAILURE OF INITIATIVE, *supra* note 259, at 310. The report mentions that the amount was paid “to relieve the immediate suffering of individuals and families, clear debris, reimburse federal agencies for the costs of technical and direct assistance, and support federal operations such as search and rescue and delivery of consumables.”

²⁶⁶ S. REP. NO. 109-322, at 16 (2006).

²⁶⁷ A FAILURE OF INITIATIVE, *supra* note 259, at 74.

²⁶⁸ RAWLE O. KING, THE NATIONAL FLOOD INSURANCE PROGRAM: STATUS AND REMAINING ISSUES FOR CONGRESS 6 (2013), available at <https://www.fas.org/sgp/crs/misc/R42850.pdf>.

²⁶⁹ Michael Faure & Jing Liu, *The Tsunami of March 2011 and the Subsequent Nuclear Incident at Fukushima: Who Compensates the Victims?*, 37 WM. & MARY ENVTL. L. & POL’Y REV. 129, 198–201 (2012).

²⁷⁰ *Id.* at 201.

²⁷¹ See Faure, Liu, & Wibisana, *supra* note 9 (expounding on whether the tsunami that was at the origin of the nuclear accident at Fukushima would constitute an ‘act of God,’ thereby eliminating the operator’s liability).

²⁷² Faure, *supra* note 13, at 258.

domestic governments, but from international donors as well. Payments made by governments are often referred to as *ex gratia* payments.²⁷³

e. Compensation Funds

A compensation fund for natural catastrophes is similar to the charity solution, with one important distinction: In the case of *ad hoc* compensation, the government decides in each case, depending upon the size of the catastrophe, whether public funds will be made available or not²⁷⁴ and, if so, to what extent. In the case of a compensation fund, there is a more structured solution whereby victims can call on the compensation fund to receive lump sum payments. One specific feature of compensation funds is that the government will usually have to declare a particular event a catastrophe before compensation can be paid.²⁷⁵ Another feature of compensation funds is that full compensation is not usually provided. Rather, standardized, lump sum payments that do not amount to full compensation take place.

Examples can be found, among other places, in Belgium²⁷⁶ and Austria.²⁷⁷ In general, the role of compensation funds seems to be relatively limited. For instance, in Austria the compensation provided through the fund only covers 30–50% of the actual damage.²⁷⁸ Moreover, in Belgium the nature of the compensation fund dramatically changed as a result of statutory changes in the period of 2003–2005. Belgium moved to a system of mandatory insurance, substantially reducing the role of the compensation fund.²⁷⁹ Some maintain there is a tendency in many of the European legal systems to move away from public compensation funds towards market-based insurance solutions.²⁸⁰

There is one type of compensation fund that has a hybrid character, namely, the *ad hoc* compensation funds created after 9/11,²⁸¹ and more recently the Gulf Coast Claim Facility (GCCF), created after the Deepwater Horizon incident in

²⁷³ BARBOZA, *supra* note 81, at 55–58. *See generally* THE INTERNATIONAL LAW OF DISASTER RELIEF (David D. Caron, Michael J. Kelly & Anastasia Telesetsky eds., 2014) (providing an overview of the way in which international law has regulated disaster relief).

²⁷⁴ Faure, *supra* note 48, at 353.

²⁷⁵ *See generally* Levmore & Logue, *supra* note 215 (arguing that this leads to so-called “sorting costs” since the government will have to decide which catastrophes will be compensated via the fund and which will not).

²⁷⁶ *See* Isabelle C. Durant, *Belgium*, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES, *supra* note 257, at 59–65 (providing an overview of the way Belgium’s compensation fund works).

²⁷⁷ *See generally* Dagmar Hinghofer-Szalkay & Bernard A. Koch, *Austria*, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES, *supra* note 257, at 7–36 (providing an overview of the way Austria’s compensation fund works).

²⁷⁸ Michael G. Faure, *Comparative and Policy Conclusions*, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES, *supra* note 257, at 389, 391.

²⁷⁹ Veronique Bruggeman, Michael G. Faure & Miriam Haritz, *Remodelling Reparation: Changes in the Compensation of Victims of Natural Castastrophes in Belgium and the Netherlands*, 35 DISASTERS 766, 767, 780 (2011).

²⁸⁰ Faure, *supra* note 13, at 442–44.

²⁸¹ *See* BRUGGEMAN, *supra* note 6, at 465–82. (providing additional granularity on the matter of *ad hoc* hybrid compensation funds).

the Gulf of Mexico.²⁸² These compensation funds have a hybrid character since they are difficult to fit into any of the categories discussed so far. In some cases—like with the 9/11 compensation fund—the fund replaces tort law, since no liable tortfeasor can be found, and provides relatively generous compensation through public funding.²⁸³ In other cases—like with the GCCF—the fund was rather meant as a confidence builder to avoid increasing the damage as a result of lengthy tort litigation, thus in a way supporting the tort mechanism.²⁸⁴ In the first case, the compensation fund, much like the 9/11 Victim Compensation Fund, resembles ad hoc charity; in the second case (GCCF) the fund did not replace, but in fact supported the liability system.²⁸⁵ For that reason, these hybrid structures are not further discussed separately.

3. Potential Disadvantages

The extent to which particular disadvantages apply is strongly related to the question of how the particular funding mechanism is financed. If financing were possible based on risk-dependent contributions, most of the disadvantages would not appear. However, this is usually only possible when an extra layer of compensation is provided in case of technological hazards, but not when ad hoc government charity is provided.

a. Lacking Incentives for Prevention

One disadvantage of ad hoc compensation mechanisms is that, if funding does not come from operators—which is obviously only possible in the case of technological disasters—and if it is not related to risk, no incentives for prevention can be generated and the compensation mechanism may amount to a subsidy for operators. This problem may also arise when the government provides ad hoc charity to the victims of a natural disaster. Since the payments do not usually relate to risk under government relief, they offer no incentives for taking preventive measures. Of course, whether it is realistic for victims to take preventive measures will depend on the nature of the disaster and on the payments made. For the public good reasons discussed above, governments will primarily undertake preventive measures requiring infrastructural ex ante disaster management. For instance,

²⁸² See generally KENNETH R. FEINBERG, WHO GETS WHAT? FAIR COMPENSATION AFTER TRAGEDY AND FINANCIAL UPHEAVAL (2012) (providing an interesting account of the compensation provided through both funds).

²⁸³ See generally Kenneth P. Nolan & Jeanne M. O'Grady, *The Victim Compensation Fund—Looking a Gift Horse in the Mouth*, 53 DEPAUL L. REV. 231 (2003) (arguing that the fund is not intended as a substitute to tort law or litigation).

²⁸⁴ See Michael G. Faure & Franziska Weber, *Towards a Rapid Claims Settlement Mechanism for Disasters?*, in VARIETIES OF EUROPEAN ECONOMIC LAW AND REGULATION 735–55 (Kay Purnhagen & Peter Rott eds., 2014) (explaining that in case of disasters it is crucially important to create a rapid claims settlement mechanism that can provide victims speedy lump sum payments in order to avoid an increase in the amount of damages as a result of delays in litigation).

²⁸⁵ The GCCF in fact was an optional instrument and paid compensation on the statutory basis of the 1990 U.S. Oil Pollution Act. Hence, many victims did not use the option offered by the GCCF, but preferred litigation. Tort claims are to an important extent still pending. See generally David F. Partlett & Russell L. Weaver, *BP Oil Spill: Compensation, Agency Costs, and Restitution*, 68 WASH. & LEE L. REV. 1341 (2011) (arguing that it was not made sufficiently clear that the GCCF was a structure independent from BP, as a result of which the structure aroused suspicion among claimants).

taking structural measures to protect a country against tsunamis or terrorist attacks is primarily a government task. However, there are certainly measures that individual potential victims can take, not so much to prevent a natural disaster, but to limit its impact and damage. For example, as far as flood protection is concerned, location decision is an important factor. Damage can obviously be prevented by not building structures in flood-prone areas. But again, the government may be in the best position to know where these flood-prone areas are and thus to prevent building in such areas through zoning and refusing building permits. Even when exposed to particular risks, victims can to some extent take preventive measures. For instance, in case of flooding, one can avoid installing the most valuable objects in the cellar or on the ground floor. The impact of these measures may be limited when compared to the impact that infrastructural works undertaken by the government could have, but they remain important. The problem is that ex post relief by governments may not provide the necessary incentives to take those appropriate preventive measures.²⁸⁶ In that respect, the literature argues that, via risk differentiation, competitive insurance markets are better able to deal with moral hazard and adverse selection.²⁸⁷

b. Lacking Incentives to Purchase Insurance

The second problem related to ad hoc charity by the government is that victims may rely on government compensation. This may in turn create an incentive not to purchase insurance.²⁸⁸ Indeed, government-provided compensation may dilute incentives to purchase insurance since victims may simply freeride on the State.²⁸⁹ In the words of Gollier: “Solidarity kills market insurance.”²⁹⁰ Coate has identified the lack of insurance as a result of government generosity.²⁹¹ This problem has been referred to as the “charity hazard.”²⁹² An experimental study on crop insurance in the Netherlands showed that the willingness of producers to purchase private insurance (supported by government) was negatively influenced

²⁸⁶ For further examples see Bruggeman, Faure & Haritz, *supra* note 279, at 766–88 (presenting a comparative analysis of the development and present state of compensation for victims of catastrophes in Belgium and the Netherlands, and arguing in favor of incentive-based victim compensation financing).

²⁸⁷ Priest, *supra* note 14, at 221–25.

²⁸⁸ Levmore & Logue, *supra* note 215, at 281. See Kaplow, *supra* note 5 (showing how ad hoc charity can have negative ex ante incentive effects).

²⁸⁹ See Alfred Endres, Cornelia Ohl & Bianca Rundshagen, *Land Unter!, Ein institutionenökonomischer Zwischenruf*, 29 LIST FORUM FÜR WIRTSCHAFTS- UND FINANZPOLITIK 284, 284–94 (2003) (holding that ex post compensation will have negative effects on incentives for prevention); Anne Gron & Alan O. Sykes, *A Role for Government?*, REG. (2002) [hereinafter Gron & Sykes I] (holding that any type of government provided compensation will negatively affect incentives); Anne Gron & Alan O. Sykes, *Terrorism and Insurance Markets: A Role for the Government as Insurer?*, 36 INDIANA L. REV. 447, 447–63 (2003) [hereinafter Gron & Sykes II] (arguing that government provided compensation will discourage risk prevention).

²⁹⁰ Christian Gollier, *Some Aspects of the Economics of Catastrophic Risk Insurance*, in CATASTROPHIC RISKS AND INSURANCE 25 (2005).

²⁹¹ Coate, *supra* note 256.

²⁹² See generally Paul A. Raschky & Hannelore Weck-Hannemann, *Charity Hazard—A Real Hazard to Natural Disaster Insurance?*, 7 ENVTL. HAZARDS 321 (2007) (providing a detailed explanation of ‘charity hazard’ and how it prevents the creation of a strong market for natural disaster insurance).

by the producer's belief regarding the availability of disaster relief in the future.²⁹³ The study concludes that, if governments continue to provide free ad hoc disaster relief, incentives to participate in a crop insurance program would be severely undermined.²⁹⁴ Recently, a similar conclusion was reached by empirical researchers comparing compensation mechanisms available in different countries after the August 2005 flood in Austria, Switzerland, and the German state of Bavaria.²⁹⁵ The study argues that a substantial charity hazard led to a lower purchase of insurance in Austria, where a disaster fund paid low amounts of compensation. Participation in flood insurance was higher in Bavaria, and was the highest in the Swiss canton of Grison, which featured a public monopoly on insurance and mandatory participation.²⁹⁶

The disadvantages of ad hoc charity arise both under ad hoc charity²⁹⁷ and structural compensation funds.²⁹⁸ Some literature has argued that a structural fund may be worse since it sends the wrong signal to the market.²⁹⁹ According to this argument, the availability of a structural fund would provide little incentives to market participants to develop financial solutions to deal with the consequences of a catastrophe. For that reason, they would endorse ad hoc rather than structural solutions. However, lawyers stress that ad hoc solutions have the disadvantage of creating legal uncertainty, in that the government may create an ad hoc solution for one catastrophe, but not for another. This treatment may hence violate the equality principle.³⁰⁰ Consequently, lawyers might plead in favor of more uniform and structural arrangements, which would allow victims to know ex ante whether or not they could rely on compensation after a catastrophe.³⁰¹ In practice, the real difference between structural and ad hoc solutions (as far as providing incentives is concerned) may be small. In some countries, like in Italy, compensation is formally ad hoc, meaning that there is no disaster fund and the government decides after every disaster whether or not compensation will be awarded.³⁰² However, in practice, the Italian government always compensates after a disaster. Hence, in that case potential victims will also rely on ex post disaster compensation, and the same problems will arise as with structural funds.

²⁹³ With respect to crop insurance programs in the Netherlands, see Marcel A.P.M. van Asseldonk, Miranda P.M. Meuwissen & Ruud B.M. Huirne, *Belief in Disaster Relief and the Demand for a Public-Private Insurance Program*, 24 REV. AGRIC. ECON. 196 (2002).

²⁹⁴ *Id.*

²⁹⁵ PAUL RASCHKY, REIMUND SCHWARZE, MANIJEH SCHWINDT, & HANNELORE WECK-HANNEMANN, ALTERNATIVE FINANCING AND INSURANCE SOLUTIONS FOR NATURAL HAZARDS: A COMPARISON OF DIFFERENT RISK TRANSFER SYSTEMS IN THREE COUNTRIES—GERMANY, AUSTRIA AND SWITZERLAND—AFFECTED BY THE AUGUST 2005 FLOODS 3 (2009).

²⁹⁶ *Id.*

²⁹⁷ Discussed *supra* Part III(A)(2)(d).

²⁹⁸ Discussed *supra* Part III(A)(2)(e).

²⁹⁹ The argument is specifically made in Gron & Sykes I, *supra* note 289, at 249–51.

³⁰⁰ Zeckhauser, *supra* note 8.

³⁰¹ See Karin Ammerlaan & Willem van Boom, *De Nederlandse herverzekeringsmaatschappij voor terrorismeschaden en de rol van de overheid bij het vergoeden van terreurschade*, 78 NEDERLANDS JURISTENBLAD, 2330–39 (2003) (discussing the Dutch reinsurance pool for terrorism risk as it has been created by the legislator. They explain that the Netherlands has a multilayered system whereby insurers, reinsurers and finally the state (as insurer of last resort) provide cover for the terrorism risk. They are, however, critical of this intervention by the state as reinsurer of last resort, arguing *inter alia* that it is undesirable for a state to intervene in this way in insurance markets).

³⁰² Monti & Chiaves, *supra* note 258.

c. Positive Effects on Disaster Risk Mitigation Are Doubtful

Preceding sections have argued that, theoretically, ad hoc charity by the government could have the advantage of providing incentives to politicians to invest in preventive measures. However, those incentives are very doubtful. Depoorter showed that the foresight of having to pay ex post relief in the future does not provide any incentives to politicians to invest in disaster prevention mechanisms for the simple reason that political benefits involved may be different. The result is, as Depoorter showed, an oversupply of ex post relief and an undersupply of disaster preparation measures.³⁰³

This oversupply of ex post compensation is related to the fact that politicians will receive large political rewards from those ex post payments, whereas they may receive too little reward from ex ante disaster management. As a result, preventive measures may also be undersupplied because the political benefits of planning activities might be shared with other levels of government. On the contrary, the political reward for ex post compensation can be very strong and, as a result, ex post relief is likely to be oversupplied.³⁰⁴ This effect has also been confirmed in other literature. Public choice theory shows that governments always tend to intervene when the number of victims is large.³⁰⁵ Potential victims are, after all, voters, and governments will try to seduce the largest number of electors in order to gain power or maintain their existing power. The argument of victim protection thus might hide behind a political and strategic interest. In addition, public choice theory demonstrates that public intervention is costly. Financing compensation by the State—especially through a public insurance pool—can be analyzed analogically as a bureaucracy. In that respect, Tullock shows that this type of scheme might suffer from financial waste and cost inefficiencies.³⁰⁶ This waste appears to be due mainly to internal rent-seeking activities and, in the case of a public insurance pool, to the capture of a monopolistic profit.³⁰⁷ Indeed, Garrett and Sobel illustrated that disaster expenditures by the Federal Emergency Management Agency (FEMA) are mostly politically motivated: States that are politically important to the President have a higher rate of disaster declaration by the President and disaster expenditures are higher in states having congressional representation on FEMA oversight committees.³⁰⁸ Hence, Garrett and Sobel argue that nearly half of all disaster relief is motivated by politics rather than by need. Finally, we can also point to the fact that, from the victims' perspective, government ad hoc compensation still remains ad hoc, in other words, uncertain. After a large, politically important disaster, some victims may receive generous

³⁰³ Depoorter, *supra* note 77.

³⁰⁴ *See id.* (providing empirical evidence that this may have been the case after Katrina).

³⁰⁵ *See* Richard A. Epstein, *Catastrophic Responses to Catastrophic Risks*, 12 J. RISK & UNCERTAINTY 287, 296–97 (1996); Gron & Sykes I, *supra* note 289, at 44.

³⁰⁶ *See generally* Gordon Tullock, *The Welfare Costs of Tariffs, Monopolies, and Theft*, 5 WESTERN ECON. J. 224, 224–32 (1967) (arguing that often it is more effective to have private protective expenditures than to attempt the same protection via government tariffs and taxes).

³⁰⁷ Obviously, the criticisms partially depend upon the nature of the arrangement. To the extent that government relief can be structured in such a way that some incentives can still be provided to victims (e.g. by including deductibles or by differentiating the amount of compensation taking into account preventive measures taken) and that the financing can, to some extent, still be risk-based (although that is seldom the case), the criticisms may be less serious.

³⁰⁸ Thomas A. Garrett & Russell S. Sobel, *The Political Economy of FEMA Disaster Payments*, 31 ECON. ENQUIRY 469, 496–509 (2003).

compensation, while victims of a disaster that receives less attention in the media, and is thus less politically sensitive, might receive no government compensation. The ad hoc nature of charity by government hence creates inequality.

Moreover, the assumption that the government can in principle always compensate without limits is certainly incorrect. Some small island states may be subject to large catastrophes whose costs easily outweigh their budgetary possibilities. This problem is recognized by the World Bank, which has, as a result, examined the possibility of developing sovereign natural disaster insurance for developing countries in order to solve the short-term liquidity need.³⁰⁹ This demand for sovereign natural disaster insurance illustrates that, especially in developing countries, one cannot assume that the government will always be able to compensate the victims. It is precisely because their budgets are limited that they seek sovereign insurance. This shows that the assumption that governments will solve all compensation problems is simply not realistic.

B. Analysis

1. Extra Layer Compensation

It may be clear that, to the extent that a part of the compensation resulting from a technological disaster is not paid by the operator who caused the risk but by others (usually tax payers), an additional layer of compensation will not generate incentives for disaster risk mitigation.³¹⁰ It was already mentioned when discussing the potential disadvantages of solidarity payments that these payments could, especially in the case of technological disasters, negatively affect the operators' incentives for disaster risk mitigation.³¹¹ Based on the description of the compensation model in the international regime for nuclear accidents, this seems to be a serious problem. To a lesser extent, negative incentives for disaster risk mitigation are also potentially a problem in the field of marine oil pollution.

a. Nuclear

The distortions created by the additional layers of compensation provided in the nuclear accident regime are rather obvious and have often been described in the literature.³¹² The problem is not only that a large part of the compensation is not paid by the operator, but by the state,³¹³ but also that there are low financial caps on the liability of the operator.³¹⁴ Moreover, the cost of an average nuclear

³⁰⁹ See Francis Ghesquiere & Olivier Mahul, *Sovereign Natural Disaster Insurance for Developing Countries: A Paradigm Shift in Catastrophe Risk Financing* (The World Bank, Working Paper No. 4345, 2007) (arguing that because sovereign insurance is usually more expensive than post-disaster financing, it should mainly cover immediate needs).

³¹⁰ And it will hence violate the principles mentioned above under Part II(B).

³¹¹ See *supra* Part IV(A)(3)(a).

³¹² See Michael Trebilcock & Ralph Winter, *The Economics of Nuclear Accident Law*, 17 INT'L REV. L. & ECON. 215, 235 (1997) (arguing that limited liability and additional compensation schemes lead to inadequate incentives for investing in safety).

³¹³ Recall that the second layer of compensation is paid by the installation state and the third layer is paid by all contracting states.

³¹⁴ See *supra* Part III(C)(2).

accident would be substantially higher than either type of compensation—not only higher than the liability limits of the operator, but also higher than the additional layers of liability provided by the states. For example, a report by the French Institut de Radioprotection et de Sûreté Nucléaire (IRSN) has indicated that a serious nuclear accident in France would cost about EUR 120 billion.³¹⁵ A small part of this damage relates to damage to the site. The other damages are: Radiological costs off-site, costs of radioactive contamination, costs related to the production of electricity, and reputation damage. According to the study, the last two types of damages account for about seventy-five percent of the total damage. This scenario assumes that about 3,500 people will have to be evacuated. The other scenario in the study presupposes the evacuation of 100,000 persons and assumes severe radioactive fall-out in neighboring countries. According to this scenario, the total cost of the accident would amount EUR 400 billion. The damage caused to third parties would be as high as EUR 300 billion.

Both these estimates and the estimates related to the costs of Fukushima show that the financial caps on the operator's liability and the additional compensation layers lead to substantial undercompensation. Even if the additional protocols and the Brussels Supplementary Convention had entered into force, they would only provide EUR 1.5 billion in compensation for damages now estimated at EUR 300 billion. This result effectively means that the international regime would only compensate for less than one percent of the damage. Yet the additional layer of compensation financed by public funding, rather than by the operator, creates even more problems.

i. A Distortive Subsidy

The default internalization of the risk costs by the nuclear operator creates a bias in favor of the competitiveness of his activity because all the costs are not reflected in the kWh price. This argument is a classic embodiment of the theory of market failures and externalities,³¹⁶ according to which all the costs generated by an economic activity must be integrated into the sale price. On the one hand, this permits the producer to recover his costs and to guarantee a minimal profitability. On the other hand, the price becomes an information vector and a signal for consumers.

Faure and Fiore estimate the impact of this subsidy under the international regime by using the example of France and its monopolistic operation of EDF, the fifty-nine nuclear reactors located in France.³¹⁷ In their study, they calculate

³¹⁵ Ludivine Pascucci-Cahen & Momal Patrick, "Les Rejets radiologiques massifs diffèrent profondément des rejets contrôlés", INSTITUT DE RADIOPROTECTION ET DE SURETE NUCLEAIRE 5, available at www.irsn.fr/FR/Actualites_presse/Actualites/Documents/FR_Eurosafe-2012_Rejets-radioactifs-massifs-vs-rejets-controles_Cout_IRSN-Momal.pdf.

³¹⁶ See, e.g., ALFRED MARSHALL, PRINCIPLES OF ECONOMICS (8th ed. 1920). See generally ARTHUR C. PIGOU, THE ECONOMICS OF WELFARE (1920) (arguing that the taxation system should be used to internalize externalities); Ronald Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 1–44 (1960) (showing that when transaction costs are low or at zero, an optimal allocation of resources can be reached without government intervention).

³¹⁷ See Michael Faure & Karine Fiore, *The Civil Liability of Nuclear Operators: Which Coverage for the New 2004 Protocols? Evidence from France*, 8 INT'L ENVTL. AGREEMENTS 227–48 (2008) (attempting to provide an explanation for the high price for nuclear insurance as well as examining the cost of reserves to compensate for the nuclear risk).

various scenarios, analyze how an abolition of the financial cap would affect the prices of nuclear energy, and compare the results to other energy sources.

Faure and Fiore provide the following table illustrating the production costs of the main power sources in 2008:

Energy Sources	kWh Production Cost (€)
Nuclear Energy	0.03
Coal	0.0337
Gas	0.035
Hydraulic	0.04
Fuel	0.05
Wind	0.6
Geothermic	0.06
Biomass	0.10
Solar	0.15

Table 5: kWh production cost of the main power sources in 2008.³¹⁸

In another study, Faure and Fiore calculated the effects of abolishing the cap and adding the additional costs of full liability to the price of the nuclear production costs.³¹⁹ Without the implicit subsidy, it would amount to between EUR 0.03002 and EUR 0.0004714 before the 2004 Protocol, and between EUR 0.0300027 and EUR 0.0304 after the Protocol. Note, however, that the estimates in the 2008 study were based on variations in accident costs between EUR 1 billion and EUR 100 billion. As mentioned above, more recent data from France reported possible damage amounts in the range of EUR 300 billion; as a result, the amounts of the implicit subsidy could already be higher today than the 2008 estimates. Indeed, according to Faure and Fiore's 2009 study,³²⁰ the price would be negligibly affected. This study has important consequences: On the one hand, one can argue that the value of the implicit subsidy is relatively low and therefore does not substantially affect the competitiveness of the nuclear industry; on the other hand, the relatively small impact of the subsidy on the nuclear production costs is yet another argument against the limits of liability, since these apparently do not substantially affect the competitiveness of that industry.

ii. *Reduced Incentives for Disaster Risk Mitigation*

The operator's incentives to prevent nuclear accidents may be affected by the partial internalization resulting from a nuclear subsidy. Accordingly, the

³¹⁸ Michael Faure & Karine Fiore, *An Economic Analysis of the Nuclear Liability Subsidy*, 26 PACE ENVTL. L. REV. 419, 441 (2009).

³¹⁹ Faure & Fiore, *supra* note 317, at 232–36.

³²⁰ Faure & Fiore, *supra* note 318, at 441.

operator will adopt the level of prevention that corresponds to the risks he generates. However, since the operator does not take into account all of the risks he generates, his behavior might be inadequate to prevent accidents in an optimal way. Therefore, if he underestimates the level of risk, his preventive actions are necessarily maladjusted and, thus, insufficient to impede an accident. Indeed, the optimality of his level of prevention is determined by the optimality of the level of the considered risks. As a result, a suboptimal estimate of risks leads to a suboptimal level of prevention. The literature has analyzed this economic consequence of lack of internalization.³²¹ The partial internalization of the risk costs, combined with the operator's liability cap, does not supply appropriate prevention incentives because it leads to underdeterrence. The distortion created by the nuclear subsidy is all the more problematic since the potential damages of a nuclear accident are very serious and occur over long periods of time.

iii. *Reduced Victim Compensation*

Finally, as discussed above, even with the second layer of compensation provided by the state, victims would still remain largely uncompensated. The reason for this effect is that, as indicated, the expected costs of a nuclear accident are much greater than the available compensation, even if all second-generation conventions entered into force.

b. Marine Oil Pollution

One advantage of the International Oil Pollution Compensation Fund, described above,³²² is that the fund is financed by levies on the oil transported, which is paid by oil receivers.³²³ The international regime for maritime pollution therefore consists, on the one hand, of tanker owners' limited liability and, on the other hand, of compensation provided through a fund financed by oil receivers. This structure differs importantly from the nuclear liability regime since it is not the state that finances the second layer, but rather oil receivers and the private industry. The 1969 Conference that led to the creation of the Civil Liability Convention (CLC) held that, because part of the compensation would be provided through oil interests (via the IOPC Fund), tanker owner liability was acceptable.³²⁴

The fact that oil interests have to finance part of the compensation can be considered positive since it could provide them with incentives for disaster risk mitigation. However, the problem is that the contribution to the fund simply consists of a tax that is determined on the basis of the amount of oil received, and not on the basis of preventive measures taken by the ships or of actual pollution incidents. Thus, because the oil receivers' contributions to the fund are not risk-dependent, oil receivers will not be rewarded for choosing safer ships, or punished

³²¹ See *id.* at 441–43 (arguing that the partial internalization resulting from the nuclear subsidy may affect the nuclear power plant operators' incentives to prevent nuclear accidents).

³²² See Part IV(B)(1)(b).

³²³ See Michael Faure & Wang Hui, *Economic Analysis of Compensation for Oil Pollution Damage*, 37 J. MAR. L. & COM. 179, 213 (2007).

³²⁴ For a detailed historical account see Wang, *supra* note 119, at 60–73.

for choosing riskier ones. One could argue that, since the contribution to the fund is merely dependent on the amount of oil received, it only affects the level of activity and not the level of care.³²⁵ The incentives provided by the current financing structure for disaster risk mitigation are, therefore, relatively limited.³²⁶

c. Comparison

A brief comparison of the additional compensation mechanisms in the nuclear liability and marine pollution conventions shows that the mechanism under the nuclear liability conventions is much more problematic than the one under the marine pollution convention.

The reasons are simple: The first relevant issue is the ability of the international mechanism to provide adequate compensation. The analysis above showed that in the case of a major nuclear accident the international regime would still provide less than approximately one percent compensation.³²⁷ In the case of marine pollution, it was already held during the 1969 conference which created the IOPC Fund that only five percent of large-scale oil casualties could not be dealt with under the existing rules.³²⁸ Moreover, the damages in the international liability regime have increased to such an extent that EUR 862 million is already available today, which will be largely sufficient to compensate most marine pollution incidents, including catastrophic incidents.³²⁹

As a result, the current problem of undercompensation, and hence of insufficient incentives for disaster risk mitigation, is much more serious for nuclear accidents than for marine pollution.

Moreover, the second layer of compensation in the case of nuclear accidents is provided through public funding—with distortive effects on disaster risk mitigation—whereas in the marine pollution regime the additional layer is provided through private financing provided by oil receivers, and not by public funds. Even though one may criticize the lack of risk differentiation of the fund contributions, the international regime for marine oil pollution is generally far more effective in providing incentives for disaster risk mitigation than the international regime for nuclear accidents. Of course, one could always ask whether the particular nature of the industry—nuclear or oil—could be the reason for the different structure of liability and compensation mechanisms. As a principal matter, there are not that many normative reasons to structure the efficient liability rules outlined above³³⁰ differently for one particular industry or the other. Obviously, for one type of industry the expected damage could be higher than for the other industry—that could surely be the case when comparing nuclear accidents

³²⁵ On the importance of affecting both care and activity levels, see *supra* Part III(A)(2)(a).

³²⁶ For a further analysis see Faure & Wang, *supra* note 323, at 213–14 (arguing that the problem with the current financing of the International Oil Pollution Compensation Fund is that it is only based on the amount of oil received, and not on the preventive measures taken by oil receivers, which does not provide incentives to choose safer ships).

³²⁷ The total compensation would be a total amount of EUR 1.5 billion for an estimated damage of EUR 300 billion.

³²⁸ Faure & Wang, *supra* note 323, at 213–14.

³²⁹ See Liu Jing, Michael Faure & Wang Hui, *Compensating for Natural Resource Damage Caused by Vessel-Induced Marine Oil Pollution: Comparing the International, U.S. and Chinese Regimes*, 29 J. ENVTL. L. & LITIG. 123, 146, 180 (2014); see also LIU, *supra* note 111, at 204.

³³⁰ See Part III(A).

with oil pollution—and this may be reflected in the amounts that would be demanded within the framework of a compulsory financial security. In practice, one can often notice that the institutional arrangement chosen may depend largely upon the nature of the industry. That choice, however, is not always related to the fact that a different institutional arrangement would be normatively desirable, but is often a reflection of the different powers of the interest groups involved. For example, the relatively higher amounts of compensation available for marine oil pollution damage may be related to the fact that, within the IMO, both flag states and coastal states are represented—that is to say tortfeasors and potential victims respectively. On the other hand, the compensation provided within this scheme is not only provided by the maritime industry—the tanker owners under the CLC framework—but also by the oil industry, which finances the IOPC fund. A comparable balanced structure is absent in the nuclear industry, where a countervailing power for nuclear interests is missing.

2. *Alternatives to Public Funding*

It is problematic that the amount of damage resulting from catastrophes can be substantially higher than the individual wealth of the operator. This discrepancy underlies the demand for an additional compensation mechanism. However, as explained above, to the extent that such a mechanism is not privately funded by operators, this may effectively constitute a subsidy with negative effects on disaster risk mitigation. The question arises as to whether there are alternatives that could provide high amounts of compensation while also holding the operator liable for technological disasters, without the negative consequences of public funding. Two examples will be provided of alternatives that generate additional compensation via private funding, either voluntarily via operators, or by statute.³³¹

a. Risk-Sharing Agreements: P&I Clubs

One alternative to public funding which may be able to generate high amounts of compensation, at least higher than compensation via traditional liability and insurance, is the use of a risk-sharing arrangement between operators. The essence of a risk-sharing agreement is that operators join forces to mutually share each other's risks. In a risk-sharing agreement, operators agree to mutually share each other's losses if one of the pool members faces the risk for which the pool is created. Since the risk-sharing agreement creates mutuality, the contribution to be

³³¹ At this stage only two alternatives will be discussed, although many others can theoretically be envisaged and are, to some extent, also available. For a more elaborate discussion of various alternative compensation mechanisms, see Hubert Bocken, *Financial Guarantees in the Environmental Liability Directive: Next Time Better*, 15 EUROPEAN ENVTL. L. REV. 1313 (2006) (arguing that the Environmental Liability Directive (ELD) does not sufficiently focus on providing adequate mechanisms to compensate environmental harm). See also Hubert Bocken, *Alternative Financial Guarantees for Environmental Liabilities under the ELD*, 18 EUR. ENERGY & ENVTL. L. REV. 146 (2009) (discussing a wide variety of alternative compensation mechanisms to cover environmental harm, in addition to insurance).

paid by all members depends on the safety measures adopted by others, which creates strong incentives for mutual monitoring.³³²

Since the likelihood that the members of the pool will have to pay depends on the performance of all members, they will have strong incentives for mutual monitoring. If one member were to free-ride and not take safety efforts seriously, this would create a moral hazard problem in the same way a moral hazard arises in insurance contracts. Just as in insurance contracts, where monitoring by the insurer is intended to cure the risk of moral hazard,³³³ in this case the pool members will have strong incentives for mutual monitoring to avoid having a risky member increase the collective risk.³³⁴

Risk pooling has another major advantage: If contributions do not have to be paid upfront, risk pooling does not necessarily lead to immobilization of capital, which can still be used for other socially beneficial activities. Of course, risk pooling based merely on a mutual commitment between the parties supposes more than mutual trust: There should be adequate control, including on the solvency of the members in the pool, in order to avoid free-riding, moral hazard, and negative redistribution.

One example of a mutual risk-sharing agreement in the maritime area are protection and indemnity clubs, also known as P&I clubs. A P&I club is a non-profit mutual insurance association established by ship owners and charterers to cover their third party liability related to the use and operation of ships. Today, thirteen separate and independent clubs cooperate together to form an international group of P&I clubs, which accounts for approximately ninety percent of the world's oceangoing tonnage.³³⁵

P&I coverage usually includes both pollution damage liability and other liability caused by ship-owners. A P&I Club provides more services than a pure insurer and operates as a mixture of an insurance company, a law firm and a loss adjuster. Besides offering insurance coverage, a P&I Club can also provide a worldwide network of correspondents and representatives to give on-the-spot assistance to the ship-owner, give Letters of Undertaking to offer security when members' vessels are arrested, and assist in handling claims and settlements.³³⁶

The P&I Group arranges reinsurance for each of the Clubs. At this moment, in line with the ship owners' policies, each Club retains the first eighty million. An amount between eight million and sixty million is divided among all the Clubs. The captive insurer of the Group—Hydra Insurance Company—and

³³² See generally Paul Bennet, *Mutual Risk: The P&I Insurance Clubs and Maritime Safety and Environmental Performance*, 25 MARINE POL'Y 13 (2001) (explaining the operation of P&I Clubs and the way in which they enforce preventive environmental measures upon their members).

³³³ Regarding the remedies to cure moral hazard, see Steven Shavell, *On Moral Hazard and Insurance*, 93 Q.J. ECON. 541 (1979) (explaining that moral hazard can be cured by either monitoring the behaviour of the insured and adapting the premium conditions, or by partially exposing the insured to risk).

³³⁴ On the basic principles of risk sharing via pooling, see Göran Skogh, *Risk Sharing Institutions for Unpredictable Losses*, 155 J. INSTITUTIONAL & THEORETICAL ECON. (JITE) 505 (1999) (arguing that mutually beneficial risk-sharing is possible without the assignment of a probability). See also Göran Skogh & Hong Wu, *The Diversification Theorem Restated: Risk-Pooling Without Assignment of Probabilities*, 31 J. RISK & UNCERTAINTY 35 (2005) (showing that equal risks can be mutually shared in a beneficial manner, even if probabilities of losses are unpredictable or genuinely uncertain).

³³⁵ INTERNATIONAL GROUP OF P&I CLUBS, <http://www.igpandi.org> (last visited Dec. 25, 2015).

³³⁶ Norman J. Ronneberg, *An Introduction to Protection & Indemnity Clubs and the Marine Insurance They Provide*, 3 U.S.F. MAR. L.J. 1, 25–29 (1990).

reinsurance with the international insurance market also play an important role in providing reinsurance for the upper layers. This brings the upper limit of its reinsurance program to USD 3.06 billion. The limit for compensation for oil pollution is limited to USD 1.06 billion.³³⁷

The example of P&I Clubs shows that mutual risk sharing between operators generates relatively high amounts of compensation, even for catastrophic oil pollution. The mutual monitoring between operators has, moreover, the positive effect of creating incentives for disaster risk mitigation.

b. U.S. Price-Anderson Act

Above, the U.S. Price-Anderson Act was discussed as an example of a nuclear liability regime that creates better incentives for disaster risk mitigation by avoiding channeling legal liability.³³⁸ The Price-Anderson Act has, moreover, another important feature compared to the international regime. In 1975 it was decided that the regime's public funds provision needed to gradually disappear. The Joint Committee on Atomic Energy argued that in the early years, the nuclear industry was not capable of bearing the financial burden arising from nuclear electricity production, but that after several years the industry should bear all of its responsibilities; this could be achieved by shifting the government's burden towards the industry.³³⁹

The shift was achieved by introducing a new tier in the compensation scheme, the so-called *retrospective premium*.³⁴⁰ This premium is financed by all U.S. nuclear operators that have received a license from the U.S. Nuclear Regulatory Commission (NRC). If the damage exceeds the amount of the nuclear operator's individual liability coverage of USD 60 million, the retrospective premium comes into play. It implies an additional financial protection per power plant and per incident, payable in annual installments up to a certain maximum amount per incident per power plant. Basically, the 1975 amendment to the Price-Anderson Act gradually replaced the public funding by a collective tier of all U.S. licensed nuclear operators.

The NRC had the power to determine the amount of this premium: In 1975 this premium was thus set at USD 5 million.³⁴¹ It was also decided that the individual liability insurance coverage of each nuclear operator should be consistent with the evolution of the U.S. nuclear insurance market.

The 1975 amendments to the Price-Anderson Act resulted in a total shift to private funding in the U.S. compensation scheme for nuclear damage in 1982. At that time, the operators had to buy an individual insurance coverage of USD 160 million (first tier of the U.S. compensation system); similarly, an amount of USD 400 million in retrospective premiums was available (second tier). Thus, in 1982 the U.S. nuclear compensation scheme offered exactly the same

³³⁷ *Pool Reinsurance Programme 2015–2016*, IGP&I, <http://www.igpandi.org/Group+Agreements/Pool+reinsurance+programme+2015-16> (last visited Dec. 25, 2015).

³³⁸ See Part III(C)(3)(a).

³³⁹ H.R. REP. NO. 94-648, at 9 (1975); S. REP. NO. 94-454, at 10 (1975).

³⁴⁰ See further on this retrospective premium scheme LIU, *supra* note 111, at 244–46.

³⁴¹ For further details see Vanden Borre, *supra* note 155, at 261–311.

amount of coverage as in 1957 (USD 560 million), but in 1982 it was entirely financed by private funds: Both the individual and the collective tier had to be provided for by the nuclear operators. Thereafter, the amount increased as new nuclear reactors became operational.

The most recent amendment of the Price-Anderson Act took place in 2005 as a result of the Energy Policy Act of 2005.³⁴² The liability of the individual operator was increased to USD 300 million. Moreover, the U.S. Nuclear Regulatory Commission (NRC) is required to adjust the maximum and total annual deferred premiums not less than once during each five-year period, in accordance with the aggregate percentage change in the Consumer Price Index.

In October 2008, the NRC adapted the amounts in the second tier to reflect inflation: The amount available in the second collective tier was set at USD 111.9 million plus an extra five percent for legal costs, with a maximum of USD 17.5 million per reactor per year.³⁴³ With regard to the first tier, U.S. Nuclear Insurers (ANI) has decided to make available, as of January 1, 2010, a maximum of USD 375 million for domestic nuclear third-party liability, amounting to a 25% percent increase from the USD 300 million limit established in 2003.³⁴⁴

In July 2013, NRC adjusted the amounts for inflation. As of September 10, 2013, the following amounts apply per reactor per accident: USD 375 million in the first tier, and USD 121.255 million in the second collective tier, plus 5% for legal expenses. Thus, since that date the total amount of compensation available in the United States is USD 13.6 billion [375 million + (104 * (121,255 million + 6,062,750))], with a maximum contribution of USD 18.963 million per reactor per calendar year.

The United States is not the only country in the world to have such a two-tier system. In Germany, the nuclear operator's liability is unlimited;³⁴⁵ there is, however, a limit to the insurance requirement—up to EUR 2.5 billion³⁴⁶—of which EUR 256 million is to be provided by each individual operator.³⁴⁷ The remaining part is to be provided collectively by the operators of all 17 nuclear reactors.³⁴⁸

The major advantage of retrospective risk pooling under the Price-Anderson Act is that it can generate a high amount of compensation—currently more than USD 13.6 billion. Not only is this amount substantially higher than the amounts provided under international conventions, but under the Price-Anderson Act the second layer of compensation does not consist of public funding and is paid

³⁴² Energy Policy Act, Pub. L. 109–58 (2005); *see also* *Legislative Updates*, 23.2 NEA NEWS, 32 (2005).

³⁴³ Decision of 9 September 2008, 73FR56451 (29 Sept. 2008). This decision is applicable as of Oct. 29, 2008.

³⁴⁴ *See* LIU, *supra* note 111, at 237, 243.

³⁴⁵ Atomgesetz [Atomic Energy Act], Dec. 13, 2001, BGBL at 41 § 31; *see also supra* Part III(C)(3)(b).

³⁴⁶ Atomgesetz [Atomic Energy Act], Apr. 22, 2002, BGBL at 41. *See generally* on the functioning of nuclear liability in Germany: Paul Dangelmaier, *Nuclear Liability Insurance in the Federal Republic of Germany*, in *NUCLEAR ACCIDENTS: LIABILITIES AND GUARANTEES* 426–33 (1993) (explaining the functioning of the insurance cover for nuclear accidents in Germany. Of course, the amounts stated have since been increased).

³⁴⁷ LIU, *supra* note 111, at 300–01.

³⁴⁸ For further information on the nuclear liability regime in Germany *see id.* at 299–301.

by all operators via retrospective premiums. In this case, the risk-sharing is not voluntary, as in the case of the P&I Clubs, but rather mandated by statute. Some also argue that such a statutorily mandated risk-sharing agreement could have the positive effect of providing incentives for disaster risk mitigation.³⁴⁹ Both examples, the P&I Clubs and the retrospective pooling under the Price-Anderson Act, show that it is possible to generate high amounts of compensation even for catastrophic risks without using public funding. In addition, voluntary risk-sharing through mutual pooling by operators or statutorily mandated risk-pooling via retrospective premiums can generate equally high amounts of compensation and operators' liability. At times, this avoids the negative effects of government subsidies, while still providing positive effects for disaster risk mitigation.

3. *Government Compensation*

It is important to bear in mind that the different forms of ad hoc charity and structural compensation funds that provide government financed compensation to victims are used often both in domestic law and in case of natural disasters. The potential disadvantages of these compensation mechanisms, already discussed from a theoretical perspective,³⁵⁰ also seem to appear in reality.³⁵¹

a. *Lacking Incentives for Disaster Prevention*

The literature predicts that ex post government compensation will reduce the incentives for potential victims to invest in preventive efforts.³⁵² Therefore, law and economics scholars generally consider ex post government compensation problematic. This view is nicely expressed by the title of one of Epstein's contributions, in which he qualifies ex post relief as "catastrophic responses to catastrophic risks."³⁵³

There is no data on the effective efforts of individual victims as far as disaster mitigation is concerned. However, there is some evidence that politicians do indeed systematically underinvest in disaster mitigation. Take again the example of hurricane Katrina. As shown above, substantial amounts were paid in ex post recovery after hurricane Katrina.³⁵⁴ However, there is equally overwhelming evidence that ex ante efforts in disaster risk mitigation were largely lacking. Indeed, many of the different reports issued after Katrina point to serious underinvestments with respect to preparation, particularly by public authorities (both FEMA and state authorities; reports on untaken desirable precautionary efforts by individuals are not available). For example, the Bipartisan committee report "A Failure of Initiative" reports that FEMA sustained losses of USD 80

³⁴⁹ See Faure & Vanden Borre, *supra* note 99, at 269–75.

³⁵⁰ See discussion *supra* Part IV(A)(3).

³⁵¹ However, it is not claimed that there is a clear causal relationship between government-provided compensation and lacking prevention or reduced incentives to insure. Rather, it is merely argued that the way in which the government provided compensation is likely to lead to the negative consequences predicted in the literature.

³⁵² See discussion *supra* Part IV(A)(3)(a).

³⁵³ Epstein, *supra* note 305.

³⁵⁴ See discussion *supra* Part IV(A)(2)(d).

million and USD 90 million in fiscal years 2003 and 2004 and that “these budget reductions were preventing FEMA officials from maintaining adequate levels of trained and ready staff.”³⁵⁵ The Department of Homeland Security presented similar data, reporting, *inter alia*, that between 1995 and 2003 FEMA’s budget decreased to such an extent that the organization was “unable to conduct a large scale catastrophic event exercise.”³⁵⁶

b. Underinsurance

As previously mentioned, government compensation may also negatively affect the incentives to purchase insurance since victims could largely free-ride on the states.³⁵⁷ In the words of Gollier: “[S]olidarity kills market insurance.”³⁵⁸ There is quite a bit of evidence of underinsurance regarding natural disasters. This was shown, for example, after the “flood of the century” of the river Elbe in Germany,³⁵⁹ as well as in the United States, especially after Katrina.³⁶⁰ Some literature indicates that the “charity hazard,” that is to say the generosity of the government, is indeed the cause of the underinsurance.³⁶¹

4. Alternatives

It may be clear from the critical analysis of government-provided compensation that this means of compensation is not only problematic on a theoretical level,³⁶² but also on a practical level given the negative effects that result from the structure of government compensation. However, it is equally important to stress that it is possible to design compensation for victims of natural disasters differently by making use of insurance solutions, and thus both stimulating the market and providing incentives for disaster risk mitigation. In addition to comprehensive insurance and public funding by the government, different techniques could also provide the necessary higher capacity to deal with catastrophic risk. For example, the government could act as reinsurer of last resort, thus stimulating the functioning of the private insurance market and positively contributing to disaster risk mitigation. The design of both alternatives will be the subject of the next section.

³⁵⁵ A FAILURE OF INITIATIVE, *supra* note 259, at 156.

³⁵⁶ A PERFORMANCE REVIEW, *supra* note 262, at 129.

³⁵⁷ See discussion *supra* Part IV(A)(3)(b).

³⁵⁸ Gollier, *supra* note 290, at 25.

³⁵⁹ See, e.g., Endres, et al., *supra* note 289; Magnus, *supra* note 257; Schwarze & Wagner, *supra* note 213.

³⁶⁰ See WALTERS & KETTL, *supra* note 74.

³⁶¹ See generally Raschky & Weck-Hannemann, *supra* note 292, at 321–29 (discussing this charity hazard).

³⁶² For failing to provide positive incentives for disaster risk mitigation, or stimulating market solutions such as insurance.

IV. FIRST-PARTY INSURANCE

It was clear from the discussion on the function of liability rules³⁶³ that these only compensate victims and provide incentives for disaster risk mitigation for technological disasters. Alternative compensation mechanisms must be employed when dealing with natural disasters and terrorism since, as argued in the previous Part, government-provided compensation is not ideal precisely because it does not provide adequate incentives for disaster risk mitigation. Conversely, the instrument that may provide these incentives to potential victims of natural disasters is first-party insurance. First-party insurance has not been the subject of specific international environmental agreements and, for that reason, will not be discussed in great detail.³⁶⁴ However, discussing insurance is interesting because it provides an example of how a market mechanism like insurance can be used to provide potential victims with adequate incentives for disaster risk mitigation. Moreover, to deal more particularly with the capacity problem resulting from natural catastrophes, a few interesting mechanisms have been developed whereby the government does not intervene in a market-distortive manner, like with government-provided compensation, but rather by acting as reinsurer of last resort, and thereby stimulating the market mechanism. It will be argued that this model also constitutes an interesting example for the revision of international conventions regarding technological disasters, where the government provides an additional layer in addition to the operators' liability—specifically, the international regime for nuclear accidents. First, potential problems and solutions concerning the use of first-party insurance for natural disasters will be discussed (A); at the same time, examples of how regulations stimulate insurance markets will be provided. This is followed by a thorough analysis (B).

A. *Potential, Problems and Solutions*1. *Potential*

The type of insurance referred to here is a so-called first-party insurance coverage. This is a system whereby the insurer provides insurance coverage and awards compensation directly to the victim. It is the potential victim who buys this type of insurance coverage with an eye towards possible future harm and corresponding damages. In a first-party insurance system, insurance coverage is triggered by damage, not by liability.³⁶⁵ The main benefits of first-party insurance are strongly advocated in law and economics literature.³⁶⁶ Priest has argued that first-party insurance has the advantage of allowing easier risk segregation than third-party insurance.³⁶⁷ Particularly in the area of catastrophes, the ability of first-

³⁶³ See discussion *supra* Part III.

³⁶⁴ For a more detailed account of this issue see Michael Faure & Véronique Bruggeman, *Catastrophic Risks and First-Party Insurance*, 15 CONN. INS. L.J. 1 (2008).

³⁶⁵ For a discussion of the use of first-party insurance to cover catastrophes see generally Faure & Bruggeman, *supra* note 364 at 11–14.

³⁶⁶ See BRUGGEMAN, *supra* note 6, at 82–94 (discussing the theoretical advantages of insurance).

³⁶⁷ George L. Priest, *The Current Insurance Crisis and Modern Tort Law*, 96 YALE L.J. 1521, 1557 (1987).

party insurance to differentiate risks is quite important: First-party insurance allows insurance companies to adapt the premium and policy conditions to the risk.³⁶⁸ In the area of catastrophes this would mean that insurers could, for example, charge a higher premium for risky activities—such as building a house on a flood plain. Alternatively, insurers could reward prudent risk takers, as in the case of those who construct their dwellings using materials that are less vulnerable to the impact of earthquakes. Under first-party insurance, victims are in principle able to purchase disaster coverage according to their own preferences; the insurer can, via the control of moral hazard, charge risk-dependent premiums and thus provide incentives for disaster risk mitigation. Essentially, insurance has the main advantage that a correct pricing of the risk takes place.³⁶⁹

2. Problems

a. Lacking Demand

Notwithstanding the theoretical advantages of first-party insurance, the literature indicates that people do not use these advantages to their full extent,³⁷⁰ resulting in dramatic cases of underinsurance. As mentioned above, after recent disasters both in Europe and in the United States only a relatively low amount of victims carried insurance against the consequences of a natural catastrophe like flooding.³⁷¹

Empirical evidence also shows that disaster insurance systems have generally low market penetration rates in all legal systems without a mandatory purchase requirement.³⁷² This low demand for disaster insurance has several reasons. First, due to cognitive limitations, low probability events like natural disasters are systematically misjudged,³⁷³ resulting in an “it will not happen to me” attitude.³⁷⁴ Second, there is empirical evidence that, *ex ante*, people prefer uncertain losses to the certain loss incurred by paying a premium. Insurance is considered an investment. The problem with disaster insurance is that, while a potential victim is confronted with the certain loss of a premium, there is a low expectation of return on the “investment” during a lifetime and, hence, a low demand for it.³⁷⁵ Third,

³⁶⁸ Priest, *supra* note 14, at 223–25.

³⁶⁹ See Howard Kunreuther, *Mitigating Disaster Losses Through Insurance*, 12 J. RISK & UNCERTAINTY 171, 171–87 (1996) (arguing that the use of insurance has the potential to contribute positively to disaster risk mitigation).

³⁷⁰ For a summary of the problems in insuring catastrophic risks see BRUGGEMAN, *supra* note 6, at 97–112.

³⁷¹ See discussion *supra* Parts IV(A)(3)(b) & IV(C)(3)(b).

³⁷² Youbaraj Paudel, *A Comparative Study of Public-Private Catastrophe Insurance Systems: Lessons from Current Practices*, 37 GENEVA PAPERS ON RISK & INS. ISSUES & PRAC. 257, 279 (2012).

³⁷³ See generally Paul Slovic, Howard Kunreuther & Gilbert F. White, *Decision Processes, Rationality and Adjustment to Natural Hazards*, in THE PERCEPTION OF RISK 1, 1–31 (Paul Slovic ed., 2000).

³⁷⁴ Kunreuther, *supra* note 369, at 175.

³⁷⁵ See Paul Slovic et al., *Preference for Insuring Against Probable Small Losses: Insurance Implications*, 44. J. RISK & INS. 237, 237–58 (1977) (presenting results of laboratory experiments concerning insurance decisions which show that people buy more insurance against events that have a moderately high probability and relatively small losses than against low probability, high damage risks).

some literature indicates that, as noted above,³⁷⁶ ex post government relief may also reduce incentives to purchase insurance coverage.³⁷⁷

b. Lacking Supply

A second problem is related to the supply side, in particular to the “difficult to predict” nature of catastrophes.³⁷⁸ Many have argued that the losses due to a catastrophe can be of such magnitude that they may even endanger the financial viability of insurance companies.³⁷⁹ Not only can the capacity of individual insurers be too limited for the large amount of losses caused by a catastrophe, but the low probability, high loss character of a catastrophe also makes it difficult to insure.³⁸⁰

3. Solutions

a. Comprehensive Disaster Insurance

Possible remedies to address these problems exist, and may render insurance for catastrophes feasible. An obvious solution to the problem of relatively low demand for insurance coverage would be making disaster insurance mandatory if that would increase the expected utility of individuals. Many scholars, and Kunreuther in particular, have argued in favor of compulsory first-party insurance for property damage caused by all kinds of natural disasters.³⁸¹ This model, whereby the duty to insure against disasters is combined with an insurance against a high probability, low damage event, is also supported by behavioral literature. Individuals would prefer disaster insurance when it is combined with an insurance against high probability, low damage losses.³⁸² Even though such compulsory insurance does not go totally undisputed, especially in cases where it would also force individuals who run no risk at all to take insurance coverage, there

³⁷⁶ See discussion *supra* Part IV(A)(3)(b).

³⁷⁷ This is a point strongly made by Scott E. Harrington, *Rethinking Disaster Policy*, 23 REG. 40, 40–46 (2000); Epstein, *supra* note 305, at 294.

³⁷⁸ For a more detailed analysis of problems on the supply side, see KENNETH A. FROOT, *THE FINANCING OF CATASTROPHE RISK* (1999) (providing an overview of various financing and insurance models that can provide cover in case of catastrophic risks); Gollier, *supra* note 290.

³⁷⁹ Attention is also increasingly paid to the consequences of climate change for insurance companies. In that respect see JAAP SPIER & ELBERT DE JONG, *SHAPING THE LAW FOR GLOBAL CRISES: THOUGHTS ABOUT THE ROLE THE LAW COULD PLAY TO COME TO GRIPS WITH THE MAJOR CHALLENGES OF OUR TIME* 19–21 (2012); Christophe Courbage & Walter R. Stahel, *Insurance and Extreme Events*, in *EXTREME EVENTS AND INSURANCE: 2011 ANNUS HORRIBILIS* (Christophe Courbage & Walter R. Stahel eds., 2012) (discussing how climate change is equally affecting insurance practice and disaster risk management).

³⁸⁰ The problem is that the total capital needed to insure catastrophes is often higher than the total amount of premiums that can be collected. THE “KATRINA EFFECT”: ON THE NATURE OF CATASTROPHE n. 56 (William M. Taylor et al. eds., 2015). See also Courbage & Stahel, *supra* note 379, at 24.

³⁸¹ It is an argument already made by Howard Kunreuther, *The Case for Comprehensive Disaster Insurance*, 11 J.L. & ECON. 133, 133–63 (1968) and repeated regularly, inter alia, after Katrina. See Howard Kunreuther & Mark Pauly, *Rules Rather than Discretion: Lessons from Hurricane Katrina*, 33 J. RISK & UNCERTAINTY 101, 101–16 (2006).

³⁸² See PAUL SLOVIC, *THE PERCEPTION OF RISK*, *supra* note 373, at 60–61, 70–71.

seems to be wide support for such a regulatory policy in law and economics scholarship, though not necessarily at the political level as well.³⁸³

The most well-known and internationally praised example of mandatory disaster insurance can be found in France.³⁸⁴ France has an elaborate system of first-party insurances for property damage.³⁸⁵ Eighty-five percent of all inhabitants of France own such first-party insurance³⁸⁶ and therewith a right to compensation for property damage within the scope of the insurance policy. A typical example of such a policy is the so-called *multi-risque habitation*, covering most risks with respect to real estate and movables within the house.

In addition to voluntary first-party insurance, the French system typically also includes a mandatory additional cover for the consequences of natural disasters. The “Code des Assurances” offers a definition of what is considered a natural disaster. Remarkably, the Code defines a natural disaster as an accident that causes damage that is unusual, unavoidable, and normally not insurable.³⁸⁷ The fact that this damage would normally not be insurable is precisely the reason for the mandatory additional coverage.³⁸⁸ Insurers are only held liable to compensate damage if the government declares a certain incident a natural disaster. Agricultural damage is excluded.

It is noteworthy that in France the government must first declare an incident a natural disaster before the insurer is bound to provide coverage. This is an administrative act that can also give rise to an administrative appeal.³⁸⁹ The declaration of the event as a disaster is published in the *Journal Officiel*. From the date of that publication the victim only has ten days to file a claim with his insurer. This very short time limit aims to pressure the victim to act carefully and to allow the insurer’s experts to establish the extent of the damage as soon as possible. The *Code des Assurances* further stipulates that the insurer must make an offer of compensation within three months after the victim’s claim. Moreover, the insurer must also make an advance payment within a period of two months.³⁹⁰

Belgium has recently followed France’s example in 2003 and 2005. As a result, 90–95% of the Belgian population is now covered against natural catastrophe risks. The insurer can investigate the natural hazard risk for every individual case and adjust the extra premium accordingly.³⁹¹ The final premium will hence differ in function of the real risk. In Germany, a mandatory insurance scheme for disasters was proposed in 2004.³⁹² However, the proposal failed. Schwarze and Wagner

³⁸³ For more details see Faure & Bruggeman, *supra* note 364; Levmore & Logue, *supra* note 215, at 268, 304.

³⁸⁴ This praise comes specifically from Howard Kunreuther, who already argued in 1968 in favor of comprehensive disaster insurance (Kunreuther, *supra* note 381) and who repeated that many times, *inter alia* after Katrina. Howard Kunreuther, *Has the Time Come for Comprehensive Natural Disaster Insurance?*, in ON RISK AND DISASTER, *supra* note 74, at 175–201.

³⁸⁵ We prefer to discuss the French case first, since the new Belgian model relies heavily on the French case.

³⁸⁶ This can be deduced from the *AZF* case, where it was noticed that only 15% of the victims were uninsured.

³⁸⁷ Michel Cannarsa, Fabien Lafay & Olivier Moréteau, *France*, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES, *supra* note 257, at 81, 86.

³⁸⁸ *Id.*

³⁸⁹ *Id.* at 95.

³⁹⁰ *Id.* at 96.

³⁹¹ For further details see Bruggeman et al., *supra* note 279, at 768–72.

³⁹² See, e.g., Endres et al., *supra* note 289; Schwarze & Wagner, *supra* note 213.

argue that this was mainly due to political reasons: The introduction of the bill would lead to a volume of premiums of EUR 2.85 billion a year, which would de facto cause a withdrawal of purchasing power of the same amount, which was considered to endanger the political goal of stimulating growth. Moreover, the real political reason behind the failure was that politicians still prefer ad hoc responses since these can provide them greater discretion and reputational gains with a view towards potential reelection.³⁹³

Some developing countries have also introduced some forms of comprehensive disaster insurance. For example, apartment owners in Turkey are required to purchase insurance that covers part of their losses caused by earthquakes.³⁹⁴ Taiwan also has a similar insurance model. There is no direct obligation to contract disaster insurance. However, if persons voluntarily subscribe to home fire insurance this will automatically include earthquake insurance as well.³⁹⁵

b. Government as Reinsurer of Last Resort

Another issue with providing cover for catastrophic risk is that the magnitude of the loss caused by a catastrophe may easily outweigh the individual capacity of an insurer and even of a collectivity of insurers or reinsurers.

An interesting model has been developed, which comes down to the government acting as reinsurer of last resort, whereby the State assumes at least part of the risk for losses from catastrophes. Even though government intervention is required, since the private insurance market cannot provide adequate catastrophe insurance coverage, the underlying philosophy of this approach is that private insurance should keep playing a significant role in allocating compensation for victims of catastrophes.

Both legal and economic scholarship has formulated criticisms regarding such a facilitative role of government-stimulated insurance markets. For example, Gron and Sykes argue in several papers that it would be unjust for the government to provide reinsurance at a lower price than the market price.³⁹⁶ This would give the wrong signal to the market as far as stimulating insurability is concerned. It is striking that most of this criticism is not addressed at the intervention of the government as such, but is based on the assumption that the government will not ask premiums that reflect market prices. Levmore and Logue are skeptical of these types of interventions in the market for terrorism insurance, arguing that without government intervention, “the market would likely have been able to provide the necessary coverage.”³⁹⁷

³⁹³ See Reimund Schwarze et al., *Natural Hazard Insurance in Europe: Tailored Responses to Climate Change are Needed*, 21 ENVTL. POL’Y & GOVERNANCE 14 (2010) (showing that the Swiss Monopoly Insurance System is, thanks to a unique direct voting environment, best able to reduce the disruptions resulting from natural hazards); Reimund Schwarze & Gerhard Wagner, *The Political Economy of Natural Disaster Insurance: Lessons from the Failure of a Proposed Compulsory Insurance Scheme in Germany*, 17 EUR. ENV’T 413, 413 (2007).

³⁹⁴ Joanna Linnerooth-Bayer & Reinhard Mechler, *Disaster Safety Nets for Developing Countries: Extending Public-Private Partnerships*, 7 ENVTL. HAZARDS 2, 8 (2007).

³⁹⁵ Information provided by Dr. Anton Ming-Zhi Gao, National Tsing Hua University, Taiwan.

³⁹⁶ Gron & Sykes I, *supra* note 289, at 44–51; Gron & Sykes II, *supra* note 289, at 447–63.

³⁹⁷ Levmore & Logue, *supra* note 215, at 311.

However, without State intervention, insurance coverage for disasters would probably not have developed. This type of government intervention has the advantage that ex post relief sponsored through the public purse can be avoided. Where the government acts as reinsurer, this at least has the advantage that a premium can be paid by those who actually cause or run the risk.³⁹⁸ It can thus facilitate market solutions, provide incentives for prevention to potential victims, and avoid the negative redistribution discussed above.³⁹⁹ Thus, a state's intervention as reinsurer may avoid "catastrophic responses to catastrophic risks." Kunreuther and Michel-Kerjan also argue in favor of this type of government-provided reinsurance. They argue that the government has the capacity to diversify the risks over the entire population and to spread past losses to future generations, thus creating a form of cross-time diversification that the private market could not achieve.⁴⁰⁰

In summary, when the government intervenes as reinsurer of last resort, a public-private partnership with the insurance and reinsurance industry could be organized whereby a market solution—insurance—is stimulated. In order to correspond with market principles this government intervention should, however, correspond with several principles:⁴⁰¹

- It has to be clear that reinsurance cannot be obtained on the regular market;
- the government charges a competitive price for the reinsurance it provides;
- the government intervention is temporary (with a so-called sunset clause); and
- structured in such a way that it provides incentives to market participants to develop market solutions.

There are many examples of governments acting as reinsurers of last resort. An interesting example is again provided by France: The *Caisse Centrale de Réassurance* (CCR), which is completely owned by the state, offers reinsurance for natural disasters. Half of all the premiums for the coverage of natural disasters are paid to the CCR. As a consequence, the CCR will always cover half of the insured natural disasters.⁴⁰² Moreover, via the CCR, the French government additionally provides unlimited coverage for natural disasters and for terrorism risk. The financial results for the CCR would be quite beneficial.⁴⁰³

In the United States there are many examples of public-private partnerships wherein the government does not even act as reinsurer of last resort, but rather as primary insurer. This seems to be the case with the California Earthquake

³⁹⁸ See further on those advantages of the government acting as reinsurer of last resort Bruggeman, Faure & Heldt, *supra* note 252, at 185–241.

³⁹⁹ More particularly the negative redistribution that would occur if ad hoc government compensation is provided from the tax payers to the victims who exposed themselves to risks. See on those dangers *supra* Part IV(A)(3).

⁴⁰⁰ See Kunreuther & Michel-Kerjan, *supra* note 216, at 210.

⁴⁰¹ See Véronique Bruggeman, Michael G. Faure & Karine Fiore, *The Government as Reinsurer of Catastrophic Risks?*, 35 GENEVA PAPERS ON RISK & INS. 369, 376–79 (2010) (arguing that reinsurance by the government as reinsurer of last resort can positively stimulate a market solution and is preferable to ad hoc government compensation for disasters, provided that particular conditions are met).

⁴⁰² Cannarsa et al., *supra* note 387, at 101–03.

⁴⁰³ *Id.* at 103.

Authority (CEA). Although the CEA represents a model whereby the state has relieved the private insurers of uncertainty, it would not be correct to state that the system is completely state funded. Indeed, the CEA is funded by participating insurers, along with bond sales, reinsurance, and the premiums charged for policies sold. Moreover, the initial operating capital was provided through mandatory contributions by the participating insurers.⁴⁰⁴ The system is hence still primarily funded through premium payments, and that is the case with flood insurance as well. This is an interesting model whereby, on the one hand, insurers do engage actively in the financing of a system like the CEA but, on the other hand, the CEA's intervention relieves private insurers of the uncertainty associated with a major earthquake, thus enabling them to continue the earthquake coverage. In these systems, governments take over responsibility for potentially catastrophic losses, but private insurers still primarily fund the system.

Many other examples could be provided, such as the National Flood Insurance Program (NFIP), which equally provides government-subsidized insurance premiums.⁴⁰⁵ However, it is beyond the scope of this paper to discuss all of these programs in detail.⁴⁰⁶

Finally, it should be mentioned that this model whereby the government acts as a reinsurer of last resort can also be found in many schemes that have been developed for the insurance of terrorism-related risks after 9/11. Following 9/11, many countries created so-called terrorism pools such as GAREAT in France, EXTREMUS in Germany, POOL RE in the United Kingdom, and the Dutch Terrorism Risk Reinsurance Company, NHT, in the Netherlands.⁴⁰⁷ In the United States a similar model was developed through the Terrorism Risk Insurance Act.⁴⁰⁸ Although there may be differences in their specific design, a common feature of all the different models is that a kind of public-private partnership is created whereby the government takes over part of the risk. The Dutch Terrorism Risk Reinsurance Company NHT provides an interesting example of a "smart" design that allows for government intervention to stimulate the functioning of insurance markets. The overall capacity provided by the NHT is EUR 1 billion per calendar year. This would be provided via three layers: The first EUR 400 million would be provided by primary insurers; the second layer of EUR 400 million by the reinsurance market, and the third layer of EUR 200 million by the Dutch government, acting as a reinsurer of last resort.⁴⁰⁹

⁴⁰⁴ For further details, see Bruggeman, Faure & Heldt, *supra* note 252, at 224–25 (arguing that the CEA provides an example of a government stepping into the private insurance market and assuming the risk of a potential natural catastrophe).

⁴⁰⁵ For a detailed analysis, see BRUGGEMAN, *supra* note 6, at 415–37.

⁴⁰⁶ Note, however, that some programs such as the NFIP are debated, precisely because the desirable incentive effects on disaster risk mitigation are lacking. For a detailed analysis and proposals to reform the NFIP, see, among others, Erwann Michel-Kerjan, *Catastrophe Economics: The National Flood Insurance Program*, 24 J. ECON. PERSP. 165, 165–86 (2010).

⁴⁰⁷ On the role of the government as reinsurer of last resort in the case of terrorism for these four pools, see Véronique Bruggeman, Michael Faure & Tobias Heldt, *Insurance Against Catastrophe, Government Stimulation of Insurance Markets for Catastrophic Events*, 23 DUKE ENVTL. L. & POL'Y F. 185, 231–35 (2012).

⁴⁰⁸ For details, see BRUGGEMAN, *supra* note 6, at 438–59.

⁴⁰⁹ See Bruggeman, Faure & Heldt, *supra* note 252, at 234. For a detailed analysis, see Ammerlaan & van Boom, *supra* note 301, at 2330–39; Faure & Hartlief, *The Netherlands, in FINANCIAL COMPENSATION FOR VICTIMS OF CATASTROPHES*, *supra* note 257, at 206.

Interestingly, reinsurance is not provided for free, but the Dutch government charges a premium which is set precisely at a level intended to price itself out of the market when the insurability of the terrorism risk is restored. The premium setting is such that an incentive is built into the system to move back to commercial insurance.⁴¹⁰ This incentive scheme apparently worked, since one year after the creation of the system a commercial reinsurer took over EUR 100 million of the coverage provided by the government, thus reducing the government intervention to EUR 200 million.⁴¹¹

The NHT thus provides a nice example of reinsurance by the government where risk-based premiums are charged and the market solution is stimulated, since premiums are set in such a way that it becomes attractive for commercial insurers to take over the layer of compensation provided by the government. This example shows that with a smart design, government intervention as reinsurer of last resort can not only be non-distortive, but can also stimulate the creation of effective market solutions.

B. Analysis

1. Positive Effect on Disaster Risk Mitigation

When looking at the use of first-party insurance it is interesting to notice that increasingly more domestic legal systems follow the French model of mandatory comprehensive cover for natural disasters.⁴¹² Already in 1968, Kunreuther held that this model has substantial advantages, since it provides positive incentives to potential victims for disaster risk mitigation.⁴¹³ Taking into account the starting points mentioned above,⁴¹⁴ this insurance model can be judged as positive because, certainly in comparison to charity by the government, it will positively contribute to disaster risk mitigation. The payment of an insurance premium can create risk awareness among potential victims, which in turn can contribute to disaster risk mitigation.⁴¹⁵

This positive evaluation not only applies to making disaster cover mandatory, but also to having the government act as reinsurer of last resort. The latter solution has the major advantages of allowing the market solution of insurance, with its positive effects on incentives for disaster risk mitigation, to function even when the potential magnitude of damage caused by a disaster is large. Moreover, this intervention by the government is preferable to undifferentiated

⁴¹⁰ Bruggeman, Faure & Heldt, *supra* note 252, at 235.

⁴¹¹ *Id.*

⁴¹² See ALBERTO MONTI, DISASTER RISK FINANCING IN APEC ECONOMIES: PRACTICES AND CHALLENGES (2013), available at http://www.oecd.org/daf/fin/insurance/OECD_APEC_DisasterRiskFinancing.pdf (providing an overview of the efforts that have been made within the APEC countries to promote financial resilience against disasters by strengthening insurance and other compensation mechanisms); Faure, *supra* note 257, at 432–35; Paudel, *supra* note 372, at 257–85.

⁴¹³ Kunreuther, *supra* note 381.

⁴¹⁴ See *supra* II(B) & (C).

⁴¹⁵ Priest, *supra* note 14.

lump sum payments via charity, which have negative effects on disaster risk mitigation.⁴¹⁶

2. *Limits*

However, this insurance solution also has its inherent limits. One limit relates to the fact that insurance is based on the assumption that potential victims can take disaster risk mitigation measures and that they can afford to pay the premium. In some countries (particularly in the developing world) relocation to safer areas may not be an option—for example, in the case of Bangladesh, moving to a flood-free area. The other problem is that some individuals may lack the financial capacity to pay for insurance premiums. The latter problem has been addressed in the literature, which argues that it remains important that insurance premiums reflect risk. If individuals in disaster-prone areas lack capacity to pay insurance premiums, governments could provide insurance vouchers or victims could be reimbursed by the government for a portion of the increased costs of insurance coverage. But the advantage would be that premiums would still reflect risk. Moreover, through the voucher system, individuals could still be incentivized to adopt mitigation measures.⁴¹⁷ This conclusion relies on a study by Coate, who argues that if the government makes in-kind transfers of insurance to the poor they will not rely on disaster relief ex post in case of a loss.⁴¹⁸ This shows that the charity hazard could be avoided by subsidizing insurance premiums.⁴¹⁹ There is indeed a trade-off between, on the one hand, the efficiency requirement of charging risk-dependent premiums, and on the other hand, the equity problem that risk-dependent premiums may lead to problems for some individuals who are not in a position to reduce their risk exposure at a reasonable cost and who cannot afford the insurance premiums.⁴²⁰

A second limit is related to the fact that these mandatory first-party insurance solutions are mainly developed for natural catastrophes, and not for technological disasters. However, that is to some extent logical. In the case of technological disasters, there is in principle a tortfeasor who can be held liable and should hence be provided incentives for disaster risk mitigation through appropriate

⁴¹⁶ See Epstein, *supra* note 305, at 297; Kaplow, *supra* note 5 (holding that ex post government compensation can negatively affect incentives for prevention).

⁴¹⁷ Kunreuther, *supra* note 7, at 13. The idea is, of course, that the subsidy would only be provided on the condition that disaster reduction measures would be taken, otherwise the negative effects on the incentives of victims would be as problematic as in the case of ad hoc disaster relief by the government.

⁴¹⁸ Coate, *supra* note 256 (holding that the reliance by the poor on private charity will have negative efficiency effects which can be avoided when the government represents the rich and makes in-kind transfers of insurance to the poor).

⁴¹⁹ See Scott E. Harrington & Greg Niehaus, *Government Insurance, Tax Policy and the Affordability and Availability of Catastrophe Insurance*, 19 J. INS. REG. 591, 591–612 (2001) (arguing that affordability problems related to catastrophe insurance have led to the creation of a federal reinsurance program, whereas the authors discuss alternative approaches for dealing with catastrophe insurance market problems); Pierre Picard, *Natural Disaster Insurance and the Equity-Efficiency Trade Off*, 75 J. RISK & INS. 17, 17–38 (2008) (showing that many individuals may not be in a position to reduce their exposure to disaster risks at reasonable costs, thus making it difficult to charge risk-adjusted insurance premiums).

⁴²⁰ If risk-reducing behavior is indeed not possible, the insurance premium becomes analogous to a lump sum tax without any significant effect. See Picard, *supra* note 419, at 19.

liability and compensation mechanisms.⁴²¹ Therefore, it is logical that in the case of technological disasters, the legal solutions go in the direction of forcing potential tortfeasors (e.g., operators of hazardous installations) to seek financial cover—for example via mandatory liability insurance—rather than forcing potential victims to purchase first-party insurance.

A third limit is related to the fact that these insurance solutions strongly vary and are mostly found in domestic law, not in international conventions. Still, the insurance solutions discussed in this Part provide interesting lessons for international environmental agreements that include provisions on liability and insurance. The liability and compensation regimes in those conventions were criticized for providing low limits on the operator's liability and, especially in the case of nuclear liability conventions, state subsidies via the additional layer of compensation. The insurance model discussed in this title shows that high levels of capacity can be generated through a form of government intervention which is not a subsidy, and is therefore in principle not distortive. In case the government provides reinsurance of last resort and charges actuarially fair premiums, eventually the price of risk is still passed on to the operator. The insurance model therefore provides interesting lessons for a different design of international conventions that excludes government subsidies and exposes operators to the catastrophic risks they are creating. Such a design may hence provide better incentives for disaster risk mitigation.

V. OUTLOOK

Having started with a few basic points on how a liability and compensation mechanism could provide optimal incentives for disaster risk mitigation (II), we outlined the function of liability rules (III), additional compensation mechanisms (IV) and first-party insurance (V), and equally indicated to what extent those instruments can be found in international environmental law and to what extent their designs can contribute to disaster risk mitigation. By evaluating those instruments we can observe serious limits in the liability and compensation schemes included in international environmental agreements (A). However, there has been a remarkably dynamic evolution in instrument design which provides a few indications on how liability and compensation instruments interact at different levels of governance and how a revision of the international regime could be triggered (B). This leads to a brief discussion of the scope for policy change (C).

A. Status Quo: Limits of the Liability and Compensation Schemes in International Environmental Agreements

When we addressed the sources of liability and compensation schemes in international environmental law we noticed that, in addition to general principles, there are a few conventions that provide rather vague principles on liability without specifying in further detail how the liability and compensation scheme should be designed.⁴²² In fact, we found relatively few international environmental

⁴²¹ See *supra* Part III(A).

⁴²² For example, as explained above, this is the case for the UNCLOS Convention. See *supra* Part II(E).

agreements that provide more detailed rules on liability and compensation mechanisms.⁴²³ The most important conventions can be found in the domain of nuclear accidents and in the area of marine pollution.

It is no coincidence that international conventions were created specifically in those domains. This is on the one hand related to international politics and to the demand of specific interest groups for whom the conventions were drafted, and on the other hand to the international institutional environment. The intervention of particular interest groups appeared very clearly as far as the creation of the nuclear liability conventions is concerned.⁴²⁴ The main reason for creating of the conventions was U.S. nuclear material suppliers' fear of exposure to liability in export countries. The exclusive liability channeling to the licensees of the nuclear power plants in the installation state (as provided for in the conventions) could address that risk. In addition, the international institutional environment is an important factor in creating international environmental agreements. For nuclear risk, as well as for marine pollution, international organizations provided a framework within which the negotiations that led to the international conventions could take place. As mentioned above, nuclear liability conventions were drafted within the framework of the Nuclear Energy Agency, a specialized agency of the Organization for Economic Cooperation and Development (OECD),⁴²⁵ and the International Atomic Energy Agency (IAEA).⁴²⁶ The marine pollution conventions were drafted under the auspices of the International Maritime Organization (IMO), a specialized UN organization.⁴²⁷

The fact that these conventions were drafted under the auspices of international organizations may seem like a formality, but it certainly is not. It is apparently much more difficult to create an international convention in the absence of such international organizations competent on the subject matter at hand. The liability and compensation for damage resulting from an offshore installation can illustrate this. After the accident with the mobile deep water offshore rig "Deepwater Horizon" which took place on April 20, 2010 in the Gulf of Mexico, the public of course asked whether there is an international convention with respect to "Deepwater Horizon"-like activities. The simple answer is no. The reason is that the international conventions that were drafted within the IMO all deal with vessel-based pollution because the IMO only considers itself to be a maritime organization and hence not competent for damage resulting from offshore oil and gas activities which are not considered ships. Many members of IMO believe that offshore liability is outside the scope of the IMO, which is primarily focused on shipping.⁴²⁸ The IMO has hence started to work on the issue, but with a very low-key approach. For those reasons, regional or bilateral arrangements are preferred to a truly IMO initiative.⁴²⁹ The problem is that, currently, IMO does not have the competence to create a convention for offshore-related risks. The IMO Council

⁴²³ See *supra* Part III(B).

⁴²⁴ See *supra* Part III(C)(3)(a).

⁴²⁵ See NUCLEAR ENERGY AGENCY, <http://www.oecd-nea.org/> (last visited Dec. 25, 2015).

⁴²⁶ See INT'L ATOMIC ENERGY AGENCY, <https://www.iaea.org/> (last visited Dec. 25, 2015).

⁴²⁷ See INT'L MAR. ORG., <http://www.imo.org/en/Pages/Default.aspx> (last visited Dec. 25, 2015).

⁴²⁸ E-mail from Richard Mason, Accredited Representative of the European Comm'n to the Int'l Mar. Org., to Michael Faure (Mar. 30, 2013) (on file with author).

⁴²⁹ *Id.*

decided that they are not willing to take up the issue.⁴³⁰ Of course, oil companies may, especially when they are state-owned, have a strong influence on the position that will formally be taken by the state that is the member of the IMO.⁴³¹

At the ninety-ninth session of the IMO Legal Committee in April 2012, the possibility of a global liability and compensation regime for offshore oil and gas activities was re-examined. This option was first proposed by the Indonesian delegation in September 2010 and followed the Montara offshore oil pollution incident that occurred in August 2009, where damage was caused in the Timor Sea.

The Legal Committee recognized that bilateral and regional arrangements are the most appropriate means to address the matter and hence decided not to pursue an international regime, as there was no compelling need to do so.⁴³²

This, therefore, shows that the mere fact that an international convention was never drafted for an important risk like damage resulting from offshore installations is simply due to the absence of an international organization or agency that considers itself competent to deal with those matters.

As a result, the international environmental agreements containing specific rules on liability and compensation are relatively limited, which likewise explains the relatively limited impact of international environmental law—at least as far as liability and compensation mechanisms, and thus contribution to disaster risk mitigation as well.⁴³³

B. *Dynamic Evolution*

Although we just established that there are few international conventions with liability and compensation mechanisms that could potentially provide incentives for disaster risk mitigation, it is interesting to mention that the conventions we reviewed have undergone a dynamic evolution. A review of this evolution may provide interesting lessons for a potential review of the international regime.

1. *Adaptation to Changing Circumstances*

First, it is interesting to note that the conventions have undergone important revisions over the past decades (five decades for nuclear accidents and four decades for marine oil pollution). Usually those changes took place after yet another catastrophe demonstrated the inability of the international regime to adequately provide compensation. One could, on the one hand, blame the international regime for not being sufficiently proactive and only amending the conventions on an ad hoc basis when large political pressure made the amendment necessary. On the other hand, one could hold that the international regime showed flexibility by adapting itself to changing circumstances. However, the way in which this dynamic evolution took place has undoubtedly been more successful in

⁴³⁰ *Id.*

⁴³¹ Interview with Alan Spackman, Vice-President Offshore Div. IADC (June 5, 2013).

⁴³² *Legal Committee (LEG)—99th Session, 16–20 April 2012*, INT'L MAR. ORG. (Apr. 20, 2012), <http://www.imo.org/MediaCentre/MeetingSummaries/Legal/Pages/LEG-99th-session.aspx>.

⁴³³ Obviously, there are many other international instruments that deal with preventing risks and, in that sense, equally contribute to disaster risk mitigation.

the area of marine pollution than in the domain of nuclear accidents. As we discussed above,⁴³⁴ the international marine oil pollution regime underwent several changes and initiatives to adapt the conventions every time a new catastrophe showed the existing regime's inability to cover losses. The adaptation of the conventions was not always easy.⁴³⁵ For example, the 1984 Protocols, which were drafted after the Amoco Cadiz incident of 1978, never entered into force because they did not garner sufficient ratifications.⁴³⁶ However, after the latest changes to the international regime, the overall maximum compensation available is now EUR 862 million.⁴³⁷ This amount is considered to be so large that it can provide compensation for most catastrophic cases of marine oil pollution. As a result of the dynamic evolution, the international regime dealing with marine oil pollution is now able both to provide adequate compensation in most cases and to provide incentives for disaster risk mitigation.⁴³⁸

From a comparative perspective, the international regime for nuclear accidents has been less impressive in adapting to changing circumstances than the regime for marine oil pollution. After all, the basic conventions dealing with nuclear liability still date from the 1960s and contain very low limits on the liability of the licensee of the nuclear power plant. After the Chernobyl accident of April 26, 1986, several new conventions were drafted, but out of the four new nuclear liability conventions that were drafted only the Protocol to the Vienna Convention entered into force on October 4, 2003. Even almost thirty years after Chernobyl, the other conventions which would lead to an increase in liability amounts have not yet entered into force. Moreover, even when the second-generation conventions of the NEA regime enter into force, the total amount available under the NEA regime would still only be EUR 1.5 billion, which is largely insufficient to cover the costs of an average nuclear accident. Moreover, of this EUR 1.5 billion, only EUR 700 million would be based on the liability of the operator; EUR 800 million would still be paid through the installation state or through a collective state fund, and would hence constitute a subsidy. It is therefore fair to say that there have not yet been substantial changes in the international regime for nuclear liability, and even if the changes entered into force the compensation would still largely be insufficient and the regime—as a result of the state subsidy and amounts of compensation that are too low—would not provide incentives for disaster risk mitigation.

2. *Interactions in a Multi-level Governance Setting*

An interesting feature of the dynamic evolution of some of the international regimes is that one notices dynamic interactions between the domestic, regional, and international levels. International conventions of course are not created and do not function in isolation at the supranational sphere, but cooperate

⁴³⁴ See *supra* Part III(B)(3).

⁴³⁵ See WANG, CIVIL LIABILITY, *supra* note 119, at 132–36.

⁴³⁶ *Id.* at 163–64. The main problem was the lack of U.S. ratification.

⁴³⁷ This includes the compensation payable by the fund, as well as the compensation paid by the ship owner or his insurer under the CLC.

⁴³⁸ This may not yet be perfect since, as we explained above in Part IV(C)(1)(b), the liability of the tanker owner is limited, and the contributions to the international oil pollution compensation fund are not risk-related.

dynamically with the domestic and regional spheres. That dynamic interaction also provides some interesting insights.

a. International Versus Domestic

As far as the international regime for nuclear accidents is concerned, it is important to mention that many important nuclearized countries, such as China, Japan, and the United States, did not join the international regime. The fact that the territorial scope of the international conventions is relatively limited could be considered a problem, but it is interesting to note that, for example, the United States did not join the international conventions because its domestic regime—the Price-Anderson Act—provides a much better scope of protection than the international nuclear liability conventions.⁴³⁹ The same is true of Japan. Japan is also not a party to the international conventions, but the level of protection awarded under Japanese national law is surely not lower than under the international conventions. Japan requires unlimited liability, and the duty to provide financial security is for much higher amounts than under the international conventions.⁴⁴⁰ The same is the case for the regime on marine oil pollution. As we explained above,⁴⁴¹ the U.S. Oil Pollution Act (OPA) of 1990 also provides better protection than the international regime. Moreover, since the OPA does not preempt state law, there can still be unlimited liability under state law.

These examples show that it would be wrong to assume that the contents of international environmental agreements are, by definition, better than domestic law. A few examples show that domestic law, particularly in the United States, grants better protection to victims and better incentives for disaster risk mitigation than international agreements. That was also the reason why the United States refused to join those international conventions. The reason for these differences is obviously that the need to reach an agreement among many countries may lead to a watered-down level of protection. In some cases, this watering-down is also the result of effective lobbying by interest groups, as the case of the nuclear conventions clearly showed.⁴⁴²

The mere fact that in some cases a different, and even better, protection is provided under domestic law when compared to the international conventions should not always be considered problematic. To the contrary, victims often try to call on domestic law since it often provides better protection—no channeling and no limits on liability—than the international conventions. This was the case with the damage caused by *Erika*, the tanker that sank off the coast of Brittany, France on December 12, 1999. Victims did everything within their power to circumvent the

⁴³⁹ For a detailed analysis of the U.S. Price-Anderson Act, see Part III(C)(3)(a).

⁴⁴⁰ See Jing Liu & Michael Faure, *Compensation for Nuclear Damage: A Comparison Among the International Regime, Japan and China*, INT'L EVTL. AGREEMENTS: POL., L. & ECON. 1–23 (2014).

⁴⁴¹ See *supra* Part III(C)(3)(c).

⁴⁴² For an interest group analysis of the nuclear liability conventions, see Michael G. Faure & Roger Van den Bergh, *Liability for Nuclear Accidents in Belgium from an Interest Group Perspective*, 10 INT'L REV. L. & ECON. 241, 241–54 (1990) (arguing that the regulation of the liability for nuclear accidents can be seen as promoting the interests of the nuclear power plant operators rather than the public interest).

international conventions.⁴⁴³ One advantage of such differentiation is that the different legislative solutions in domestic law may also provide for mutual learning.⁴⁴⁴ The different solutions adopted in domestic law can also inspire international conventions and could thus lead to a policy change at the international level. Examples were provided from the U.S. Oil Pollution Act and the U.S. Price-Anderson Act that could serve as a source of inspiration for a revision of the international conventions.

b. International Versus Regional

A similar type of interaction can also be observed between the regional and the international level. The international oil pollution regime constitutes a striking example. After the European Union had been confronted with serious cases of oil pollution in European waters, particularly the *Erika* (1999)⁴⁴⁵ and the *Prestige* (2002) cases,⁴⁴⁶ the European Commission proposed to set up a European fund with a ceiling of EUR 1 billion.⁴⁴⁷ Interestingly, this European initiative⁴⁴⁸ led to the establishment of a supplementary fund of SDR 750 million, which at the time of the adoption corresponded to approximately EUR 920 million or USD 1 billion.⁴⁴⁹ It was hence this regional initiative by the European Union that initiated, or at least sped up, decision-making at the international level to change the Fund convention and to eventually adopt the 2003 Supplementary Fund Protocol.⁴⁵⁰ This constitutes an interesting example of how the fear of a regional solution can trigger a change at the international level. An interesting current question is whether a similar evolution may take place as far as the international regime for nuclear accidents is concerned. The European Commission to a large extent did not take any action as far as environmental liability is concerned, and only relied on the E.U. Member States' adherence to the different international nuclear liability regimes. However, the Commission is increasingly dissatisfied with the scope of protection under the international regimes and has hence launched initiatives to examine whether a European nuclear liability regime that allows compensation for much higher

⁴⁴³ See Sophia Kopela, *Case Note: Civil and Criminal Liability as Mechanisms for the Prevention of Oil Marine Pollution: The Erika Case*, 20 REV. EUROPEAN CMTY. & INT'L EVTL. L. (RECIEL) 313, 318–24 (2011); see also Sands & Peel, *supra* note 25, at 754–55.

⁴⁴⁴ See also Roger Van den Bergh, *Subsidiarity as an Economic Demarcation Principle and the Emergence of European Private Law*, MAASTRICHT J. EUROPEAN & COMP. L. 129–52 (1998) (showing how the economic theory of federalism could be employed to decide on the optimal division of competences between the European and the Member State level as far as the regulation of private law is concerned); Roger Van den Bergh, *Towards an Institutional Legal Framework for Regulatory Competition in Europe*, 53 KYKLOS 435, 435–66 (2000) (providing an institutional analysis explaining under which specific conditions regulatory competition between the various legislators in the European Member States could take place).

⁴⁴⁵ The Maltese tanker *Erika* was carrying some 31,000 tons of heavy fuel oil as cargo broke in two in a severe storm on December 12, 1999, causing an oil spill of approximately 20,000 tons. See *ERIKA, West of France, 1999*, ITOFF, <http://www.itopf.com/in-action/case-studies/case-study/erika-west-of-france-1999> (last visited Dec. 25, 2015).

⁴⁴⁶ The *Prestige* was a tanker that sank before the coast of Galicia, Spain in 2002, causing thousands of kilometers of coastline to be polluted in Spain, France, and Portugal.

⁴⁴⁷ See WANG, CIVIL LIABILITY, *supra* note 119, at 176–77.

⁴⁴⁸ Which dated from September 2002. *Id.* at 176.

⁴⁴⁹ *Id.* at 179.

⁴⁵⁰ See *id.* at 207–09 (analyzing the issue of EU activism and its influence at the European level).

amounts than the conventions should be worked out.⁴⁵¹ Those initiatives have not led to legislative proposals yet. But if they do, the interesting question will arise to what extent this regional initiative could trigger a further revision of the international nuclear liability conventions.

Interestingly, as we mentioned above, that is also the approach taken by the IMO as far as liability and compensation for offshore oil and gas activities is concerned. Again, the IMO does not seem willing to take action itself, but rather supports the development of regional initiatives.

On February 22, 2013, the Legal Committee of the IMO issued another statement concerning the liability and compensation issues connected with transboundary pollution damage from offshore oil exploration and exploitation activities.⁴⁵² According to this report from the Legal Committee, the IMO was still considered the most appropriate forum to deal with the issue of transboundary damage caused by offshore pollution, due to its extensive experience and skill in various maritime and marine environmental issues. Thus, it was agreed that Indonesia should continue the process of developing principles in order to assist states to enter into bilateral or regional arrangements. The principles to which the Legal Committee explicitly referred are (i) the precautionary approach, (ii) strict liability, and (iii) the polluter-pays principle. The issue would hence be further discussed within the Legal Committee.⁴⁵³

Again, those regional initiatives point at the trade-off between, on the one hand, waiting for an all-inclusive global agreement which may take too long, and, on the other hand, the possibility of having bilateral or regional initiatives. To the extent that those would be developed, they could also act as a first mover, as in the case of the European Union, and then subsequently trigger action at the international level.

These examples show interesting interactions between the domestic, regional, and international levels whereby domestic and regional initiatives may both provide guidance and stimulate reform at the international level.

C. *Scope for Policy Change*

The international environmental agreements currently do not greatly contribute to disaster risk mitigation, at least as far as the rules on liability and compensation in those international agreements are concerned. In addition, learning from “best practices” in a few domestic regimes or from the compensation scheme for natural catastrophes, there is certainly scope for improving the design of

⁴⁵¹ See, e.g., *International Workshop on Nuclear Liability*, EUROPEAN COMM’N, available at <https://ec.europa.eu/energy/en/events/international-workshop-nuclear-liability> (last updated Dec. 26, 2015) (describing the international workshop on nuclear liability organized in January 2014 by Directorate-General Energy of the European Commission).

⁴⁵² Report of the Legal Committee on the Work of its Hundredth Session, 15-19 April 2013, Legal Committee of the IMO, Document LEG 100/14, p. 21–24, available at www.uscg.mil/imo/leg/docs/leg/00-report.pdf (last accessed on Nov. 9, 2015) (holding that preference will be given to the development of bilateral or regional arrangements concerning liability and compensation issues related to damage from offshore exploitation activities).

⁴⁵³ This statement followed an international conference that took place in Bali from November 21–23, 2012 concerning liability and compensation for transboundary oil damage resulting from offshore exploration and exploitation activities.

the liability and compensation scheme in international environmental agreements, thus enabling them better to contribute to disaster risk mitigation.

The crucial question is how much compensation can be provided, where compensation is structured in such a way that positive incentives for disaster risk mitigation are generated. The lessons from the various solutions that were discussed can be summarized as follows:

Improve the functioning of liability rules by exposing all operators contributing to disaster risks to liability, thus avoiding channeling legal liability. The U.S. Price-Anderson Act and the U.S. Oil Pollution Act provide interesting examples in that respect.

Abrogate financial caps on liability in order to provide operators incentives for disaster risk mitigation. The U.S. liability regime for marine pollution (where the limits in the OPA are easily breakable and the OPA does not preempt state law) provides an interesting example; the same is the case for domestic statutes governing nuclear liability without financial caps, such as in Japan and Germany.

A system of statutorily mandated risk pooling by operators, through a scheme of retrospective premiums, could be employed to generate high amounts of cover for catastrophic risks as well. The second layer provided under the U.S. Price-Anderson Act provides an example.

Operators' strict liability for technological disasters should be accompanied by a duty to provide financial security in amounts equaling the average expected damage from a disaster.

Undifferentiated lump-sum charity payments by the government (or other actors) should be limited to immediate relief after a disaster, but should not be extended to larger compensation aimed at recovery after the disaster. Those could reduce incentives for disaster risk mitigation or for purchasing first-party insurance against disaster risk.

Given information and behavioral problems related to the demand for disaster risk insurance, comprehensive disaster cover should be mandated by statute.

To generate high amounts of compensation for catastrophic risk, too, the government could (to the extent that market solutions cannot provide sufficient cover) act as reinsurer of last resort. By charging risk-dependent premiums, the government could on the one hand stimulate insurance markets and provide high cover, including for catastrophic risks, and on the other hand provide positive incentives for disaster risk mitigation.

CONCLUDING REMARKS

Rules related to liability and compensation should not merely be considered instruments that can provide ex post compensation to victims of disasters. These rules can, if well designed, also provide incentives for disaster risk reduction by exposing operators to the social costs of their activities. However, the way in which liability rules and compensation mechanisms are designed in many international environmental agreements provides a rather one-sided protection to industrial interests, for example by limiting the liability of operators. Those features are problematic, since they not only reduce the compensation available to victims, but also limit the ability of liability and compensation mechanisms to

contribute to disaster risk reduction. It is therefore no surprise that victims of disasters often prefer to call on rules of domestic law which may provide better protection than the mechanisms in international environmental agreements. It is therefore equally not surprising that some states, like the United States, decided not to be a party to the international regimes concerning nuclear accidents or marine pollution.

The various mechanisms that have been developed in domestic law show that it is possible to shape a liability and compensation regime that also deals with catastrophic risks, thus providing higher amounts of compensation and contributing in a better way to disaster risk reduction. That obviously presupposes political will at the international level to substantially revise the contents of some of the international environmental agreements that currently seem to better protect the interests of industrial operators, rather than provide adequate compensation to victims and incentives for disaster risk reduction.