



Policy Issues in Insurance

Environmental Risks and Insurance

**A COMPARATIVE ANALYSIS
OF THE ROLE OF INSURANCE
IN THE MANAGEMENT
OF ENVIRONMENT-RELATED RISKS**



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No. 6

*A comparative Analysis of the Role of Insurance
in the Management of Environment-Related Risks*



ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Foreword

From the increasing incidence of environmental pollution and soil contamination, to natural disasters occurring on seasonal to inter-annual time scales, the risks posed by the constant interaction between human activities and the environment are diverse, manifold and often catastrophic in their consequences. This sixth volume of the series “Policy Issues in Insurance” is devoted to an in-depth comparative analysis of the role of insurance and reinsurance companies, as well as financial markets and governments, in the management of environmental risks – environmental pollution risk and natural catastrophe risk in particular.

While the first Chapter of the report introduces the general issue of insurability of environment-related risks, Chapter 2 deals with the risk of liability for environmental pollution, taking into account both factual and legal variables that may affect risk insurability. In particular, the author analyses the major trends in the development of environmental liability regimes in OECD countries, as well as the desirable features of an efficient regulatory framework. The author also describes the new products and techniques designed by the insurance industry to respond to induced insurability problems, and the various potential roles played by insurers in the management of environmental pollution risks.

Chapter 3 of this study is devoted to the management of natural catastrophe risks, i.e. the risk posed by the potential occurrence of such extreme natural events as hurricanes, floods, and earthquakes. The author underlines the role of insurers as well as the limits of private insurance solutions for the coverage of such extreme risks, due to the magnitude of their economic consequences and the difficulties faced in pooling risks. He also gives an overview of complementary or alternative risk management options already tested in different institutional contexts, and analyses the crucial role played by governments in partnerships with the private sector, as well as the development of new financial instruments by capital markets (e.g. catastrophe bonds or weather derivatives) to provide funding and economic protection against large losses from natural disasters.

The study has been elaborated by Professor Alberto Monti, from Bocconi University and is updated as of August 2003. The views expressed here are the sole responsibility of the authors and do not necessarily reflect those of the Insurance Committee, the Secretariat or OECD member countries.

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Introduction

In the recent times, the complex relationship between human activities and the environment has become a major public concern, raising issues of legal, political and economic relevance.

The adverse impact of industrial activities on natural resources and biodiversity, as well as the need for sustainable development, stimulated a debate on appropriate policies and techniques aimed at improving the current level of environmental protection and preservation. Conversely, a growing concern has developed over the effects of such extreme natural events as hurricanes, typhoons, floods and earthquakes which pose a serious threat to human life and property, being able to disrupt local communities and to affect the economic stability and growth of entire nations.

From the increasing incidence of environmental pollution and soil contamination, to natural disasters occurring on seasonal to inter-annual time scales, the risks posed by the constant interaction between human activities and the environment are diverse, manifold and often catastrophic in their consequences. Therefore, the elaboration of effective risk-management plans, aimed at formulating viable response strategies, requires the pro-active contribution of all the economic actors involved: governments, public officials, international organisations, financial institutions and private parties are all called upon to take part in this endeavor.

Against such backdrop, this report focuses upon the role of insurance and reinsurance companies in the management of environmental risks. In particular, according to the proposed research plan, the analysis concentrates on issues related to two different kinds of environment-related risks:

1. the **environmental pollution risk** and
2. the **natural catastrophe risk**.

For the purposes of this report,

1. the **environmental pollution risk** is the risk associated with industrial and commercial activities that may adversely affect the environment, cause human health problems, damage property, contaminate natural resources and affect biodiversity. From the standpoint of the owners and operators of such activities, in most, if not all, OECD countries it can be framed as the risk of incurring legal liability for the consequences of environmental pollution phenomena. The scope and nature of environmental liabilities are

changing over time and they may greatly vary from jurisdiction to jurisdiction. At present, the most important categories are:

- a) liability for bodily injury, property damages and economic losses caused by pollution to third parties;
- b) liability for the costs of preventive and remediation measures, including the cost of cleaning up the polluted site;
- c) liability for ecological impairment, including reduced biodiversity and other natural resources damages (NRDs).

While,

2. the **natural catastrophe risk** is the risk associated with the occurrence of natural disasters, such as earthquakes, floods, hurricanes or other extreme environmental conditions: such catastrophic events often cause large-scale material damages, as well as severe economic losses.

Both these environment-related risks, as mentioned, are characterized by the potential for catastrophic consequences. However, even if they may share some common features, they are structurally different from the standpoint of the insurer and, therefore, they deserve to be treated separately in this report.

After a brief overview (Chapter 1) of the traditional functioning of the insurance and reinsurance mechanisms and an introduction to the general problems affecting the insurability of certain risks, Chapter 2 of this study deals with the risk of liability for environmental pollution, taking into account both **factual and legal variables that may affect risk insurability**. Environmental pollution risk, in fact, is highly influenced by the underlying legal and regulatory framework. **Identifying the major trends in the development of environmental liability regimes in OECD countries, therefore, constitutes the basis for any discussion concerning the role of the insurance sector in this field.**

In this perspective, a **theoretical discussion** of the most relevant features of an environmental liability regime is complemented by a comparative overview of the main evolutions of environmental legislation in some OECD countries, as well as by the **evaluation of the most recent developments** that are taking place at the European Community level.

To this purpose, particular attention is devoted to the recent proposal for a “Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage” presented by the Commission of the European Communities on January 23, 2002 [COM(2002) 17 final]. The proposal aims to establish a framework whereby environmental damage would be prevented or remedied; the main benefits expected include improved enforcement of environmental protection standards, in line with the “Polluter Pays Principle”,¹ and efficient

levels of prevention. According to the text of the proposal (article 16), EU member States should encourage:

- **the use** by operators of any appropriate insurance or other forms of financial guarantee, in order to provide effective cover for obligations under the Directive;

and

- **the development** of appropriate insurance or other financial security instruments and markets by the appropriate economic and financial operators, including the financial services industry.

In response to the above, the insurance industry is developing new strategies and techniques aimed at tackling the peculiar insurability problems posed by ecological damage phenomena and it made strong commitments at an international level.²

This report presents an **overview of the different environmental insurance products** currently available on the international market and suggests that modern ecological insurance may serve **different purposes**: in addition to contributing in the solution of the “**judgment proof**” (or “insolvency”) problem, in fact, it would guarantee the **ex ante internalization of pollution costs** posed by the industry and it might also be able to work as a **surrogate regulation mechanism**,³ providing appropriate incentives for increased levels of prevention and precaution.

With a view to throwing some brighter light on the role that the insurance sector is expected to play in the near future, the interaction among regulation, liability, funds and insurance is briefly discussed.

Chapter 3 of this report, in turn, is devoted to the analysis of **the role of insurance in the management of natural catastrophe risk**, i.e. the risk posed by the potential occurrence of such extreme natural events as hurricanes, floods and earthquakes.

Starting from the observation that natural disaster risks pose severe problems to the traditional functioning of insurance and reinsurance – mainly because the risks associated with these events are not independent and because of the **magnitude of their economic consequences** –, this part of the study discusses alternative risk management solutions already tested in different institutional contexts.

Since the law of large numbers does not apply – at least at the primary market level⁴ –, aggregating risks is unproductive and the natural comparative advantage of insurance may be lost when dealing with natural catastrophes.⁵ This factor, together with the size of expected losses, explains why the **partnership between governments and the private sector** is crucial in developing effective natural catastrophe risk management strategies.

This part of the study, therefore, describes and analyzes the main features of several governmental disaster schemes and other institutional arrangements that have been designed and tested around the world in order to supplement or replace traditional reinsurance.

Moreover, since capital markets have developed new **financial instruments** such as **catastrophe bonds**, **weather derivatives** and other complex **risk securitization** devices aimed at providing funding and economic protection against large losses from natural disasters, the present analysis will also take into account the current role of such financial techniques.

As a conclusion, this report suggests that, while **private insurance** may not be considered as a straightforward and ready-to-use solution to the complex problems posed by the “environmental pollution risk” and by the “natural catastrophe risk”, it **certainly has the potentials to play a decisive role** in this field and, therefore, it should be regarded by governments and policy makers as a **key instrument** in the available array of risk management tools.

Notes

1. The polluter-pays principle, stated in Article 174(2) EC (ex art. 130r of the EC Treaty), is acknowledged in the 1972 OECD GUIDING PRINCIPLES CONCERNING INTERNATIONAL ECONOMIC ASPECTS OF ENVIRONMENTAL POLICIES:

“a) *Cost allocation: the Polluter-Pays Principle*

2. Environmental resources are in general limited and their use in production and consumption activities may lead to their deterioration. When the cost of this deterioration is not adequately taken into account in the price system, the market fails to reflect the scarcity of such resources both at the national and international levels. Public measures are thus necessary to reduce pollution and to reach a better allocation of resources by ensuring that prices of goods depending on the quality and/or quantity of environmental resources reflect more closely their relative scarcity and that economic agents concerned react accordingly.

3. In many circumstances, in order to ensure that the environment is in an acceptable state, the reduction of pollution beyond a certain level will not be practical or even necessary in view of the costs involved.

4. The principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so-called “Polluter-Pays Principle”. This principle means that the polluter should bear the expenses of carrying out the above mentioned measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption. Such measures should not be accompanied by subsidies that would create significant distortions in international trade and investment.

5. This principle should be an objective of member countries; however there may be exceptions or special arrangements, particularly for the transitional periods, provided that they do not lead to significant distortions in international trade and investment.”

See: RECOMMENDATION OF THE COUNCIL ON GUIDING PRINCIPLES CONCERNING INTERNATIONAL ECONOMIC ASPECTS OF ENVIRONMENTAL POLICIES, 26th May, 1972, Council Document No. C(72)128. Paris: OECD. See also: THE RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT of June 1992 (Principle 16).

2. See, especially, the UNITED NATIONS ENVIRONMENTAL PROGRAMME – UNEP Statement of Environmental Commitment by the Insurance Industry, signed in Geneva, on 23 November, 1995.
3. See: Abraham, K. S. (1988), Environmental Liability and the Limits of Insurance, 88 Columbia L. Rev. 946 ff.
4. With respect to the international reinsurance market, some professional risk carriers affirm that natural catastrophe risks can be relatively well diversified on a global scale, since natural disasters are independent from each other, provided sufficiently broad terms of reference are defined. See: Swiss Reinsurance Company (2002), Natural Catastrophes and man-made disasters in 2001, Swiss Re SIGMA series 1/2002. Zurich, Swiss Reinsurance Company, 11.
5. Priest, G.L. (1996), The Government, the Market, and the Problem of Catastrophic Loss, Journal of Risk and Uncertainty 12 (Number 2/3): 219-237

Chapter 1

Risk, Information and Insurance

After a brief overview of the traditional functioning of the insurance and reinsurance mechanisms, this chapter introduces the general issue of insurability of environment-related risks. It describes the different types of attitudes towards risks and provides a synthesis of the criteria of insurability, which could be summed up under the following headings: assessability, randomness, mutuality and economic feasibility. Against this backdrop, it is argued that two major factors influence in practice the provision of insurance policies for a particular risk: generalized uncertainty, which largely depends on the legal framework, and informational asymmetries, which may lead to adverse selection and moral hazard problems. As underlined by the author, the assessment of these two factors is of paramount importance in order to establish appropriate insurance mechanisms to cover environment risks.

1. Different attitudes towards risk and the traditional functioning of insurance and reinsurance mechanisms

Economic actors have different attitudes towards risks. It depends on several factors, including the nature of the risk, the probability of loss, the potential magnitude of the loss and the ability to absorb its economic consequences. Assuming rationality and perfect information, economic actors are able to calculate the actual value (present discounted value) of a given risk by discounting the magnitude of the loss by the probability of its occurrence ($P \times L$).

Once the risk is properly identified and evaluated, however, risk management decisions still need to be taken. In this perspective, economic actors may be:

- **Risk averse:** if they are willing to pay even more than the discounted value of the risk in order to transfer its harmful consequences to someone else.
- **Risk preferring:** if they prefer to retain the risk of loss, rather than transferring it by paying upfront an amount equal to its discounted value.
- **Risk neutral:** if they are indifferent with respect to the alternative between (a) retaining the risk and (b) transferring it to someone else by paying upfront an amount equal to its discounted value.

Risk aversion, therefore, generates demand for insurance. Insurance companies, in turn, are willing to undertake the risk in exchange for an amount of money relatively close to its discounted value (the insurance premium), because the law of large numbers makes them able to manage such risks effectively, by making predictable, with reasonable accuracy, the claims they will pay from year to year. According to this mathematical law, the larger the number of exposures considered, the more closely the losses reported will match the underlying probability of loss. This means that insurance companies need to pool together a rather **large number of homogeneous but independent risks** in order to become risk neutral.

Against such background, the functioning of the traditional insurance mechanism can be divided into four phases:

- **Risk assessment** (i.e. the overall evaluation of risk, which is usually performed through statistical and probabilistic analyses).
- **Risk transfer** (i.e. the shifting of its harmful consequences by way of the insurance contract).

- **Risk pooling** (i.e. the placement of the risk in a pool of homogeneous but independent risks allows the insurer to spread the risk and to benefit from the law of large numbers).
- **Risk allocation** (i.e. the pricing of the risk through premium setting techniques).

As the magnitude of expected losses increases, **the insurers' financial ability to absorb them can be severely jeopardized**. In other words, insurance capacity is limited, since over and above certain levels of financial exposure insurers themselves tend to be **risk averse**. In this context, **coinsurance** and **reinsurance** are viable options for primary carriers who are willing to cede part of the risk they undertook, in exchange for the payment of a fraction of the premiums they collected.

Reinsurance agreements may be of different types, among which:

- **Quota share (proportional) treaties** (by which the reinsurer undertakes a quota of the risk transferred to the primary carrier).
- **Excess of loss (or stop loss) treaties** (by which the reinsurer undertakes the upper layer of the risk, after a certain attachment point).

2. Risks predictability, generalized uncertainty and informational asymmetries

The briefly described insurance mechanism is able to perform its functions correctly under specific conditions of risk and uncertainty.¹ In a well-known contribution, Frank Knight distinguished between risk (predictable probabilities) and uncertainty (unpredictable probability of loss) and argued that insurance works best with the former.²

In other words, the basic argument is that the insurer must possess *ex ante* accurate information on the probability that the insured event will occur, as well as on the magnitude of its economic consequences: without such information, the insurer is not able to adequately calculate the premium.

In the past decades, several **criteria for insurability** of risks have been identified and discussed by the literature.³ Baruch Berliner,⁴ for instance, proposed the following nine criteria against which evaluate any risk:

1. Randomness (of the loss occurrence).
2. Maximum possible loss.
3. Average loss amount upon occurrence.
4. Average period of time between two loss occurrences (i.e. loss frequency).
5. Insurance premium.
6. Moral hazard.
7. Public policy.

8. Legal restriction.

9. Cover limits.

The author maintained that the above set of criteria forms a concise and almost complete evaluation system, in the sense that its use allows professional risk carriers to determine whether or not a risk is **subjectively insurable**.⁵ In fact, the insurability of a risk depends on calculations made based on insurance techniques, but also a complex decision-making process by each individual insurer who takes several considerations into account. Such criteria contain subjective as well as objective aspects and they are not independent from one another; if only one of them is not fully satisfied with respect to the position of a professional risk carrier, then the risk may be considered subjectively uninsurable.

The intersection of all subjective domains of uninsurability forms the **objective domain of uninsurability**, while the intersection of all subjective domains of insurability constitutes the objective domain of insurability. Between these two domains, lies an area of separation, consisting of all risks that are insurable for some professional risk carriers and uninsurable for others.

A more concise set of criteria for evaluating the insurability of risks in general has been recently restated⁶ and it consists of the following four elements:

- a) **ASSESSIBILITY:** the probability and severity of losses must be quantifiable.
- b) **RANDOMNESS:** the time at which the insured event occurs must be unpredictable and the occurrence itself must be independent of the will of the insured.
- c) **MUTUALITY:** numerous persons exposed to a given hazard must join together to form a risk community within which the risk is shared and diversified.
- d) **ECONOMIC FEASIBILITY:** private insurers must be able to charge a premium commensurate with the risk.

Risks that do not readily satisfy all of these criteria may be considered by professional risk carriers as uninsurable and, therefore, coverage may become unavailable on the market. It is worth noting that, the actual availability of insurance coverage for a certain risk does not merely depend on its insurability, but also on its attractiveness in comparison to risks from other branches that are competing for the available insurance capacity. With respect to the above issues, severe problems are posed by:

- a) generalized uncertainty; and
- b) informational asymmetries.

a) **Generalized uncertainty** – A condition of uncertainty is said to be generalized when both the insurer and the prospective insureds are equally affected by it. It is important to note that **generalized uncertainty** depends on both **factual and legal circumstances**; it means that the general level of uncertainty and ambiguity concerning a certain risk is often influenced by the underlying legal regime.

As said, in order to be insurable, a risk must be predictable *ex ante* to a certain extent, at least by means of past experience and statistic calculations.⁷ the insurance company must possess sufficient information about the probability and magnitude of the expected loss, in order to properly assess the risk undertaken and to calculate the so-called **actuarially fair premium**. A severe condition of generalized uncertainty about the features of a certain risk may hinder its insurability. Even if uncertainty is not so critical to impede risk insurability, it still has an impact on the cost of insurance, since the premium charged to the insured contains a series of loadings, some of which (*e.g.* safety and fluctuation loadings) are precisely aimed at covering the residual level of unpredictability that characterizes every risk.

As this report will discuss in more details *infra*, since several features of the underlying legal framework greatly affect uncertainty, ambiguity and insurability of environment-related risks, **choices made by legislators and policy makers very often play a determinant role in this field**.

b) **Informational asymmetries** – Whenever the insured possesses more information than the insurer about the risk (asymmetrical uncertainty), problems of **adverse selection** and **moral hazard** may occur.

The notion of **adverse selection** identifies the tendency of poorer-than-average risks to buy and maintain insurance. Adverse selection occurs when insureds select only those coverages that are most likely to have losses.⁸

Moral hazard, instead, refers to the increase in probability of loss that results from a decrease in the preventive measures adopted by the insured following the purchase of insurance coverage. In other words, it identifies the hazard arising out of an insured's indifference to loss because of the existence of insurance.⁹

These informational asymmetries generate **agency costs**¹⁰ and, in order to cure these problems, risk carriers are forced to employ a variety of **monitoring** and **bonding devices**. Monitoring devices are mainly aimed at controlling the insured's behavior, thereby leveling the information asymmetry, while bonding devices provide incentives meant to realign the otherwise diverging interests of insurer and insureds. Common examples of these devices are the use of complex application screening processes, risk differentiation techniques, feature and experience ratings, exclusions of coverage, co-insurance clauses and deductibles.

With respect to asymmetrical uncertainty as well, choices made by legislators and regulators are extremely relevant. A legal rule that mandates compulsory coverage for a certain risk, for example, may help reducing the problem of adverse selection. Conversely, a creative interpretation of insurance policy terms (especially: exclusions and conditions of coverage drafted to prevent moral hazard) made by courts in order to favor the insured parties in the short run, may ultimately lead to unavailability of coverage for such risk.

In summary, therefore, both generalized and asymmetrical uncertainty influence **risk insurability**, since they have the potential to reduce: **(1)** the ability of risk carriers to undertake certain risks, **(2)** the scope and availability of insurance coverage on the market and **(3)** the willingness of prospective insureds to purchase coverage, which might be perceived as too costly.

With respect to uncertainty and insurability, this report will address some of the problems and difficulties that the traditional insurance and reinsurance mechanisms face when dealing with:

- the **environmental pollution risk** (Chapter 2) and
- the **natural catastrophe risk** (Chapter 3).

Environmental pollution risk is tightly connected with the **underlying legal and regulatory framework**, whose **features may generate uncertainty, or otherwise limit risk insurability**. On the contrary, well drafted and defined environmental rules and regulations yield predictable losses and may foster the development of an effective pollution insurance market. The **factual uncertainty** associated with gradual pollution risk and the effects of environmental contamination on human beings and biodiversity, however, are also problematic. Long-tail environmental risks are extremely challenging for insurers because they must be able to establish a realistic and reliable estimate of compensation to be paid over a period of a specific and reasonable duration. Relevant obstacles, moreover, are posed in this field by severe **information asymmetries**.

The traditional insurance and reinsurance mechanisms may also encounter problems in coping with the natural catastrophe risk, since **risk predictability**, the ability to **spread the risk both geographically and over time** and the **financial capacity** of the market are severely limited for such type of risks.

In both cases, moreover, the **magnitude of expected losses** and the **information problems** affecting risk predictability and assessment require joint efforts (e.g. pooling) by several insurers and reinsurers.

It is worth noting that the highlighted need for **information sharing practices** and **market concentration** – in order to increase capacity – suggests a careful approach to antitrust regulations and **competition policies** in this area¹¹. Furthermore, regulatory barriers to the free determination of premium

levels and conditions of coverage may hinder the willingness and ability of insurance carriers to enter the market for environment-related risks.

In light of the above, this report suggests that all institutional actors, including legislators, governments, regulators and courts, may play a crucial role in addressing and solving the problems of predictability and insurability of environment-related risks.

Notes

1. See: Abraham, K.S. (1986), *Distributing Risk: Insurance, Legal Theory and Public Policy*, New Haven: Yale University Press.
2. Knight, Frank H. (1921), *Risk, Uncertainty, and Profit*, Boston: Houghton Mifflin Company.
3. See: Berliner, B. (1982), *Limits of Insurability of Risks*. Englewood Cliffs, NJ, Prentice-Hall, Inc.; Faure, M.G., *The Limits to Insurability from a Law and Economics Perspective*, Geneva Papers on Risk and Insurance, 1995, 454-462; Skogh, G. (1998), *Development risks, strict liability and the insurability of industrial hazards*, Geneva Papers on Risk and Insurance, 87, 247.
4. Berliner, B. (1982), *Limits of Insurability of Risks*. Englewood Cliffs, NJ, Prentice-Hall, Inc.
5. See also: Berliner, B., Spühler, J. (1990), *Insurability issues associated with managing existing hazardous waste sites*, in "Integrating Insurance and Risk Management for Hazardous Waste", edited by Howard Kunreuther and Rajeev Gowda, Kluwer Academic Publishers, 134 ff.
6. Swiss Reinsurance Company (2002), *Natural Catastrophes and man-made disasters in 2001*, Swiss Re SIGMA series 1/2002. Zurich, Swiss Reinsurance Company, 18.
7. Skogh, G. (1998), *Development risks, strict liability and the insurability of industrial hazards*, Geneva Papers on Risk and Insurance, 87, 247.
8. "This problem may arise when the policyholder has some hidden information that is not in the possession of the insurer. Assume, for illustrative purposes, that there are two types of policyholders according to the insurer's point of view: 'good' risks and 'bad' risks. The insurer cannot distinguish between them and the policyholders do not reveal their nature – both maintain that they are good risks. In that case the market may break down. The logic is as follows: initially, the insurer charges the same premium for the two. The premium is based on the average actuarially expected costs. Insurance will then be a good affair for the bad risk and a relatively poor affair for the good risk. Consequently, many bad risks and few good risks will purchase insurance and the insurer will incur a loss on average. It will, then, be necessary to increase the premium the next round, thus discouraging good risks, attracting bad risks and precipitating a new loss. The cycle will repeat itself. In the end there may be no market left." Skogh, G. (2000), *Mandatory Insurance: Transaction Costs Analysis of Insurance*, in Bouckaert, B. and De Geest, G. (eds), *Encyclopedia of Law and Economics*, Volume II. Civil Law and Economics, Cheltenham, Edward Elgar.
9. See: Shavell S. (1979), *On Moral Hazard and Insurance*, *Quarterly Journal of Economics* (QJE), 541-562.

10. See: Abraham, K. S. (1988), *Environmental Liability and the Limits of Insurance*, 88 *Columbia L. Rev.* 946.
11. As for the application of EU competition policies to the insurance sector, see: Commission Regulation 358/2003 of 27 February 2003 (OJ L53/8 of 28 February 2003) which replaces Commission Regulation 3932/92 of 21 December 1992 (OJ L398 of 31 December 1992, p. 7). See also: "Report to the European Parliament and to the Council on the Operation of Commission Regulation No. 3932/92 concerning the application of Article 81 (Ex-Article 85), Paragraph 3, of the Treaty to certain categories of agreements, decisions and concerted practices in the field of insurance", issued by the Commission on 12 May 1999, COM (1999) 192 final.

Chapter 2

Environmental Pollution Risk and Insurance

This chapter focuses on the management of risks related to environmental pollution. Insurability of such risks is tightly connected with the underlying legal and regulatory framework. The author analyses different legal approaches to environmental risks and liability, sketches out the experiences of various OECD countries in this field, and describes recent EU developments. He also examines the factual and legal uncertainty stemming out of the complex and potentially long-tail consequences of environmental pollution. The chapter then provides an overview of the new products and techniques designed by the insurance industry to respond to induced insurability problems, and underlines the various potential roles to be played by insurers in the management of environmental pollution risks. Finally, the author raises the issue of the slow development of the insurance market for environmental pollution risks and appraises different solutions to overcome this problem, among which a compulsory insurance coverage or the development of alternative financial guarantees.

1. Environmental pollution as a negative externality

Environmental pollution is commonly considered in the law and economics literature as an external cost of production (**negative externality**) generated by the industry.¹ The release of pollutants into the environment by commercial and industrial activities may often impair natural resources, reduce biodiversity and cause bodily injury, property damages and economic losses to third parties.

Unless full internalization of these pollution costs is imposed by the legal system, environmentally dangerous activities may receive incentives to continue doing business even if they generate socially inefficient outcomes, since part of their costs are falling on someone else.

The environment is a public good and, therefore, the impairment of such natural resources as air, water, land, flora and fauna negatively affects the society as a whole. Nowadays, environmental protection is a worldwide growing concern:² natural resources are becoming really scarce on our planet and, to a greater or lesser extent, all the nations are adversely affected by inefficient uses of them.

2. Different legal approaches to the externality problem: *ex ante* regulation v. *ex post* liability

The goal of imposing full internalization of pollution externalities is, therefore, very important and, theoretically, it can be achieved through different legal devices.

A way of dealing with this problem is characterized by the strict centralized enforcement of a sophisticated net of **public law regulations**: those command-control rules, setting standards and sanctions, operate *ex ante* and reflect the results of a costs-benefits analysis already performed by the authorities.

A second possible solution is the *ex post* imposition of the external costs on the actors through a mechanism of **liability rules**,³ enforced by the courts or by other adjudication or authoritative bodies; in this perspective, the polluter can freely pursue his activity, but he is then forced to pay compensation for the damages caused to the environment and to third parties, thereby internalizing *ex post* the costs of pollution.

Of course, both these alternative theoretical approaches have already been widely analyzed and criticized: the former mainly because of its own intrinsic

rigidity and the latter in light of the relevance of litigation costs and of the so-called “judgment proof” (or “insolvency”) problem.⁴ It seems well established that **a combination of the two is possibly the most efficient solution.**⁵

Starting from this assumption, this report tries to go a step forward, by focusing upon **the impact of modern environmental insurance on both the liability system and the regulatory framework.** In particular, the advantages and the limits of the *ex post* mechanism of environmental liability and the role of professional ecological insurance in preventing the most common failures of this device are considered and discussed.

3. Environmental liability: compensation and deterrence

It is recognized that environmental liability regimes should be aimed at achieving efficient levels of **compensation** and **deterrence.**

In other words, applying economic theory to environmental policies, the enactment of a liability regime in response to the ecological emergency can be explained as an attempt to pursue two important and interrelated policy goals:

- **compensation** for damages caused by pollution and
- **deterrence** of inefficient activities, thereby preventing pollution that is not cost-justified.

By focusing on compensation for the losses sustained, the position of the injured parties is mainly taken into account. The deterrence function, on the other hand, is more concerned with the need to provide appropriate behavioral incentives to the potential polluters. From a slightly different perspective, however, both these goals constitute the beneficial results of an effective mechanism of **risk allocation** that imposes **full internalization** of the pollution costs.

a) The choice between negligence and strict liability

In determining the features of a liability rule, the first choice that legislators face is between **strict liability** and a **negligence** standard.

While negligence can be considered as an effective mechanism of risk spreading, it has been shown that strict liability is more efficient in circumstances where the potential tortfeasor is in a better position to evaluate the costs and benefits of a particular **level of activity** than either the potential victims or the court (finder of fact).⁶ The negligence standard, in fact, provides appropriate incentives to the parties only with respect to:

- **the level of care** (the diligence in performing a given activity),
but not with respect to
- **the level of activity** (the intensity and frequency of a given behavior or activity).

Both variables, however, affect the probability of an accident.⁷

When the injured party has substantially no control over the risk of loss (**unilateral accidents**) there is little need to give him/her incentives to invest in precautions and it suffices to control the behavior of the potential tortfeasor (i.e. the potential polluter). A strict liability standard, imposing a full internalization of the negative externalities, forces the potential tortfeasor to consider both the **level of care** and the **level of activity** and, therefore, it generates incentives to behave in an efficient manner.⁸ Strict liability allocates the risk of loss to the party who is better able to control it and, therefore, who is the **least cost avoider** of the harm.

Environmental pollution events, in the vast majority of cases, are **unilateral accidents**. Hence, in order to achieve an efficient level of **deterrence**, strict liability proves to be more appropriate than negligence, at least with respect to dangerous activities.⁹

As regards the **compensation** perspective, strict liability offers many advantages compared to a negligence standard, especially in the industrial pollution cases. In the typical pollution dispute, in fact, the proof of negligence can be perceived by the injured parties as a *probatio diabolica* – an obstacle often too difficult to overcome – given the difficulties in accessing relevant information and the technical character of the notions involved.¹⁰

On the other hand, a strict liability rule is conceivable as a form of insurance, whose beneficiaries are the injured parties. Moreover, deprived of any punitive character, this form of liability should be more easily transferable on the commercial insurance marketplace. In this sense, environmental insurance would work as a form of reinsurance.

In light of the above, it is not surprising to find out that strict liability is established as the basis for all new environmental legislation enacted in several OECD countries in the recent years¹¹ and that liability is generally imposed on owners and operators of dangerous activities (i.e. the persons in better control of the environmental pollution risk).

b) Allocation and apportionment of concurrent liabilities

Another dilemma arises in the very usual situation in which more polluters are involved in the same environmental accident: should the liability be imposed on an **individual basis** (proportional liability) or should all the polluters be held **joint and severally liable**?

If the **compensation** function is considered alone, joint and several liability clearly offers great advantages to the injured parties. The **deterrence** goal, however, requires that each polluter pays for the consequences of his or her own activity: if liability is not individual, the mechanism of incentives may

not work properly, since the potential polluter may not be able to perform a correct costs-benefits analysis.

Moreover, if insurability issues are taken into consideration, a strict, joint and several standard should be avoided, because it impairs the ability of risk-carriers to properly evaluate and assess the risks posed by their prospective customers.

In practice, the general trend in most OECD countries appears to be towards the adoption of a system which combines elements of both options: even if joint and several liability is frequently adopted as a general rule, the polluter often has the possibility to limit his financial exposure by proving the extent of his contribution.

c) Direct v. indirect protection of the environment

A third set of options, which characterizes the process of selecting an optimal environmental liability rule, has been pointed out by scholars engaged in the comparative study of environmental laws¹² and it concerns the scope of environmental liabilities, as well as the type of damages to be covered by the special regime.

On one hand, we have the possibility to grant **direct protection** to the environment by holding the polluter liable for all the harmful consequences of his activity, including cleanup costs and damages caused to biodiversity and natural resources such as air, water, soil, flora and fauna (the so-called “**environmental damage**” or “**ecological damage**”).

In case of pollution, therefore, the legal system will oblige the responsible party to pay compensation for any kind of harm caused to the environment, including site remediation and clean-up costs, natural resources damages (NRDs) and biodiversity damages, in addition to and apart from any other property damage, bodily injury or economic loss (the so-called “**traditional damages**”) caused to third parties by the polluting event.

In other words, with the adoption of a direct protection scheme, the traditional boundaries of tort law are extended in such a way to comprehend the obligation to compensate for **damages to a public good**, i.e. the **environment**, which is broadly defined as to include natural resources, biodiversity, endangered species, etc.

An authority (generally, the State) will then be entitled to receive compensation for ecological damage on behalf of the citizens, or to apply for a judicial remedy, such as an injunction, that compels responsible party to undertake remediation measures in the first place. It is often the case that the special environmental liability regimes enacted in those legal systems that have opted for a direct protection scheme does not cover traditional damages caused by pollution; in this case, compensation for such damages is governed

by general tort law rules (i.e. rules contained in a civil code, or common law rules, depending on the jurisdiction), adapted by case law to the specific problems posed by environmental pollution. This peculiar choice has been made, among others, by the United States, Italy, Switzerland and Portugal,¹³ each to a different degree.

On the other hand, nevertheless, stands the option to introduce new and tougher liability rules aimed at covering “traditional damages” whenever they are caused by a polluting event. Even if liability for the “environmental damage” (as defined above) is excluded, the environment still receives an **indirect protection**, since environmentally dangerous activities are subject to much more severe rules concerning damages caused by pollution to human health and private property.

This view is embodied in the German *Umwelthaftungsgesetz* of 1991. As we will see in more details *infra*, under § 1 of the German Environmental Liability Act operators of facilities listed in a specific appendix to the law are strictly liable to injured persons for bodily injury and property damage due to an environmental impact that issued from said facilities, and causation is presumed, pursuant to § 6.

Imposing the obligation to compensate for natural resources damages (NRDs) and cleanup costs – compared to the indirect protection scheme – has the clear advantage to force the polluter to **internalize the negative externalities** of his activity to the full extent. However, the choice for a direct protection scheme introduces new problems, the most important of which is related to the monetary **evaluation** and **quantification** of the so-called “**environmental damage**” or “**ecological damage**”.

In particular, the issue of quantification is extremely controversial with respect to the **value of natural resources** or other environmental services that cannot be fully restored or replaced after the occurrence of a polluting event. Some of the proposed monetary evaluation criteria – such as the contingent valuation method¹⁴ and the travel cost method¹⁵ – can be extremely subjective and they may lead to almost unpredictable results.

It shall be noted, conversely, that holding responsible parties liable for the remediation costs and for the costs of cleaning up impaired resources on and around the polluted site under a “limited” direct protection scheme appears to be a more practicable and viable option.

With respect to this last issue, it is extremely important to point out that, in the recent years, several OECD countries, instead of – or in addition to – civil liability regimes for environmental pollution, have enacted public law schemes consisting of specific rules aimed at **imposing the obligation to cleanup contaminated sites** under the threat of **administrative** and/or **criminal sanctions**.

In case of pollution, the operator of the facility and/or the owner or occupier of the site, in other words, may be forced by the competent public authority to immediately adopt security and preventive measures and then to decontaminate the site, under the threat of penalties, fines, or even imprisonment.

The main difference between a private law regime relying on civil liability (i.e. tort law) and a public law regime based on administrative and/or criminal liability is that, in the latter scheme, preventive and restorative measures – such as cleanup obligations – are mandated by compulsory orders of the competent public authority entrusted with regulatory and enforcement powers, without the prior need for court adjudication. Sometimes, the administrative bodies may well employ the concurrent civil liability mechanism in order to seek reimbursement of the remediation costs from the liable parties, but they generally have the power to issue compulsory cleanup orders in the first place.

Recent examples of this trend in OECD countries include:

- **DENMARK:** The Contaminated Soil Act No. 370 of 2 June 1999.
- **FINLAND:** The Environmental Protection Act No. 86 of 2000 (Chapter 12)
- **GERMANY:** The Federal Soil Protection Act (BSG) of 1998, that came into force in March 1999.
- **ITALY:** Ministerial Decree No. 471 of 25 October 1999 and Legislative Decree No. 22 of 5 February 1997 (Ronchi Decree).
- **NEW SOUTH WALES (AUSTRALIA):** The Contaminated Land Management Act of 1997.
- **SPAIN:** Wastes Law No. 10 of 1998 (Title V).
- **SWEDEN:** Chapter 10 of the new Environmental Code, in force from 1 January 1999.
- **UK:** The implementation in England (1 April 2000), Scotland (14 July 2000) and Wales (14 July 2001) of Part IIA of the Environmental Protection Act 1990 on contaminated land (introduced by Section 57 of the Environment Act 1995).

This general trend towards the introduction of **public law regimes**, whose effects are to impose environmental cleanup obligations or other financial responsibilities upon certain parties (generally: the causer of the harm and the owners or occupiers of the polluted land), increases the complexity of the picture and raises important questions concerning the most appropriate types of applicable insurance coverages.¹⁶

In those jurisdictions that have enacted a public law scheme for contaminated land remediation, in fact, liability insurance might not be

suitable to cover on-site cleanup obligations or other expenses made compulsory by an administrative order issued by the competent authority. Mixed products – combining property and liability cover –, therefore, may prove important in the future developments of environmental pollution insurance.¹⁷

In any event, from an insurability perspective, it is always very important to distinguish between liability (being it civil or administrative) for cleanup of soil or water pollution and the obligation to pay monetary damages to compensate for harm to natural resources and biodiversity (both belonging to the general notion of “environmental damage” or “ecological damage”, as opposed to that of “traditional damages”, consisting of third party bodily injury, property damages and economic loss).

As mentioned, the monetary evaluation of natural resources damages (NRDs) and biodiversity damages may in fact be extremely subjective and unpredictable, while technical cleanup standards could well be determined by the competent authorities with a sufficient level of clarity, stability and predictability. If this is the case, the risk of liability for environmental cleanup and remediation costs may prove to be fully manageable by the insurance sector.

4. A comparative overview of different legal approaches

In this section, a sample of different legal responses to the environmental pollution risk is examined. Comparative tables summarizing these different approaches are available at the end of this section. The aim is not to explore the details of the selected legal systems, but rather to outline the most relevant provisions of their environmental liability regimes, taking into account the issues of insurability, according to the terms of the present analysis.

To this purpose, this section addresses some of the most relevant features of: **a)** the US Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) **b)** the German Environmental Liability Act (Umwelthaftungsgesetz) of 1991 and the Federal Soil Protection Act of 1998 **c)** the Italian Law No. 349 of 1986 and the Legislative Decree No. 22 of 1997 (Ronchi Decree) and **d)** the proposal for a Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage, presented by the Commission of the European Communities on 23 January 2002.

a) The US Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)

In 1980 the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)¹⁸ has been enacted in the United States. Section (§) 107 of CERCLA imposes on an extremely broad category of Potentially

Responsible Parties (PRPs)¹⁹ strict, retroactive, joint and several liabilities for response costs, including cleanup costs and natural resource damages.²⁰

Notwithstanding detailed regulations on assessment and valuation of lost or injured natural resources have been issued by the Department of the Interior (DOI),²¹ however, § 107 (a) (1-4) (C) of CERCLA concerning NRDs – i.e. “damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from such a release” – has been seldom enforced by courts, while the provisions related to liability for response costs have been widely litigated during the past two decades.

CERCLA is a statute that combines an almost absolute liability regime²² with a collective funding mechanism, in order to deal with the highest priority hazardous waste sites. The federal statute, in fact, established a trust fund, better known as the *Superfund*, which is sustained by various fiscal impositions, such as a petroleum tax, an environmental income tax on major enterprises and a tax on producers of those chemicals that typically compose hazardous waste.²³

The enforcement of this act has been delegated to the US Environmental Protection Agency (EPA), established in 1970. The resources of *Superfund* are mainly used by the EPA to assess necessary removal and remedial actions and to locate Potentially Responsible Parties, with a view to making them pay for the costs of cleaning up polluted sites.

CERCLA is a mixed systems containing civil liability rules as well as rules granting authoritative powers that allow the EPA to issue compulsory cleanup orders, backed by the threat of severe fines and punitive (treble) damages for noncompliance. The two main mechanisms for securing response costs from PRPs are: **1)** unilateral administrative orders pursuant to § 106(a) and **2)** cost recovery actions against liable parties following removal and remedial measures financed from the Superfund (§ 107). After a few years, the “enforcement first” strategy took the lead; the effects of the implementation of this strategy on PRPs is not indifferent, considering that the Act prohibits any pre-enforcement review, or hearing, on liability before completion of the remedial work. A massive phenomenon of litigation characterized the fifteen years following the enactment of CERCLA: several disputes involved the EPA, Potentially Responsible Parties (PRPs) and their general liability insurers. PRPs were seeking coverage for cleanup costs imposed by retroactive CERCLA liabilities under *Comprehensive General Liability* policies (CGL) issued several decades before on an occurrence basis.²⁴ Courts very often ruled in favor of policyholders, thereby shifting a relevant part of the remediation costs onto the insurance industry. As a result, however, substantial amounts of money

have been spent in litigation and other transaction costs, to the detriment of environmental protection.

Moreover, in consequence of the unpredictable development of case law with respect to the interpretation of insurance policy exclusions and conditions²⁵ a crisis hit the US environmental insurance market and very little pollution coverage has been available until the recent years. Both the rigorous features of the CERCLA liability regime and the early controversial case law on environmental insurance issues under CGL policies created an unbearable level of legal uncertainty, which discouraged the development of environmental pollution policies.

At present, environmental liability coverage is completely excluded from the standard CGL policy by the 1986 absolute pollution exclusion and it became available again under new specific contracts, issued on a claims made, manifestation, or discovery basis, with coverage often limited to bodily injury, property damages and response (cleanup) costs.²⁶ This positive trend can be explained by observing that courts' decisions are becoming more predictable, cleanup costs amounts are more steadily determined and some sort of legislative reform is expected. The provisions of CERCLA that appear to be under more serious scrutiny concern the retroactive nature of the liability regime (a feature that is not expressly stated in the Act), the limited scope of available defenses and the very severe joint and several standard. Moreover, since the US environmental regulatory framework is extremely sophisticated and strictly enforced, the insurance industry is able to offer to the regulated activities pollution insurance at reasonable prices,²⁷ by excluding coverage in case of violation of administrative standards. Except for *Resource Conservation and Recovery Act's* (RCRA)²⁸ financial requirements imposed on TDSFs (Hazardous treatment disposal and storage facilities)²⁹ and for the mandatory insurance coverage for underground storage tanks and marine damages caused by oil pollution, environmental insurance is generally not compulsory in the United States.

b) The German Environmental Liability Act of 1991 and the Federal Soil Protection Act of 1998

The Environmental Liability Act (*Umwelthaftungsgesetz*) was enacted in Germany in 1991. This statute imposes strict liability upon certain categories of industrial and commercial enterprises, listed in two appendixes to the Act,³⁰ for bodily injury and property damages caused by pollution incidents.³¹ The environment, therefore, receives indirect protection in the German civil liability regime and only specified types of listed activities are subject to the provisions of the 1991 Act.³²

Liability standards under the *Umwelthaftungsgesetz* are extremely severe: § 6 introduced a presumption of causation, which practically works – under certain circumstances – as a reversion of the burden of proof in favor of the plaintiff.³³ Liability is triggered also for damages caused during normal operations (*Normalbetrieb*) of a plant that is fully authorized and which is complying with all regulatory requirements.³⁴ In this case, however, the presumption of causation stated in § 6 does not operate.³⁵

Enterprises falling under the regime are also liable for the development risk (*Entwicklungsrisiko*). Besides, with a view to assuring the effectiveness of the system, the 1991 Act granted rights of information in favor of the injured parties (§ 8 Rights of Information *versus* plant owners – § 9 Right of Information *versus* the public authority), as well as in favor of the plant owners (§ 10).³⁶ Environmental liabilities under the Act are capped by § 15 at euro 85 million for death and bodily injuries and euro 85 million for property damages deriving from each release of pollutants.³⁷

The plants belonging to the categories listed in Appendix II to the Act (i.e. the most dangerous installations), eventually, must meet certain financial requirements, pursuant to §19. The compulsory insurance program for high-risk activities has not yet been fully implemented; however, following the enactment of the Act, a new environmental liability policy (HUK-Umwelthaft-Modell) has been offered on the German pollution insurance marketplace by the *Verband der Haftpflichtversicherer, Unfallversicherer, Autoversicherer und Rechtsschutzversicherer e.V.* (Huk-Verband), the German Association of Casualty Insurers.³⁸ Coverage is provided on a manifestation basis and tailor made on the prospective insured's needs: many different "bricks" of pollution coverage are offered under the policy, so that the insured can build up the wall of environmental protection more suited to fulfill his/her own particular needs (*Bausteinsystem*).

New rules concerning soil contamination and remediation have been enacted with the Federal Soil Protection Act (BSG) of 1998, entered into force on 1 March 1999. This federal statute provides uniform provisions concerning clean-up of contaminated sites in Germany. The Act introduced a public law regime based on strict liability which covers harm to land and associated damage to ground and surface waters. Liability for preventive and remediation measures falls on the causer of harm, his successor and current or past owners or occupiers. Apportionment involves joint and several liability in the form of a right of compensation or contribution from other liable parties.

The BSG introduced a mechanism for identifying, and monitoring hazardous sites, allocating responsibilities between the competent public authorities and liable parties. Special provisions, moreover, allow a form of contractual clean-up agreement to be submitted by the responsible parties for

approval by the authorities. In case of approval, the authority withholds any administrative order.

c) The Italian Law No. 349 of 1986 and the Legislative Decree No. 22 of 1997 (Ronchi Decree)

Law No. 349 of 8 July 1986 (*Istituzione del Ministero dell’Ambiente e norme in materia di danno ambientale*) introduced in Italy a private law regime aimed at granting direct protection to the environment. In fact, article 18 L. 349/86 imposes civil liability on the causer of pollution for damages to natural resources and the State is entitled to receive compensation on behalf of the citizens.³⁹

Liability for “environmental damage” is based on negligence and its scope is not limited to dangerous activities or classified installations. The release of pollutants or the other wrongful action that causes environmental damage must occur in violation of administrative rules and standards aimed at protecting the environment. The choice for a negligence standard, in spite of the dissenting opinion of legal scholars,⁴⁰ may be considered as a legacy of the “criminal” origins of the liability regime introduced by art.18 L. 349/86.⁴¹ At the very beginning, in fact, the Italian response to the ecological emergency followed the traditional criminal law approach to public policy issues.⁴² Relying substantially on the enforcement of previously determined administrative standards, the environmental liability provision contained in article 18 L. 349/86 resembles the sanctioning part of a centralized regulatory framework. In this perspective, it is not difficult to understand why liability is imposed on an individual basis.⁴³ Art. 18 comma VIII states that restoration of impaired resources (*i.e. restitution in integrum*) shall be granted as a remedy whenever it is materially possible, without the limit of “excessive hardship” set forth by art. 2058 of the Italian civil code. For the residual cases in which restoration is technically unfeasible, art. 18 comma VI sets forth several criteria to be employed by judges in the monetary evaluation of natural resource damages (NRDs). In light of the hybrid background of art. 18 L. 349/86, it is not surprising to find out that the degree of fault (⁴⁴) and the profit earned by the polluter from the violation of environmental norms shall be taken into account in determining the size of the monetary damages award.⁴⁵

Since 1986, Italian courts have rarely applied article 18 L. 349/86 and when they decided to do so, they managed to confuse even more an already troublesome situation.⁴⁶ Some courts have said that liability under this rule is triggered by the mere violation of environmental standards, even if there is no actual proof of damage to the environment.⁴⁷ The only two reported court decisions concerning the monetary evaluation of NRDs, rendered by *Pretore di Milano, sez. Rho* in 1989⁴⁸ and by *Tribunale di Venezia* in 2002,⁴⁹ do not provide much guidance in the application of the quantification criteria provided by

the law. Most recent decisions of the Italian Supreme court of cassation, eventually, stated that art. 18 L. 349/86 shall apply retroactively⁵⁰ and according to a strict liability standard.⁵¹ As a result, the level of legal uncertainty affecting environmental pollution risk in Italy became quite relevant and problematic.

In the recent years, moreover, Legislative Decree No. 22 of 5 February 1997 (Ronchi Decree) and the implementation guidelines enacted by Ministerial Decree No. 471 of 25 October 1999 introduced new important provisions on liability for soil contamination.

Pursuant to article 17 of the Ronchi Decree, in fact, anyone who causes land, surface or groundwater to exceed statutory contamination limits, or a significant and imminent threat of such harm, is obliged to pay for remedial action, to make the site safe, to clean up the pollutants and to restore the environment. Liability is strict and the polluter is also required to notify the local authorities immediately, who have the power to issue compulsory cleanup orders. Site owners who are not directly involved in the polluting activity bear the liability if the causer can not be made to pay, with the authorities imposing a first charge on the land if they are forced to carry out the work themselves.⁵² It shall be noted, furthermore, that article 58 Legislative Decree No. 152 of 11 May 1999 introduced similar obligations on the causer of water damage. It shall be noted that, in both cases, compulsory cleanup orders are backed by criminal sanctions (art. 58 Legislative Decree No. 152 of 11 May 1999 and art. 51 bis of the Ronchi Decree).

The various liability regimes concerning “environmental damage” in Italy (i.e.: Law No. 349 of 1986, Legislative Decree No. 22 of 1997 and Legislative Decree No. 152 of 1999) appear to be overlapping to some extent, as well as poorly coordinated and this generates additional legal uncertainty.

At present, the environmental liability policy offered by the Italian Environmental Insurance Pool (Pool R.C. Inquinamento) does not provide any coverage for on-site cleanup obligations imposed by the Ronchi Decree, nor for the “environmental damage”, as identified by art. 18 L. 349/86, with the limited exception of the costs of cleaning up impaired properties belonging to third party claimants. The Italian Pool, however, is currently working on a new draft policy, in order to provide coverage also for on-site remediation costs.

d) The proposal for a “Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage” presented by the Commission of the European Communities on January 23, 2002 [COM(2002) 17 final]

Following the White Paper on Environmental Liability of February 9, 2000,⁵³ the Commission of the European Communities presented on January 23, 2002

a proposal for a Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage [COM(2002) 17 final]. With this proposal, the Commission started to implement an action foreseen by the Sixth Environmental Action Programme.⁵⁴

The proposal is aimed at preventing and remedying “environmental damage”, defined for the purpose of the Directive as:

- a) biodiversity⁵⁵ damage, which is any damage⁵⁶ that has serious adverse effects on the conservation status of biodiversity;
- b) water damage, which is any damage that adversely affects the ecological status, ecological potential and/or chemical status of the waters⁵⁷ concerned to such an extent that this status will or is likely to deteriorate from one of the categories defined in Directive 2000/60/EC with the exception of adverse effects where Article 4(7) of Directive 2000/60/EC applies;
- c) land damage, which is any damage that creates serious potential or actual harm to public health as a result of soil and subsoil contamination.⁵⁸

Pursuant to article 4 of the Directive, where environmental damage has not yet occurred but there is an imminent threat of such damage occurring, the competent authority shall either require the operator⁵⁹ to take the necessary **preventive measures** or shall itself take such measures; without prejudice to any further action which could be required by the competent authority, member States shall provide that, when operators are aware of an imminent threat or ought to be aware of such an imminent threat, those operators are required to take the necessary measures to prevent environmental damage from occurring, without waiting for a request to do so by the competent authority. member States shall provide that where appropriate, and in any case whenever an imminent threat of environmental damage is not dispelled despite the preventive measures taken by the relevant operator, operators are to inform the competent authority of the situation. If the operator fails to comply with his obligations, the competent authority shall take the necessary preventive measures.

According to article 5, moreover, where environmental damage has occurred the competent authority shall either require the operator to take the necessary **restorative measures** or shall itself take such measures. If the operator fails to comply with a request issued, the competent authority shall take the necessary restorative measures. The necessary restorative measures shall be determined in accordance with Annex II.⁶⁰

Operators of certain dangerous activities listed in Annex I having caused an environmental damage are **strictly liable** for the costs of preventing and remedying the **environmental damage**. Operators of other activities are liable

for the costs of remedying **bio-diversity damage** (a component of the “environmental damage”), but only when they are found to be **negligent**.

Contrarily to the environmental liability regime previously envisaged by the White Paper of 2000, the current proposal for a Directive does not contemplate liability for “traditional damages” (i.e. bodily injuries, property damage and economic loss) caused by pollution; such damages, therefore, would continue to receive protection under the existing national laws.

As for the allocation of concurrent liabilities, the proposal states that where the competent authority is able to establish with a sufficient degree of plausibility and probability that one and the same instance of damage has been caused by the actions or omissions of several operators, member States may provide either that the relevant operators are to be held jointly and severally liable for that damage or that the competent authority is to apportion the share of the costs to be borne by each operator on a fair and reasonable basis. Operators who are able to establish the extent to which the damage results from their activities shall be required to bear only such costs as relate to that part of the damage.

It is very important to note that several limits to the scope of the environmental liability regime are clearly recognized and emphasized in the proposal. Such regime, in fact, **would not cover** environmental damage or imminent threats of such damage caused by **pollution of a widespread, diffuse character, where it is impossible to establish a causal link between the damage and the activities of certain individual operators**. Moreover, biodiversity damage, as defined above, does not include adverse effects which result from an **act by the operator which was expressly authorized** by the competent authorities.

The Directive shall also not cover environmental damage or an imminent threat of such damage caused by a) an act of armed conflict, hostilities, civil war or insurrection; b) a natural phenomenon of exceptional, inevitable and irresistible character; c) an emission or event allowed in applicable laws and regulations, or in the permit or authorization issued to the operator; d) emissions or activities which were not considered harmful according to the state of scientific and technical knowledge at the time when the emission was released or the activity took place (i.e. the development risk). The operators, moreover, shall not be liable for the cost of preventive or restorative measures taken when the environmental damage or imminent threat of such damage occurring is the result of a) an act done by a third party with intent to cause damage, and the damage or imminent threat in question resulted despite the fact that appropriate safety measures were in place; b) compliance with a compulsory order, instruction or other legally binding or compulsory measure emanating from a public authority.⁶¹

In order to assure an effective environmental protection mechanism even outside the scope of the liability regime, article 6 specifies that member States shall ensure that the necessary preventive or restorative measures are taken a) where it is not possible to identify the operator who caused the damage or the imminent threat of damage; b) where the operator can be identified but has insufficient financial means to take any of the necessary preventive or restorative measures; c) where the operator can be identified but has insufficient financial means to take all of the necessary preventive or restorative measures; or d) where the operator is not required under the Directive to bear the cost of the necessary preventive or restorative measures.

The competent authority shall be entitled to initiate cost recovery proceedings against the operator who has caused the damage or the imminent threat of damage in relation to any measures taken in pursuance of the Directive during a period of five years (limitation period) from the date on which the measures in question were effected.

Without prejudice to any investigation initiated by the competent authority of its own motion, persons adversely affected or likely to be adversely affected by environmental damage and qualified entities shall be entitled to submit to the competent authority any observations relating to instances of environmental damage of which they are aware and shall be entitled to request the competent authority to take action.

The proposed Directive does not contemplate any specific requirement to provide proof of insurance or other forms of adequate financial security. EU member States, however, are generally requested to encourage:

- the use by operators of any appropriate insurance or other forms of financial guarantee, in order to provide effective cover for obligations under the Directive;

and

- the development of appropriate insurance or other financial security instruments and markets by the appropriate economic and financial operators, including the financial services industry.

e) Summary of the trends in environmental legislations governing pollution risks

As announced in the introduction, for the purposes of this report the environmental pollution risk can be conceived as the risk of incurring legal liabilities for the consequences of environmental pollution phenomena.

We observed that the frontiers of environmental liabilities in OECD jurisdictions are rapidly expanding. An increasing number of potentially responsible parties is involved in private and/or public law regimes imposing

Table 1. **Environment pollution risk and insurance: a comparative overview of different legal approaches**

	Strict liability versus negligence	Additional features of the civil liability regime	Natural resources damages and biodiversity damage	Contaminated site cleanup costs obligations	Potentially responsible parties	Compulsory environmental insurance
UNITED STATES THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT OF 1980 (CERCLA)	STRICT LIABILITY	JOINT AND SEVERAL STANDARD, RETROACTIVITY.	YES, but rarely enforced. Traditional damages (death, bodily injury and property damage) are covered by common law (tort law) rules and not by CERCLA.	YES. The competent authority (EPA) has the power to issue compulsory cleanup orders.	An extremely broad category of parties listed in CERCLA § 107(a), including the present and past owners of the site.	NO. Insurance is not mandatory for liabilities under CERCLA. Other statutes require certain financial guarantees, among others for: disposal facilities; underground storage tanks; marine damages caused by oil pollution.
GERMANY THE ENVIRONMENTAL LIABILITY ACT OF 1991 (UHG) AND THE FEDERAL SOIL PROTECTION ACT (BSG) OF 1998	STRICT LIABILITY, both under the UHG and the BSG.	JOINT AND SEVERAL (UHG and BSG). PRESUMPTION OF CAUSATION (§ 6 UHG). Liability also for damages caused during NORMAL OPERATIONS of a fully authorized activity (UHG).	NO. The UHG covers ONLY TRADITIONAL DAMAGES: death, bodily injury and property damages caused by environmental pollution. Liabilities are capped (UHG § 15).	YES. Under the 1998 BSG, the competent authority has the power to issue compulsory cleanup orders.	Under the 1991 UHG: only those dangerous activities listed in the appendixes to the Act. Under the 1998 BSG: anyone who causes the harm, his successor and the current or past owners or occupiers of the site.	YES, environmental insurance is mandatory for the most dangerous activities listed in Appendix II to the 1991 Act (UHG § 19). The compulsory insurance scheme has not been fully enforced yet.
ITALY LAW N. 349 OF 1986 AND LEGISLATIVE DECREE N. 22 OF 1997 (RONCHI DECREE)	NEGLIGENCE (art. 18, L.349/86). Case law, however, enforced a stricter liability regime against operators of dangerous activities, pursuant to art. 2050 of the civil code. STRICT LIABILITY (D.22/97)	Under art. 18, L.349/86: liability for environmental harm is INDIVIDUAL and LINKED TO THE VIOLATION OF ANOTHER NORM aimed at protecting the environment. Recent Italian case law, however, enforced civil liability for environmental harm on a RETROACTIVE and JOINT AND SEVERAL basis.	YES, under L.349/86, but very rarely enforced. Traditional damages (death, bodily injury and property damage) are covered under different rules, among which: articles 2043 ff. of the civil code.	YES, both under L.349/86 and D.22/97. Under D.22/97, the competent authority has the power to issue compulsory cleanup orders.	L.349/86: anyone who causes damage to the environment in violation of another protective rule. D.22/97: anyone who causes land, surface or groundwater to exceed statutory contamination limits, or a significant and imminent threat of such harm. Site owners who are not involved in the polluting activity bear the liability if the causer can not be made to pay.	NO.

Table 1. **Environment pollution risk and insurance: a comparative overview of different legal approaches** (cont.)

	Strict liability versus negligence	Additional features of the civil liability regime	Natural resources damages and biodiversity damage	Contaminated site cleanup costs obligations	Potentially responsible parties	Compulsory environmental insurance
EUROPEAN UNION THE PROPOSAL FOR A DIRECTIVE ON ENVIRONMENTAL LIABILITY OF JAN. 23, 2002 [COM(2002)17/FINAL]	STRICT LIABILITY for operators of dangerous activities listed in Annex 1. NEGLIGENCE for all other parties, but in this case liability is limited to biodiversity damage.	Choice between a JOINT AND SEVERAL and an INDIVIDUAL standard. NO RETROACTIVITY. No liability for DIFFUSE POLLUTION, nor for the effects of AUTHORIZED EMISSIONS. No liability for DEVELOPMENT RISK.	YES. The definition of ENVIRONMENTAL DAMAGE includes: BIODIVERSITY damage, WATER damage and LAND damage. Traditional damages (death, bodily injury and property damage) are NOT COVERED by the proposal.	YES. The competent authority shall have the power to issue compulsory cleanup orders, but LAND DAMAGE triggers liability ONLY IF soil contamination creates serious potential or actual HARM TO PUBLIC HEALTH.	As for ENVIRONMENTAL DAMAGE: only the operators of dangerous activities listed in Annex 1. As for BIODIVERSITY DAMAGE: anyone who causes serious adverse effects on the conservation status of biodiversity.	NO. The importance of financial security is acknowledged by the Commission, but environmental insurance or other guarantees are not made compulsory by the proposed regime.

the obligation to compensate for different types of harmful consequences caused by the release of pollutants in the environment.

New private law rules on civil liability for “environmental damage” (i.e. natural resources damages and remediation costs) have been enacted in a number of legal systems, in order to supplement or replace the existing rules covering “traditional damages” (i.e. bodily injury, property damages and economic losses) caused by pollution. The formal obligations to pay monetary damages as compensation for injuries to the environment (NRDs), in any event, have been seldom enforced.⁶²

In modern environmental statutes, the liability of operators of potentially dangerous activities is generally strict, with limited defenses, and the burden of proving causation is often relaxed or reversed.

With respect to soil and water contamination, moreover, the general trend appears to be towards the enactment of public law schemes (or mixed schemes) within which a competent authority is entrusted with the power to issue compulsory cleanup orders against polluters, backed by the threat of severe criminal and/or administrative sanctions for non-compliance. In several jurisdictions, finally, liability for the costs of the preventive and remediation measures often falls also on the owners or occupiers of the polluted site, at least to a certain extent.

The recent proposal for a European Directive on environmental liability with regard to the prevention and remedying of environmental damage incorporates some of these trends, even if it shows some relevant distinctive features.

Allocating the risk of environmental pollution by way of liability rules enforced in civil or administrative proceedings may prove to be an effective mean:

- to fully comply with the **polluter pays principle** (which is one of the OECD Guiding Principles Concerning International Economic Aspects of Environmental Policies) and
- to reach efficient levels of **compensation** and **deterrence**.

However, it is important to bear in mind that the efficacy of any liability mechanism may be impaired by the potential insolvency of the responsible parties. If after the environmental accident the polluter has no assets to compensate for the damage caused, the whole system of environmental liability would collapse and the overall result would be an additional waste of resources invested in litigation. In light of the above, insurance and reinsurance may be called upon to play a crucial role in the effective management of environmental pollution risks.

5. Environmental pollution risk and insurance: factual uncertainty

The environmental pollution risk, nevertheless, presents many difficulties to the insurance industry, especially with respect to the so-called **gradual pollution** phenomena characterized by:

- **factual uncertainty** and
- **long terms effects** (giving rise to long-tail liabilities).

As outlined in Chapter 1 of this report, insurance is able to perform its functions correctly under specific conditions of uncertainty. Environmental pollution risk is quite peculiar, since it includes components of both **factual and legal uncertainty**. This is true particularly when we consider gradual pollution events which develops slowly and secretly over a long period of time and whose damaging effects may become apparent only after several years, or even decades.

In this respect, environmental pollution risk insurability may be hindered by severe problems of **asymmetrical information** as well as of **generalized uncertainty**.

Due to the complexity of modern production technologies, problems of **adverse selection**⁶³ are widely present in this field, whenever the insurer is not able to perform accurate risk classification. **Moral hazard** phenomena⁶⁴ are also seriously involved with respect to the environmental pollution risk: it is easy to understand how the owners and operators of high-risk installation could erroneously perceive the insurance coverage as a sort of perpetual “license to pollute”, bought in exchange for payment of an annual insurance premium.

In order to cope with these problems, professional risk-carriers need to develop and employ new **monitoring and bonding devices**.

Gradual pollution events also present relevant aspects of **generalized factual uncertainty**: in most cases, pollution develops unnoticed and insidiously over a substantial period of time and it is very difficult to determine when it began and how long it lasted.

The latency and the long terms effects characterizing gradual pollution phenomena, therefore, raise questions as to the adequacy of traditional **trigger-of-coverage** clauses, such as the “act committed” or the “loss occurrence” triggers. According to the “act-committed” formula, the wrongful act must have taken place during the period of validity of the liability policy, while under the “loss occurrence” clause, the injury or loss caused by the wrongful act must have occurred during the said period. Such clauses are able to work properly with respect to sudden events, but they are completely inappropriate with respect to the gradual environmental pollution risk.

If, for example, certain toxic substances are slowly but continuously seeping out of a tank, it might be extremely difficult – if not even impossible – to establish the exact moment in which the release began and how long it lasted; it may also be hard to establish the precise timing in which the consequent environmental harm occurred (i.e. the timing in which the threshold concentration of hazardous substances in soil or water is exceeded). Since the triggering events cannot be assigned to a particular point in time, determining the existence and validity of insurance coverage under the traditional formulas becomes quite problematic. Furthermore, even if it could be established that coverage is provided under a liability policy issued several years ago, it may well be the case that the limits of coverage properly stipulated at that time have become totally inadequate, due to the ongoing depreciation of money.

Factual uncertainty also regards the potentially damaging effects of new technologies and substances: in other words, the relevance of the so called **development risk** plays a great role in this context.⁶⁵ Synergetic pollution, finally, is a quite common phenomenon and it is often difficult to identify and separate single contributions.

These peculiar features of the environmental pollution risk are common to every legal system and they can explain why, at present, this risk is almost everywhere excluded from general liability insurance and gradual pollution coverage is provided only under very specific policies and according to limited terms and conditions.

6. Environmental liability risk and insurance: legal uncertainty

What differentiates the situation in the various jurisdictions is the **level of legal uncertainty**. This variable represents the level of generalized uncertainty introduced by the legal system itself and basically depends on:

- a) the way in which legal rules (i.e. the environmental liability regime) are designed by the legislative authorities;
- b) the way in which those legal rules and propositions are interpreted and applied by legal actors (governmental agencies, local authorities, judges, scholars, etc.) in a given institutional framework.

Environmental pollution risk is, for the insurance industry, a risk of liability and the **choices made by law and policy makers greatly affect risk insurability**. The domain of risk insurability is limited. If generalized uncertainty – being it factual, or legal, or both – become excessive, then insurance will become a mere gamble: the unpredictability of losses, in fact, will prevent the prospective risk-carrier from performing effectively his/her statistical calculus of probabilities. In such a situation, insurers may change their attitude towards risk, moving from risk neutrality to risk aversion. This, of course, would undermine the very basis of the whole insurance mechanism.

As mentioned, the **level of legal uncertainty** may be detected from two different perspectives: *a)* on one hand we have to consider specific features of the environmental liability regime adopted in a given legal system and *b)* on the other we have to test the intrinsic coherence of each legal formant as well as the coherence among different formative parts of that system.⁶⁶

a) Features of the liability regime

As regards the first component of the **level of legal uncertainty**, the general trend towards the enactment of strict liability regimes for environmental pollution does not constitute a problem in terms of insurability; on the contrary, the use of a negligence standard could cause troubles, since it may be interpreted as reflecting a punitive character that is not immediately reconcilable with the transfer of liability to the insurer.

Retroactive regimes are incompatible both with the basic idea that environmental liabilities should be aimed at providing appropriate incentive to potential polluters and with the very nature of the insurance mechanism.⁶⁷

With respect to the criteria for allocating liabilities among multiple polluters, a joint and several standard may create excessive uncertainty, because the risk carrier would have to compute not only the risk created by the prospective insured, but also the risks generated by all the other actors whose conduct may eventually combine with the one of the insured in the causation a polluting event. The insurer, moreover, would bear the risk of insolvency of these other subjects, without being able to monitor or control them. Such problem would notably increase the cost of insurance. Hence, an individual (proportional) standard would seem to be much more appropriate, if insurability issues are taken into serious consideration.

Rules aimed at waiving, alleviating or reversing the burden of proving causation are also problematic for analogous reasons and, in this perspective, liability does not seem to be an appropriate mechanism for the social allocation of risks and costs associated with diffuse and widespread pollution.

With reference to direct protection schemes and, more specifically, to environmental liability regimes that allow for recovery of monetary compensation for NRDs and/or biodiversity damage, the level of legal uncertainty is also negatively affected by the controversial criteria that are employed in order to place a value on reduced biodiversity and impaired natural resources that cannot be fully restored to the pre-existing conditions. As already mentioned, these values may be highly subjective, as well as very difficult to determine, since there are no well established and recognized economic guidelines. On the other hand, at present the costs of cleaning up polluted sites seem to be much more easily assessable and predictable than NRDs, since they depend on technical standards and operations.⁶⁸

The potential overlap between cost recovery actions under civil liability regimes and the authoritative enforcement of a public law scheme may also generate confusion and increase the level of legal uncertainty.

In this regard, the recent proposal for a Directive of the European Parliament and of the Council on environmental liability appears problematic in many aspects, since it introduces elements of increased legal complexity. The proposed regime, for example, would cover land contamination, but only those cases in which it creates serious potential or actual harm to public health, according to the definition of “environmental damage” offered by Article 2(18). The concept of biodiversity damages, moreover, is broadly conceived and the actual economic scope of the obligations falling on responsible parties, notwithstanding the relevant efforts put by the Commission, is still far from clear;⁶⁹ with respect to biodiversity damage and the issue of its full insurability, moreover, it seems that the proposal is based on assumptions⁷⁰ that do not correspond to the reality of insurance practice.⁷¹

From a broader perspective, the complex relationship that would be established between the harmonized rules and the existing national regimes raises questions as to the certainty and predictability of the resulting general legal framework.

If the **insurability of environmental pollution risks is considered as an important feature of modern environmental legislations**,⁷² therefore, the outlined concerns should be carefully taken into account. As long as the scope and economic consequences of environmental liabilities, be they civil or administrative, are highly unpredictable *ex ante*, in fact, the insurance industry will not be capable of assessing and managing environmental pollution risks and, therefore, it will not be willing and able to offer reasonably priced coverage.⁷³

b) On legal formants and incoherence: a complex analysis

In order to detect the second variable which affects the **level of legal uncertainty**, it is necessary to look at the way in which a given legal system actually works. The above mentioned notion of legal formants is fundamental to this layered analysis.⁷⁴ In every legal system, what is written in a statute may sometimes differ remarkably from the judgments of the courts on the same legal issue. The rule formally announced by the court in its opinion may turn out to be incompatible with the actual outcome of the case.⁷⁵

In the Italian legal system, for example, negligence is formally stated by Law 349/86 as the governing standard for environmental liabilities, but recent decisions of the Supreme court of cassation tend to enforce a strict liability regime instead, on the argument that article 2050 of the Italian civil code, concerning strict liability for dangerous activities, still applies.⁷⁶ Retroactivity

is not a feature that formally characterizes the Italian environmental liability statutes, but, again, some recent court decisions affirmed the opposite principle, based on a constitutional oriented interpretation of the relevant norms. The only two reported court decisions on the issue of monetary evaluation of NRDs in Italy⁷⁷ appear to be completely arbitrary and they do not provide any clear guidance for the future implementation of the criteria set forth in art. 18 comma VI of Law 349/86. Due to analogous problems, in the United States the provision of CERCLA regarding NRDs,⁷⁸ while being currently in force, has been seldom enforced by courts.

Those evidences of incoherence among legal formants greatly affect the **level of legal uncertainty**, introducing elements of destabilization that may undermine the development of a pollution insurance market.

7. Modern environmental liability insurance approaches

a) Integrated risk management approach through differentiation

In response to the outlined problematic factual features of environmental pollution risk, the insurance industry has developed new techniques to cope with this peculiar phenomenon.

As anticipated in Chapter 1 of this report, the traditional insurance mechanism works on a four phases basis: 1. risk assessment, 2. risk transferring, 3. risk pooling, 4. risk allocation. The insurer tends to remain external to the situation assessed in the first step, merely accepting or refusing to undertake a given risk. In modern environmental insurance, instead, professional risk-carriers have the knowledge and technical abilities needed to actively intervene on the risk features during a new phase, which can be named: **risk remodeling**, taking place before the transfer of risk.

At present, **pollution risk coverage** is almost completely excluded from general liability policies⁷⁹ and it is provided under separate contracts on a **site-specific** basis. The modern philosophy of ecological insurance requires an extremely **careful evaluation and classification** of the risk to be transferred. To this purpose, detailed historical information and technical data concerning the prospective insured's premises are collected through a preliminary questionnaire. A comprehensive inspection of the industrial installation is then performed on behalf of the insurance company by a team of qualified engineers. In addition to the evaluation of the adequacy of safety measures, protection systems and emergency plans, certain features of the surrounding area are also assessed. In this respect, several elements are taken into account, including: the density and size of population in the vicinity, the type of buildings, facilities and installations, the conditions related to emission carriers, including soil permeability, groundwater levels, the direction of

winds and, in general, all the geological, hydrological and atmospheric conditions of the area.

As soon as the risk is properly assessed – if the minimal safety requirements are met – the risk carrier will cooperate, in a new phase, with the prospective insured, in order to reduce the risk and to **enhance loss prevention strategies**.

Such feature plays a very important role in this field: **prevention of environmental harm should always be among the primary goals of every ecological policy**.⁸⁰ Even if the existence of an adequate insurance coverage may give effect *ex post* to the deterrence and compensation functions of environmental liabilities, it could easily be the case that impaired natural resources are unique and not replaceable or repairable; loss prevention, therefore, acquires great importance. Moreover, it has been pointed out that *ex ante* prevention systems have the clear advantage of reducing total risk.⁸¹

After this “risk remodeling” phase, in which cooperation between the insurer and the insured is fundamental, **pollution coverage is tailored** on the insured’s needs and it should be provided by the risk carrier on a **long term basis**. A long term contractual commitment is needed by both parties, since environmental pollution coverage is offered under new trigger-of-coverage formulas such as:

- **claims made**⁸² and
- **manifestation/discovery**.⁸³

Such trigger formulas have the effect to limit coverage in time,⁸⁴ in order to overcome the mentioned problems concerning the latency of gradual pollution phenomena and the consequent long-tail nature of environmental legal liabilities.⁸⁵ Moreover, a stable relationship is essential to justify the reciprocal investments in cooperation. In this way, the insurer would participate with his/her **expertise and technical knowledge** in the development of each customer’s risk-management strategy.

During the entire period in which the contractual relationship is in force, the risk carrier will closely monitor the insured’s activity in order to prevent the negative effects of moral hazard. Moreover, additional investments in precautions and safety devices may be rewarded by the insurer with a reduction in the annual premium and/or with a broader coverage, thereby enacting and implementing a flexible mechanism of **private surrogate regulation**.⁸⁶

The point just made, therefore, lines up with the broader perspective that considers the opportunity to conceive liability insurers, in various instances, as efficient regulators of the practice of their customers.⁸⁷

Furthermore, with a view to strengthening the relationship, in addition to loss prevention consultancy and financial coverage, several insurers recently

started to offer integrated services to their policyholder, the most important of which is **crisis management**. An effective crisis management service is very much appreciated by those policyholders that do not have experience in promptly reacting to the insured events (e.g. a release of toxic substance into the environment) and it may also help the insurance company to substantially reduce the total costs of covered claims.

b) Increased market capacity through pollution insurance pools

The current market capacity for environmental pollution risk is limited, due to the outlined peculiar factual and legal feature of the risk and because of the potential for catastrophic consequences. In this regard, it is interesting to note that in a number of European countries, insurance and reinsurance companies have formed Pools in order to aggregate capacity, develop new insurance products and share information and statistical data. The following Pools are currently in operation:

- **FRANCE:** Assurpol.
- **ITALY:** Pool RC Inquinamento.
- **SPAIN:** Pool Español de Riesgos Medioambientales.
- **THE NETHERLANDS:** Nederlandse Milieupool.

c) Different products for different needs

As discussed in the previous sections, the boundaries of environmental liabilities in OECD countries are expanding: an increasing number of responsible parties are called upon to comply with several remedial obligations. From an insurance point of view, therefore, a correct approach to the pollution risks entails the need for some technical distinctions. In particular, it seems important to distinguish between:

- **First party and third party coverages.**
- **Known and unknown pollution conditions.**
- **On site and off site contamination.**

Insurers are moving away from using traditional policies and conventional tools for assessing environmental exposures because they may provide inadequate cover. In the recent years, the international environmental insurance sector has developed **several types of new products** aimed at meeting different needs, taking into account that often businesses and site owners must assume **the costs of cleaning up their own polluted sites**, as well as others that may have been contaminated by their activities. The most important types of coverage are:

- **Environmental liability policy (EIL).** Under this label, it is frequently offered a third-party coverage for damages caused to third parties claimants by

pollution conditions originating from the insured plant, including mitigation costs. This type of policy, also marketed as Pollution Legal Liability policy (PLL), is written on a claims-made, manifestation or discovery basis and it generally excludes NRDs, biodiversity damages and the on-site cleanup obligations mandated by the competent authority.

- **Coverage for on-site cleanup liability.** This type of policy offers a first-party environmental remediation coverage for the risk of incurring on-site cleanup obligations, generally excluded from the EIL policy (it shall be noted that, sometimes, EIL and PLL policies contain a first-party extension of coverage for on-site cleanup costs).
- **Cleanup cost cap policy (brownfield site).** This type of coverage can be purchased when a claim requiring the insured to incur cleanup costs has already been made. It usually covers remediation cost overruns and other cost increases resulting from unexpected factors such as unknown or undiscovered contamination, poor remedial technology performance, regulatory changes and natural disasters, up to a limit beyond a self-insured retention. It is, therefore, designed to address the risk and uncertainty associated with beginning or continuing an environmental remediation project.
- **Contractors pollution legal liability.** This type of policy indemnifies the insured for claims and liabilities resulting from pollution conditions arising from the insured's performance of contracting operations, including contaminated soil and hazardous waste remediation works.
- **Transportation coverage.** This policy is aimed at covering the risks associated with accidents that may occur during the transportation of hazardous substances.
- **Environmental coverage for landfills.** Several hybrid insurance/financial products are currently in course of development in order to meet the special needs of landfill operators: of particular concern is the fact that their responsibilities extend far beyond the time when the landfill ceases operations. Financial protection is therefore needed for the closure and post-closure phases.⁸⁸

As mentioned, some professional risk carriers offer the possibility to combine different coverages in a single tailor made insurance policy. In this respect, one of the most interesting and innovative product is the environmental coverage offered in The Netherlands by the Nederlandse Milieupool. Presented in 1998, this policy consists of an integrated environmental insurance package with several options, combining first party insurance for on-site remediation obligations and a direct coverage (not liability coverage) for damages caused by pollution to third parties, who are therefore entitled to seek indemnification directly from the insurance company that issued the policy to the polluter.⁸⁹

d) Alternative risk transfer (ART)/Alternative risk financing (ARF) methods

At present, moreover, an alternative to insurance products for the financial management of environmental pollution risks is offered by several ART/ARF products that can be tailored on the special needs of the insured. The most important are:

- **Captive insurance companies.** Captives are insurance companies formed to insure the risk of its parent corporation. A captive may be formed for a variety of reasons, including tax benefits, improved investment returns, or – as for the case of certain environmental pollution risks- the lack of other insurance alternatives. This solution, of course, is available only to large enterprises.
- **Finite risk products.** Finite risk transfer insurance is a mechanism aimed at transferring financial liabilities associated with contaminated sites from the legally responsible party (i.e. the owner or occupier) to a professional risk carrier. The insurance company agrees to assume the cleanup obligation and to conduct the remediation work on behalf of the insured. The policy addresses both known and potential unknown site conditions up to a maximum amount (limit) for predetermined period of time.
- **Loss portfolio transfers (buyouts).** A Loss Portfolio Transfer agreement (LPT) is a buyout of retained liabilities. The LPT converts unknown future liabilities to a present day fixed price. Liabilities are quantified and sold to an insurance company that assumes responsibility for future payment of the liabilities, as defined under the insurance policy. LPTs are retrospective in nature, as they involve the transfer of incurred losses.

These financial instruments are often employed to cope with the uncertainty related to the scope and extent of environmental liability exposures in corporate mergers, acquisitions and real estate transactions.

e) Statement of Environmental Commitment of the Insurance Industry

In the recent years, participants in the insurance sector began to play an eminent pro-active role in the environmental arena, voicing their concerns and interests in public and committing themselves to the Principles of Sustainable Development affirmed in the 1992 Rio Declaration on Environment and Development.

Under the auspices of the United Nations Environmental Programme,⁹⁰ a “Statement of Environmental Commitment”⁹¹ was signed in a ceremony at the UN offices in Geneva by 17 leading insurance companies on November 23, 1995. At present, 88 insurance companies (plus 3 associated members) from 26 countries joined the initiative by signing the *Statement* and the number of participants is constantly increasing.

In this significant document, the general principles of sustainable development⁹² are fully recognized and translated into a commitment towards environmental protection by means of insurance practice, risk management strategies and loss prevention.⁹³

8. Environmental risk and insurance: a problem of incentives

In light of this modern and innovative attitude adopted by the industry, insurance seems to be an appropriate legal and economic tool available to complement both the liability system and the regulatory framework with respect to the environmental pollution risk.

Modern environmental insurance would in fact solve, at least partially,⁹⁴ the judgment proof (insolvency) problem that potentially undermines the effectiveness of any environmental liability regime and it would also increase loss prevention, by stimulating the adoption of tailored safety measures.

At present, however, it can be empirically observed that environmental insurance is not widespread at all. Gradual pollution coverage is often perceived as too costly by the industry and most firms do not decide to insure against environmental risks spontaneously.

The cost of environmental insurance policies is affected by the complexity of the new techniques outlined, by the factual features of the risk itself⁹⁵ and by the level of legal uncertainty. As a general rule, the prospective insured has to bear the costs of site inspections and technical analyses, costs that could be considerable if the insured has several premises. Moreover, many companies are very reserved about their properties, since most public law schemes dealing with soil contamination made it compulsory to immediately inform the competent authorities, should the site inspection reveal any pollution on the insured's premises.

Another explanation of the difficulties experienced by most insurers in marketing environmental liability policies and other pollution coverages can be found in the fact that gradual pollution risk is often a low probability/high consequences risk (LPHC) and, generally, such risks are not rationally faced by economic actors: they can be easily underestimated or even ignored.⁹⁶

Even from a pure rational choice theory point of view, moreover, the limited liability structure of corporations introduces significant distortions in the picture and it may alter the proper incentives mechanism.⁹⁷ Given the magnitude of potential losses associated with polluting events, in fact, it might often be the case that the amount of the expected damage greatly exceeds the limited financial exposure of the liable party (i.e. the polluter).

Another phenomenon that widely occurs is the following: after the plant has passed the insurability inspection performed by the risk-carrier's

engineers, the prospective insured refuses to purchase coverage because he/she feels that his/her activity is safe enough. Of course, the fact that a plant is insurable does not mean that it is completely safe and that an accident will never occur. The satisfactory results of the inspection, instead, merely indicate that the risk posed by that particular installation presents the characteristics of predictability that allow a professional risk carrier to undertake it. In any event, many firms have clearly stated that they will not buy pollution coverage unless they are obliged to do so.

9. Compulsory environmental liability insurance?

Further to the above considerations, a system of **mandatory pollution insurance** – at least for those activities that are particularly dangerous for the environment – might seem to be the appropriate solution. Even this conclusion, nevertheless, turns out to be, in practice, rather problematic.

A system of compulsory insurance can be bilateral or unilateral. In the former case, the firm has the obligation to buy coverage in order to be allowed to operate and the insurance industry has the obligation to provide coverage at pre-determined conditions, approved by the authority, to each and every applicant. Bilateral mandatory pollution insurance, however, is **incompatible with the very nature of modern environmental insurance techniques**. As mentioned, environmental policies are tailor-made and site-specific and not every plant necessarily has all those characteristics that make it insurable. Standard conditions set by legislature and applicable to every insured, moreover, would drag pollution insurance back to the traditional standardized scheme, which proved to be highly inappropriate in this context. A regime of bilateral compulsory insurance, moreover, may be quite problematic if certain defences based on the insurance contract (in particular: exclusions and conditions of coverage, such as regulatory compliance, etc.) are not opposable to the third party claimant and the insurance company is therefore forced to pay and bear the risk of insolvency of its insured.

As long as unilateral mandatory insurance is concerned, purchase of pollution coverage is still a condition to operate for the firms, but insurers do not have any obligation and they may, therefore, refuse coverage to anyone at their own discretion. In this latter case, the enhanced incentive mechanism provided by modern environmental insurance would be able to work properly, but the insurance industry would be placed in the uncomfortable and inappropriate position of **environmental policeman**. In fact, the insurer would be entrusted with the power to decide which firms can continue their activity and which should, instead, withdraw from the market.⁹⁸ This is a policy choice that the authority has to make.

The question of compulsory insurance, in any event, must be examined taking the degree of market maturity and the homogeneous character of the risk to be insured into account: products developed to date vary from one market to another and a single product at European level is difficult to envisage at the moment. It should be clear, however, that a strict environmental liability regime, without any requirement for financial security, can easily turn out to be completely ineffective and it may just lead to an increase in litigation and transaction costs.

10. Financial security: possible alternatives

Insurance is not the only way to provide adequate financial guarantee with respect to the environmental pollution risk. There exist, in fact, a variety of other financial instruments that could be employed, including:

- Guarantee issued by a bank or another financial institution.
- Personal or collateral security.
- Deposit paid in advance on an environmental account.

Instead of establishing a compulsory environmental insurance regime, therefore, the introduction of an obligation to provide financial security in any form approved by the competent authority may turn out to be a viable way to overcome the insolvency problems.⁹⁹ In this perspective, insurance would become just one of the possible ways to comply with a flexible financial guarantee obligation and competition among different forms of financial security would be highly stimulated by such a regime.

11. Compensation for historic pollution, diffuse pollution and orphan shares. Limits of the liability regime

As already pointed out, the social allocation of pollution risks and costs by way of an environmental liability regime does not appear to be appropriate in certain situations. In particular, a liability regime should certainly not cover:

- Historic pollution.
- Pollution for which a causal relation to a responsible party cannot be established.
- The cumulative effect of authorized emissions.

For residual pollution damages falling in the above categories, as well as for the cases in which a responsible party under the liability regime cannot be identified or is insolvent (orphaned liabilities), other compensation mechanisms should be designed. The public authority (*i.e.* the State) may be ultimately responsible for such costs, so to minimize the distortion provoked by any redistribution policy, or some sort of compensation fund may be established and maintained.¹⁰⁰

In this respect, the significant experience with the functioning of the **Superfund** established in the **United States** by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 is a prominent example of possible advantages and disadvantages.

The new **Environmental Damage Insurance Act** (81/1998), which came into force in **Finland** on 1 January 1999, is another interesting example. The act creates a fund whose aim is to guarantee full compensation for environmental damage, including the costs of measures taken to prevent or limit the damage and to restore the environment to its previous state, in cases where those liable for compensation are insolvent, or the liable party cannot be identified (i.e. the orphan shares under the Environmental Damage Act of 1994). The scheme is financed by special insurance which is compulsory for the operators of high risk activities subject to a regime of environmental operating permits.

Sweden has a similar system based on Chapter 33 (Environmental damage insurance and environmental clean-up insurance) of the new **Swedish Environmental Code**. Persons who pursue environmentally hazardous activities for which a permit must be obtained or notification submitted are required to pay contributions to the insurance scheme. If environmental damage insurance or environmental clean-up insurance contributions are not paid within thirty days of the date of demand, the insurer is obliged to report the nonpayment to the supervisory authority that may issue a compliance order backed by the threat of a fine. Compensation is paid out of the environmental damage insurance, in accordance with the relevant terms and conditions, to claimants for bodily injury and material damage, where: 1. the liable party is insolvent or the right to demand compensation has lapsed; or 2. it cannot be established who is liable for the injury or damage. Compensation is paid out of the environmental clean-up insurance for any costs for clean-up that are incurred in consequence of an authority's request, where the person who is liable pursuant to the Environmental Code is not able to pay.

12. Policy conclusions

The theoretical analysis and the comparative overview conducted in this chapter of the report are aimed to show some of the most problematic features of environmental pollution risk, as well as the recent and innovative responses of the international insurance industry. They are also aimed at pointing out the way in which different legal frameworks may affect pollution risk insurability and the development of effective risk management strategies.

These issues are currently of great concern, since modern **environmental insurance** seems to have the potential to become a very effective complement to liability and regulation in this field:

- ecological insurance, in fact, would give effect to the **compensation** function of any environmental liability regime, providing the injured parties with a reliable source of funds when pollution occurs;
- moreover, with a view to reducing the risk of a polluting event, the insurer may act as a **private surrogate regulator**, thereby aligning the interests of the insured with the most advanced environmental safety concerns;
- furthermore, by forcing the *ex ante* **internalization of environmental costs** through the payment of premiums, environmental insurance proves to be fully compatible with the **deterrence** goal of any liability regime and also with the **polluter pays principle**.

In order to encourage and stimulate the development and growth of the pollution insurance market, law and policy makers should put their best efforts in circumscribing, limiting and defining with a sufficient level of clarity and predictability the financial risks associated with environmental pollution liabilities. *Ex ante* regulation of environmentally dangerous activities also plays a fundamental role, as the public authority should be able to guarantee the enforcement of up-to-date safety and protection standards. Moreover, the enactment of rules mandating the responsibility for provision of adequate financial security, in a form to be approved by the competent authority, seems highly advisable, with a view to preventing the risk of insolvency. If pollution insurance turned out to be a competitive way to comply with this financial requirement, then the socially beneficial effects of modern environmental insurance could be appreciated to a full extent. For residual pollution damages falling outside the scope of the liability regime, as well as for the cases in which a responsible party cannot be identified, or the financial guarantees have been exhausted (orphaned liabilities), the public authority should be ultimately responsible for setting up of a complementary no-fault environmental compensation scheme, aimed at guaranteeing adequate funding for expedite pollution remediation.

Notes

1. See *e.g.*: R. Posner, *Economic Analysis of Law*, 4th ed., 1992; R. Cooter and T. Ulen, *Law and Economics*, 2nd ed., 1996; A. M. Polinsky, *An Introduction to Law and Economics*, 2nd ed., 1989; D. Barnes and L. Stout, *Cases and Materials on Law and Economics*, 1992; Trimarchi P. (1961), *Rischio e responsabilità oggettiva*, Milano: Giuffrè.
2. See *e.g.*: the “Rio Declaration on Environment and Development” of June 1992.

3. See: G. Calabresi (1970), *The cost of the accidents*, Yale University Press; for a comparative perspective see also: U. Mattei, *Tutela Inibitoria e Tutela Risarcitoria*, Milano, 1987; Id., "I modelli nella tutela dell'ambiente", in *Riv. dir. civ.* 1985, II, 389.
4. See: S. Shavell, "The Judgment Proof Problem", 6 *Int. Rev. Law and Econ.* 1986, 45-58.
5. See: M. Trebilcock and R. A. Winter, "The Economics of Nuclear Accident Law", 17 *Int. Rev. Law and Econ.*, 1997, 215-243; S. Shavell, "Liability for Harm versus Regulation of Safety", 13 *Journal of Legal Studies* 1984, 357 ff.; C. Kolstad, T. Ulen, G.V. Johnson, "Ex post Liability for Harm vs. ex ante Safety Regulation: Substitutes or Complements?", 80 *American Economic Review*, 1990, 888-901.
6. Shavell, S. (1980), *Strict Liability Versus Negligence*, 9 *Journal of Legal Studies* 1980, 1.
7. Shavell, S. (1987), *Economic Analysis of Accident Law*, Harvard University Press.
8. "The failing of the negligence rule that is under discussion can be regarded as resulting from an implicit assumption that the standard of behavior used to determine negligence is defined only in terms of care. Were the standard defined also in terms of the activity level, injurers would make sure not to engage in their activity to an excessive extent" Shavell, S. (1987), *Economic Analysis of Accident Law*, 25.
9. See: Trimarchi, P. (1961), *Rischio e responsabilità oggettiva*, Milano: Giuffrè.
10. "If a fault-based liability regime is applied to environmental damage, claimants find themselves in an impossible position from an *evidentiary* point of view, for reasons not unlike those raised in connection with product liability: the acts or omissions which may have been at the origin of the damage lie fully within the sphere of control of the defendant. It would thus seem logical to put environmental damage under a regime of liability not based on fault, or at the very least to reverse the burden of proof as regards fault." Gerven, Walter van; Lever, Jeremy; Larouche, Pierre, *Tort law. Cases, materials and text on national, supranational and international tort law. (Ius commune casebooks for the Common law of Europe)* Oxford; Portland: Hart, 2000, 684/6.
11. See: Clarke, C. (2000), *Update comparative legal study, Follow up study commissioned by the European Commission.*
12. See e.g.: Pozzo B. (1996), *The liability problem in modern environmental statutes*, 4. *ERPL* 1996, 111-144.
13. See: the US *Comprehensive Environmental Response Compensation and Liability Act of 1980*, the Italian *Law of July 8, 1986 No. 349*, at art. 18, the Swiss *Federal Act on Protection of the Environment of 1983* and the Portuguese *Environmental Act of 1987*.
14. The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services or resources. People may also be asked for the amount of compensation they would be willing to accept to give up specific environmental goods. It is called "contingent" valuation, because people are asked to state their willingness to pay, contingent on a specific hypothetical scenario.
15. This method estimates economic values associated with ecosystems or sites that are used for recreation by assuming that the value of a site is reflected in how much people are willing to pay to travel to visit the site.
16. See: Spühler, J. (2000), *Environmental impairment liability insurance for landfills*, Swiss Reinsurance Company, Zurich: Swiss Re Publishing; and also: Spühler, J.

(1999), Environmental insurance for enterprises. An insurance concept, Swiss Reinsurance Company, Zurich: Swiss Re Publishing.

17. This point will be addressed in more details *infra*, with an overview of the different types of environmental coverage currently available on the international insurance market.
18. CERCLA has been modified by *Superfund Amendments and Reauthorization Act of 1986 (SARA)*. The modified version of CERCLA is codified in 42 USC. §§9601- 9674.
19. There are four categories of potentially responsible party (PRP): current owners and occupiers, past owners and occupiers, hazardous substance generators and transporters who selected the site.
20. USC.A. § 9607 (a) : “Notwithstanding any other provision or rule of law, and subject only to the defenses set forth in subsection (b) of this section:
 - 1) the owner and operator of a vessel or a facility;
 - 2) any person who at the time of disposal of any hazardous substance owned or operated any facility at which such hazardous substances were disposed of;
 - 3) any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility or incineration vessel owned or operated by another party or entity and containing such hazardous substances; and
 - 4) any person who accepts or accepted any hazardous substances for transport to disposal or treatment facilities, incineration vessels or sites selected by such person, from which there is a release, or a threatened release which caused the incurrence of response costs, of a hazardous substance, shall be liable for:
 - A) all costs of removal or remedial action incurred by the United States Government or a State or an Indian tribe not inconsistent with the national contingency plan;
 - B) any other necessary costs of response incurred by any other person consistent with the national contingency plan;
 - C) damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from such a release; (...)”
21. On the issue of NRDs evaluation see: Thompson (2002), “Valuing the Environment: Courts’ Struggles with Natural Resource Damages”, 32 *Envtl. L.* 57; Cummings, Shultze (1984), *Valuing Environmental Goods: A state of the Art Assessment of the Contingent Valuation Method*, Washington DC; Pozzo, (1990) “La determinazione del quantum del danno ambientale nell’esperienza giuridica degli Stati Uniti”, 2 *Quadrimestre*, 324; Pozzo, (1996) *Danno Ambientale ed Imputazione della Responsabilità – Esperienze Giuridiche a Confronto*, 187-248. See also: Ackerman and Heinzerling (2002), *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 *U. Pa. L. Rev.* 1553; Rutherford, Knetsch and Brown, 22 *Harvard Environmental Law Review* 1998; Jones, Tomasi, Fluke, “Public and private claims in natural resource damage assessments”, 20 *Harvard Environmental Law Review* 1996, 111; Binger, Copple, Hoffman, 35 *Natural Resources Journal* 1995, 443; Campbell, *Baylor Law Review* 1993, 221.

22. The statutory defenses to liability, namely: act of God, act of war and act or omission of a third party not connected with the defendant, have each been so narrowly construed as to be almost ineffective.
23. See CERCLA § 111, 42 USC. § 9611.
24. In several cases, the release of pollutants into the environment began in the 1950s or 1960s and continued over a long period of time. See: Abraham, K.S. (1991), *Environmental Liability Insurance Law – an analysis of toxic torts and hazardous waste insurance coverage issues*, Prentice Hall Law and Business; see also Monti, A. (1997), *Diritto ed Economia dell'Assicurazione*, No. 1, 41-162.
25. At the very beginning, courts interpreting CGL policies were imposing liabilities on insurance companies despite express exclusions of coverage, such as the 1973 qualified pollution exclusion or the owned-property exclusion. Those decisions impaired the confidence of the insurance industry, which nearly abandoned the environmental marketplace for a long time. Scholars have written extensively on the subject, see: Abraham, K.S. (1991), *Environmental Liability Insurance Law – an analysis of toxic torts and hazardous waste insurance coverage issues*, 1991 Prentice Hall Law and Business; I. Sullivan, T. G. Reynolds, W. J. Jr. Wright, "Hazardous waste litigation: Comprehensive General Liability Insurance coverage issues", 494 *Practising Law Institute/Lit.* 1994, 267, and the Symposium issue of the 28. *Gonzaga Law Review*, 1992-1993. See also: Abraham, K.S. (1981), *Judge-Made Law and Judge-Made Insurance: Honoring the Reasonable Expectations of the Insured*, *Virginia Law Review* 67:1151-1191.
26. Those policies are too new to properly assess their effectiveness; reportedly, no significant disputes on issues related to those new coverage have been solved by US courts yet.
27. Relying on the effective enforcement of regulatory standards, less resources are invested by the insurance companies in monitoring the insured plant. A completely different situation characterizes the European insurance marketplace. See J. Spühler, *Environmental Liability Risks: a global view on present problems and their assessing and covering by insurance*, *Recycle 95 – "Environmental Technology Global Forum and Exposition"*, Davos – May 15-19, 1995; A. Gambaro (ed.), *Responsabilità delle imprese in campo ambientale*, Milano, IPA, 1997, 68 ff., 111 ff.
28. This Act of 1976 is codified as part of the Solid Waste Disposal Act in 42 USC. §§6901- 6992k.
29. Subtitle C of RCRA. To comply with these financial requirements, TDSFs frequently use a mixed form of financial insurance.
30. Listed in another appendix are those plants that are not subject to the Act.
31. *Umwelthaftungsgesetz § 1. Liability for installations having an impact on the environment*: "Where an installation mentioned in Annex I produces an impact on the environment such that someone dies or suffers injury to the body or health, or that property is damaged, the owner of the installation shall make good the ensuing damage to the injured person." In the literature, see: Hager, "Das neue Umwelthaftungsgesetz", *NJW* 1991, 136; Landsberg and Lülling, *Umwelthaftungsrecht*, Stuttgart, 1991; B. Pozzo, "La responsabilità civile per danni all'ambiente in Germania", *Riv. Dir. Civ.* 1991, I, 619; most recently, M. Hünert, "Rechtliche Bewältigung der Haftung für Massenschäden im Deutschen Recht", *ERPL* 7 (4):459-480, 1999, in particular at 466 ff.. General liability for bodily injury

and property damages was already imposed by § 823 BGB (the German civil code), but under different standards.

32. All the enterprises falling in the listed categories are subject to the liabilities imposed by the Umwelthaftungsgesetz, even if they are not yet or not any more in operation.
33. Umwelthaftungsgesetz § 6 **Presumption of causation:** “1) If, according to the circumstances of the case, an installation is inherently suited to cause the damage suffered by injured person, that damage shall be presumed to have been caused by the installation in question. Inherent suitability is assessed in each case according to the course of operation [of the installation], the equipment employed, the type and concentration of the substances that were used and released, the weather conditions, the time and place of the occurrence of damage, the nature of the damage as well as any other fact which in a given case might tend to prove or disprove causation. 2) The first paragraph is not applicable when the installation was correctly operated, that is to say when specific operational duties were respected and the operations were not disrupted. (...)”
34. See Landsberg and Lülling, *Umwelthaftungsrecht*, 82.
35. In case of damages deriving from normal operations of a plant which complied with all regulatory standards, moreover, § 5 states that no compensation is required for property damages of marginal entity or to be considered usual under local circumstances; Umwelthaftungsgesetz § 5 **Limitation of liability for property damage:** “If the installation was operated correctly within the meaning of the second sentence of § 6(2), no liability arises for property damage where the property was insignificantly affected or affected in a manner which is reasonable according to local conditions).”

As for bodily injuries, in these cases liability is capped at 50.000 DM for each person.

36. Umwelthaftungsgesetz § 8. **Right of the injured person to obtain information from the owner of the installation:** “1) If there are reasons to assume that an installation caused the damage to the injured person, that person can require the owner of the installation to disclose the information necessary to determine whether that person has the right to recover damages under the present Act. Disclosure extends only to information on the equipment employed, the type and concentration of the substances that were used or discharged and other effects produced by the installation, as well as information on the specific operational duties within the meaning of § 6(3) (...)”

Umwelthaftungsgesetz § 9. **Right of the injured person to obtain information from the administration:** “If there are reasons to assume that an installation caused the damage to the injured person, that person can require the authorities that granted a permit to the installation, that are responsible for supervising the installation or that are responsible to collect information on impacts on the environment to disclose the information necessary to determine whether that person has the right to recover damages under the present Act (...)”

Umwelthaftungsgesetz § 10. **Right of the owner of the installation to obtain information:** “1) If a claim is brought against the owner of an installation on the basis of the present Act, that owner can require information, or the examination of documents, from the injured person and from the owner of another installation, and can require information from the authorities mentioned at § 9, in so far as necessary to determine the scope of its liability towards the injured person or the scope of its claim for contribution from that other owner (...)”

37. Umwelthaftungsgesetz § 15. **Maximum liability:** “The liability of a person for all the damage arising from death or injury to the body or to health which followed from one and the same instance of impact on the environment is limited to a maximum of Euro 85 million. Liability for property damage is similarly limited to Euro 85 million. Where the sum-total of the individual awards flowing from one and the same instance of impact on the environment exceeds the maximum fixed in the previous sentences, then each award is reduced according to the proportion of the said maximum to the sum-total of the individual awards.”
38. On the Huk-Umwelthaft-Modell see: G. Küpper, “Anmerkungen zu dem genehmigten Umwelthaftpflicht-Modell und Umwelthaftpflicht-Tarif des Huk-Verbandes”, in *Die Versicherungs Praxis*, February 1993; B. Pozzo, “La responsabilità per danni all’ambiente in Germania e i connessi problemi di assicurabilità del rischio ambientale: il progetto per una nuova polizza R.C.”, in *Diritto ed Economia dell’Assicurazione*, 1994, 3, particularly at 23 ff.; W. C. Hoffman, “Environmental Liability and its insurance in Germany”, 43 *FICC Quarterly* 1993, 147; B. Hoffman, “A gradual consideration”, in *The Review*, April 7, 1993; R. Woltereck, “New environmental impairment liability policy introduced into the German market”, 5 *Int. ILR Case Comment*, 1994, p. 202; W. Pfennigstorf, “Germany: the New Model policy and the difficulty of defining compulsory insurance”, 8 *AIDA Pollution Insurance Bulletin*, May 1994, p. 6.
39. Art. 18 comma I, L. 349/86: “Qualunque fatto doloso o colposo in violazione di disposizioni di legge o di provvedimenti adottati in base a legge che comprometta l’ambiente, ad esso arrecando danno, alterandolo, deteriorandolo o distruggendolo in tutto o in parte, obbliga l’autore del fatto al risarcimento nei confronti dello Stato”.
40. See e.g.: A. Gambaro, “Il danno ecologico nella recente elaborazione legislativa letta alla luce del diritto comparato”, in 19 *Studi parlamentari e di politica costituzionale*, 1986 No. 71, 1 trim., 73; P. Trimarchi, “Responsabilità civile per danno all’ambiente: prime riflessioni”, in *Amministrazione*, 1987, 189; L. Bigliazzi-Geri, “Quale futuro per l’art. 18 Legge 8 luglio 1986, No. 349?”, in *Rivista Critica del Diritto Privato*, 1987, 685.
41. See A. Gambaro and B. Pozzo, in *Consumatore, Ambiente, Concorrenza – Analisi Economica del Diritto cit.*, 57 ff.
42. For the general argument that legal systems in distress tend to react according to a pre-determined sub-optimal path, see: Mattei, U. (2001), *Legal Systems in Distress: HIV-contaminated Blood, Path Dependency and Legal Change*, *Global Jurist Advances*: Vol. 1: No. 2, Article 4. www.bepress.com/gj/advances/vol1/iss2/art4.
43. While, on the contrary, article 2055 of the Italian civil code states that the general tort law principle is joint and several liability.
44. An echo of what is set forth by art. 133 of the Italian criminal code.
45. The quantification criteria are: 1) seriousness of the fault; 2) the remediation costs; 3) the profit earned by the polluter as a result of its misconduct. See: Art. 18 comma VI L. 349/86: “Il giudice, ove non sia possibile una precisa quantificazione del danno, ne determina l’ammontare in via equitativa, tenendo comunque conto della gravità della colpa individuale, del necessario costo del ripristino e del profitto conseguito dal trasgressore in conseguenza del suo comportamento lesivo dei beni ambientali.”
46. See: Villa, G. (2002), *Il danno all’ambiente nel sistema della responsabilità civile*, in Pozzo B. (ed.), *La nuova responsabilità civile per danno all’ambiente*, Milan: Giuffrè, 123 ff.

47. Cass. 9 aprile 1992 No. 4362, Pretore Monza 8 ottobre 1990, Pretore Rho 4 dic. 1990, Cass. pen. 31 luglio 1990 (in Nuova Giur. comm., 1991, I, 535), Pretore di Rovigo 4 dic. 1989, Pretore di Lecco 29 sett. 1989, Cass. pen. 11 gennaio 1988 (in Riv. pen., 1989, 515, m.); but see D. Feola, *L'art. 18 l.349/86 sulla responsabilità civile per il danno all'ambiente: dalle ricostruzioni della dottrina alle applicazioni giurisprudenziali*, in *Quadrimestre* 1992, 547.
48. Pretore di Milano – sez. distaccata di Rho, June 29, 1989, in *Foro it.*, 1990, II, 526; notes and comments on this decision are available in English in 6 *AIDA Pollution Bulletin*, July 1991, 7.
49. Tribunale di Venezia, Ufficio del giudice monocratico, Sez. Penale, 27 novembre 2002, No. 1286, in *Rivista giuridica dell'ambiente* (No. 1/2003), p. 164.
50. See Cass. civ., sez. III, 3 February 1998 No. 1087, in *Foro Italiano*, 1998, I, 1142 with a case note by B. Pozzo, “La retroattività della responsabilità civile per danno ambientale: alla ricerca delle ragioni di un <obiter> della Cassazione”, *Foro Italiano*, 1998, I, 1143.
51. See Cass. civ., 1 September 1995 No. 9211.
52. See Cons. Stato (Ord.), Sez.V, 03/04/2001, No. 2114; T.A.R. Veneto, Sez.III, 02/02/2002, No. 320; T.A.R. Friuli-V. Giulia, 27/07/2001, No. 488, *Foro Amm.*, 2001.
53. White Paper on Environmental Liability, COM(2000) 66 final, Brussels, 9 February 2000; see also: the Green Paper, COM (93) 47, Brussels, May 14, 1993, and the Lugano Convention of June 21-22, 1993.
54. See: Article 3(8) of the Common position adopted by the Council on 17 September 2001 with a view to the adoption of a Decision of the European Parliament and of the Council laying down the Sixth Community Environment Action Programme.
55. “biodiversity” means natural habitats and species listed in Annex I to Directive 79/409/EEC, or in Annexes I, II and IV to Directive 92/43/EEC, or habitats and species, not covered by those Directives, for which areas of protection or conservation have been designated pursuant to the relevant national legislation on nature conservation.
56. “damage” means a measurable adverse change in a natural resource and/or measurable impairment of a natural resource service which may occur directly or indirectly and which is caused by any of the activities covered by the Directive.
57. “waters” mean all waters covered by Directive 2000/60/EC.
58. “land contamination” or “soil and subsoil contamination” means the direct or indirect introduction, as a result of human activity, of substances, preparations, organisms or micro-organisms harmful to human health or natural resources into soil and subsoil.
59. “operator” means any person who directs the operation of an activity covered by this Directive including the holder of a permit or authorisation for such an activity and/or the person registering or notifying such an activity.
60. Pursuant to Annex II to the Directive, remedying of environmental damage, in terms of biodiversity damage and water pollution, is achieved through the restoration of the environment as a whole to its baseline condition. Restoration is done through rehabilitating, replacing or acquiring the equivalent of damaged natural resources and/or services at the site originally damaged or at a different location. Remedying of environmental damage, in terms of water pollution and in

terms of biodiversity damage, also implies that any serious harm or serious potential harm to human health be removed should such a harm be present. Where polluted soil or subsoil gives rise to a serious harm to human health or could pose such a risk, the necessary measures shall be taken to ensure that the relevant contaminants are controlled, contained, diminished or removed so that the polluted soil does not pose any serious harm or serious potential harm to human health which would be incompatible with the current or plausible future use of the land concerned. Plausible future use shall be ascertained on the basis of the land use regulations in force when the damage occurred. Once the competent authority has developed a reasonable range of restorative options, it shall evaluate the proposed options based on, at a minimum:

- 1) The effect of each option on public health and safety;
- 2) The cost to carry out the option;
- 3) The likelihood of success of each option;
- 4) The extent to which each option will prevent future damage, and avoid collateral damage as a result of implementing the option; and
- 5) The extent to which each option benefits to each component of the natural resource and/or service.

If several options are likely to deliver the same value, the least costly one shall be preferred.

61. Finally, the proposed liability regime shall not apply to nuclear activities, to activities the sole purpose of which is to serve national defense and to environmental damage or to any imminent threat of such damage arising from an incident in respect of which liability or compensation is regulated by any of the following agreements: a) the International Convention of 27 November 1992 on Civil Liability for Oil Pollution Damage; b) the International Convention of 27 November 1992 on the Establishment of an International Fund for Compensation for Oil Pollution Damage; c) the International Convention of 23 March 2001 on Civil Liability for Bunker Oil Pollution Damage; d) the International Convention of 3 May 1996 on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea; e) the Convention of 10 October 1989 on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels.
62. See the discussion above concerning the United States and Italy.
63. On the implications of this peculiar information asymmetry, see the study by Nobel Prize George A. Akerlof, "The Market for 'Lemons': Qualitative Uncertainty and the Market Mechanism", 84 *Quarterly Journal of Economics*, 1970, 488-500.
64. S. Shavell, "On Moral Hazard and Insurance", 93 *Quarterly Journal of Economics*, 1979, 541-562.
65. See Skogh, G. (1998), Development risks, strict liability and the insurability of industrial hazards, *Geneva Papers on Risk and Insurance*, 87, 247.
66. The notion of legal formant refers to every legal proposition that concurs in the solution of a given legal issue. Court decisions are legal formants as well as scholarly writings, constitutional norms, regulatory standards, statutory provisions et cetera. Legal formants, therefore, are sources of law in a practical sense. See R. Sacco, "Legal Formants: A Dynamic Approach to Comparative Law", 39 *Am. J. Comp. Law* 1991, 1 ff., 349 ff.; see also, U. Mattei, *Comparative Law and Economics*, cit., 104 ff.

67. This is fully recognized by the proposal for a Directive on environmental liability (see: article 19).
68. This seems to be confirmed by the availability, in several countries, of limited insurance coverage for first-party clean-up obligations. See: Faure, M.G., Grimeaud, D. (2000), *Financial Assurance Issues of Environmental Liability – Report, Follow up study commissioned by the European Commission*, 181 ff.
69. “Insurers have to be able to calculate premiums and define adequate conditions including prevention measures. The knowledge and experience regarding biodiversity damage is in its onset in Europe and it cannot be considered currently insurable even in the light of the work done by the European Commission to clarify this question. Insurers reiterate their willingness to contribute in the process to develop this concept. (...) To meet the prerequisites of insurability, means would have to be decided to establish the amount of compensation to be paid by the liable party. The means would need to be reliable and consistent within the European Union. Biodiversity damage as described in the proposal is not at the moment measurable and thus cannot be insured through the existing insurance solutions. There is no real experience of compensating these types of damage in Europe nor in the US and the first attempts to develop these concepts are only in their initial stage, developed by some environmental insurance pools. Insurers are, nevertheless, willing to contribute to any development that would allow the quantification of ecological damage.” See: Comité Européen des Assurances (CEA), *Position paper on Environmental liability with regard to the prevention and remedying of environmental damage*, May 2002.
70. “(...) (W)hether or not liability for biodiversity damage was insurable was more controversial. This type of liability was little known in the Community, and it was sometimes argued it could not be valued and insured. Given this background, the Commission conducted a study focused on the issues associated with natural resource damage – a concept similar to biodiversity damage – liability in the US. Indeed in that country liability for damage to natural resources has been enacted at the same time as liability for clean-up costs, more than 20 years ago, which makes the US a good test case for the insurability of biodiversity damage. The conclusions of the study show that the fears that biodiversity damage is uninsurable are misplaced. The study (...) gives two key insights. First, the liabilities created by the Commission’s proposal, including biodiversity damage, can be financially assured. As a matter of fact, natural resource damage liability is currently financially assurable in the US and the associated insurance markets have developed over time with little problems¹⁸. Thus there are good reasons to believe that the same will happen in the EU vis-à-vis biodiversity damage.” *Proposal for a Directive – Explanatory Memorandum*, 7-9. The referred study is: Boyd, J. (2000), *A market-based analysis of financial assurance issues associated with US natural resource damage liability*, Follow up study commissioned by the European Commission.
71. “The information provided in the explanatory memorandum of the proposal concerning the US insurance system is technically speaking in most parts correct. What, however, can be disputed, are the conclusions drawn by the Commission based on this information. These conclusions are mainly based on the information on insurance for marine damage and more specifically for oil damage. In the view of CEA, the explanatory memorandum is clearly not based on an in depth analysis of the US market for insurance for land based environmental damage and can therefore be seen as somewhat deceptive. The directive is incorrectly based on the presumption that insurance for the risks evolving from the envisaged regime is easily available in Europe. It is true that the

number of insurers providing environmental impairment insurance in the US has grown over the last decade and premiums written in the environmental insurance market presently exceed \$ 1 billion annually. The number of insurance companies in the US offering cover is, however, very limited and the size of the environmental insurance market is negligible compared to the whole non-life sector premium income of \$ 401 billion (1999)." Comité Européen des Assurances (CEA), Position paper on Environmental liability with regard to the prevention and remedying of environmental damage, May 2002

72. As the European Commission seems to recognize.
73. "In addition to insurance mathematical calculations, insurability is the result of a complex decision-taking process by the individual insurer that involves several individual considerations. The essential precondition for any risk to be insurable is that the insurer must be able to make a realistically reliable estimate of the claim amounts to be paid out over a specific and reasonably long period. Long-tail environmental risks are problematic for insurers. Any injury, damage or loss to be compensated must be quantifiable in terms of money in line with *a priori* established and known criteria. The insurer has to be able to estimate the probability of any loss and also the severity of the loss. This process results in the willingness of many, few or no insurers willing to provide coverage." Comité Européen des Assurances (CEA), Position paper on Environmental liability with regard to the prevention and remedying of environmental damage, May 2002.
74. For a discussion of the theoretical foundations of this approach, see: Mattei, U. and Monti, A. (2001), Comparative Law and Economics. Borrowing and Resistance, Global Jurist Frontiers, Vol. 1: No. 2, Article 5, 2001, www.bepress.com/gj/frontiers/vol1/iss2/art5.
75. For a sharp distinction between *definitions* and *operative rules* enforced by courts see: Sacco, cit.
76. See above and also: Villa, G. (2002), Il danno all'ambiente nel sistema della responsabilità civile, in Pozzo B. (ed.), La nuova responsabilità civile per danno all'ambiente, Milan: Giuffrè
77. Pretore di Milano – sez. distaccata di Rho, June 29, 1989, in *Foro it.*, 1990, II, 526; notes and comments on this decision are available in English in 6 *AIDA Pollution Bulletin*, July 1991, 7; Tribunale di Venezia, Ufficio del giudice monocratico, Sez. Penale, 27 novembre 2002, No. 1286, in *Rivista giuridica dell'ambiente* (No. 1/2003), p. 164.
78. See CERCLA. § 107 (1-4) (C).
79. With some exceptions for sudden and accidental events.
80. The *Principle of Prevention*, together with the *Polluter-Pays Principle*, for example, is at the very foundations of international environmental policy announced by the European Commission.
81. Insurance provides incentives and requirements to prevent losses. The cost and availability of insurance are often linked to specific risk-prevention measures. Application requirements and continuous monitoring tend to improve compliance with established safety standards. See: Freeman, P.K. and Kunreuther, H.C. (1997), *Managing environmental risk through insurance*, Boston [etc.]: Kluwer, c1997 (Studies in risk and uncertainty: 9).
82. Under a claims made formula, coverage is triggered by the filing of a claim against the insured.

83. Under a manifestation/discovery formula, coverage is triggered by the manifestation/discovery of pollution conditions.
84. Extended reporting periods may be allowed, but on a limited basis.
85. See Faure, M., Fenn, P., Retro active liability and the insurability of long-tail risks, *International Review of Law and Economics*, 1999, 487-500.
86. See K. S. Abraham, *Environmental Liability and the limits of insurance*, cit. See also: Clifford G. Holderness, *Liability Insurers as Corporate Monitors*, 10 *Int. Rev. of Law and Econ.* 1990, 115-129.
87. See, for example: Anthony E. Davis (1996), *Professional Liability Insurance as Regulators of Law Practice*, LXV *Fordham Law Review*, 209.
88. See especially: Spühler, J. (2000), *Environmental impairment liability insurance for landfills*, Swiss Reinsurance Company, Zurich: Swiss Re Publishing.
89. For a discussion of this policy, see: Faure, M.G., Grimeaud, D. (2000), *Financial Assurance Issues of Environmental Liability – Report*, Follow up study commissioned by the European Commission, 183 ff.
90. UNEP has been working with the banking and insurance industry to try to promote greater awareness of environmental issues in the business sector to encourage sound environmental management. UNEP is dedicated to promoting sustainable development, which aims to achieve a balance between trade, development and environment.
91. **“Preamble.** The insurance industry recognizes that economic development needs to be compatible with human welfare and a healthy environment. To ignore this is to risk increasing social, environmental and financial costs. Our industry plays an important role in managing and reducing environmental risk, in conjunction with governments, individuals and organisations. We are committed to work together to address key issues such as pollution reduction, the efficient use of resources, and climate change. We endeavour to identify realistic, sustainable solutions.”
92. **“1. General Principles of Sustainable Development**
 - 1.1 We regard sustainable development, defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs, as a fundamental aspect of sound business management.
 - 1.2 We believe that sustainable development is best achieved by allowing markets to work within an appropriate framework of cost efficient regulations and economic instruments. Government has a leadership role in establishing and enforcing long term priorities and values.
 - 1.3 We regard a strong, proactive insurance industry as an important contributor to sustainable development, through its interaction with other economic sectors and consumers.
 - 1.4 We believe that the existing skills and techniques of our industry in understanding uncertainty, identifying and quantifying risk, and responding to risk, are core strengths in managing environmental problems.
 - 1.5 We recognize the precautionary principle, in that it is not possible to quantify some concerns sufficiently, nor indeed to reconcile all impacts in purely financial terms. Research is needed to reduce uncertainty but cannot eliminate it entirely.”

93. **“2. Environmental Management**

2.1 We will reinforce the attention given to environmental risks in our core activities. These activities include risk management, loss prevention, product design, claims handling and asset management.

2.2 We are committed to manage internal operations and physical assets under our control in a manner that reflects environmental considerations.

2.3 We will periodically review our management practices, to integrate relevant developments of environmental management in our planning, marketing, employee communications and training as well as our other core activities.

2.4 We encourage research in these and related issues. Responses to environmental issues can vary in effectiveness and cost. We encourage research that identifies creative and effective solutions.

2.5 We support insurance products and services that promote sound environmental practice through measures such as loss prevention and contract terms and conditions. While satisfying requirements for security and profitability, we will seek to include environmental considerations in our asset management.

2.6 We will conduct regular internal environmental reviews, and will seek to create measurable environmental goals and standards.

2.7 We shall comply with all applicable local, national and international environmental regulations. Beyond compliance, we will strive to develop and adopt best practices in environmental management. We will support our clients, partners and suppliers to do likewise.

3. Public Awareness and Communications

3.1 Bearing in mind commercial confidence, we are committed to share relevant information with our stakeholders, including clients, intermediaries, shareholders, employees and regulators. By doing so we will improve society's response to environmental challenges.

3.2 Through dialogue with public authorities and other bodies we aim to contribute to the creation of a more effective framework for sustainable development.

3.3 We will work with the United Nations Environment Programme to further the principles and goals of this Statement, and look for UNEP's active support.

3.4 We will encourage other insurance institutions to support this Statement. We are committed to share with them our experiences and knowledge in order to extend best practices.

3.5 We will actively communicate our environmental activities to the public, review the success of this Statement periodically, and we expect all signatories to make real progress.”

94. It depends, of course, on the maximum available policy limits.

95. See B. Berliner and J. Spühler, “Insurability issues associated with managing existing hazardous waste sites”, in *Integrating Insurance and Risk Management for Hazardous Waste*, edited by Howard Kunreuther and Rajeev Gowda, Kluwer Academic Publishers 1990.

96. See Kunreuther and Slovic, “Economics, Psychology Protective Behavior”, 68 *American Economic Ass'n Proceedings* 1978, 64; Kunreuther, “Limited Knowledge and Insurance Protection”, 24 *Public Policy* 1976, 227; Camerer and Kunreuther, “Decision

Processes for Low Probability events: Policy Implications”, 8 *Journal of Policy Analysis and Management* 1989, 565-592.

97. See Hansmann and Kraakman, “Towards Unlimited Shareholder Liability for Corporate Torts”, 100 *Yale L. J.* 1879.
98. “Government regulation that requires insurance as a ‘virtual license to operate’ turns insurers into regulators. This changes the focus of government regulation and makes insurers watchdogs over their customers rather than service providers.” See: Freeman, P.K. and Kunreuther, H.C. (1997), *Managing environmental risk through insurance*, Boston [etc.]: Kluwer, c1997 (Studies in risk and uncertainty: 9).
99. An ample discussion is offered by: Faure, M.G., Grimeaud, D. (2000), *Financial Assurance Issues of Environmental Liability – Report, Follow up study commissioned by the European Commission*, 188 ff.
100. On this issue see: Faure, M.G., Grimeaud, D. (2000), *Financial Assurance Issues of Environmental Liability – Report, Follow up study commissioned by the European Commission*, 198 ff.

Chapter 3

Natural Catastrophe Risk and Insurance

This final chapter is devoted to the analysis of the role of insurance in the management of natural catastrophe risk. The author underlines the role of insurers as well as the limits of private insurance solutions for the coverage of such extreme risks, due to the magnitude of their economic consequences and the difficulties faced in pooling risks. He also gives an overview of complementary or alternative risk management options already tested in different institutional contexts and analyses the crucial role played by governments in partnerships with the private sector. Besides he describes the main features of several governmental disaster schemes and other institutional arrangements that have been designed in order to supplement or replace traditional reinsurance and provide regulatory incentives for the development of private coverage. The overview of alternative risk management techniques also includes an analysis of the development of new financial instruments (e.g. catastrophe bonds or weather derivatives) aimed at providing additional funding and economic protection against large losses from natural disasters.

1. The increasing risk of loss from natural catastrophes

The risk from natural disasters is increasing. Large losses created, among others, by hurricane Andrew in Florida in 1992, the Northridge earthquake in California in 1994, the Kobe earthquake in Japan in 1995, the Kocaeli earthquake in Turkey in 1999, windstorms Lothar and Martin in Europe in 1999, the Bhuj, Gujarat earthquake in India on January 26, 2001 and tropical storm Allison in the USA in 2001 put large strains on the financial capacities of the international reinsurance market and, consequently, catastrophe insurance coverage availability has substantially diminished over the past years.

The increase in the magnitude of actual and insured losses from natural disasters in the past fifteen years has significantly exceeded the predictions of the insurance industry. The size of the losses resulting from an environmental catastrophe depends on both the severity of the natural forces involved, the vulnerability of buildings and infrastructures and the efficacy of plans and emergency strategies for disaster control and mitigation implemented in the afflicted region.¹ Not surprisingly, among the several causes of this unprecedented increase in losses and risk estimates are new urbanization developments in hazard-prone areas and the lack of enforcement of building codes and land-use regulations; higher population densities, the increased concentration of values in exposed locations and the adverse meteorological effects of global climate change contribute to amplify the magnitude of the problem.

In the recent years, therefore, the threat of a mega-disaster striking a major inhabited area has dramatically altered the insurance environment. Today many insurers and reinsurers indicate that they cannot continue to provide the same level of coverage against hurricanes, floods and earthquakes, without incurring an excessive risk of insolvency or substantial losses of capital or surplus. These concerns stem from a balanced reassessment of the insurance industry's financial exposures following the severe losses cited above.

2. The financial burden of natural disasters

The financial burden of natural disaster is extremely large and the insurance and reinsurance industry may be able to handle a substantial part of it only within the appropriate legal and regulatory framework. With respect to natural catastrophe risk, in fact, insurers face several difficult challenges.

The essential problem concerns the ability of the traditional insurance mechanism to properly manage low probability and high consequences (LPHC) events, such as natural catastrophes. As mentioned in the previous paragraph, the insurance and reinsurance capacity for natural hazards risks is currently quite limited. The financial management of natural catastrophe risk is quite costly and troublesome for the industry, mainly because of:

- the **magnitude** of expected insured losses (i.e. the size of aggregate claims in case of a disaster); and
- the **inter-temporal mismatch** between the size of annual premiums and the size of the annual expected losses.

In other words, it shall be noted that the risk of loss from natural catastrophes is **correlated both temporally and spatially** and this creates both **geographical and inter-temporal risk spreading problems**.

The **risk of accumulation** is quite high in the primary market, since the same catastrophic event can cause losses involving many different insured properties and infrastructures at the same time, giving rise to immense claims burdens in a single policy period.

Adverse selection is another problem that may negatively affect the ability of insurance company to spread the risk of loss geographically, even on a national market.² Effective risk spreading, therefore, can be performed only on a global scale, through a series of international reinsurance arrangements.³

Another problem concerns the **low level of predictability of natural hazards risk**: until recent years, in fact, there has been a general lack of reliable data and objective information concerning the economic effects of natural disasters. Considerable uncertainty is associated with the estimation of the probability of disasters of different magnitudes occurring and the size of the resulting losses. Technology and computer modelling of natural perils have only recently reached the point where the risks can be clarified. As already pointed out in Chapter 2 of this report, it has been demonstrated that the limited (bounded) rationality of several individuals may lead them to underestimate or ignore LPHC risks:⁴ even a reasonably priced catastrophe insurance coverage, therefore, may often be perceived by prospective insureds as too costly.

3. The importance of public-private partnership for disaster management

In light of the above considerations, it seems clear that the financial burden of natural catastrophe risk cannot be carried exclusively by the private insurance sector. Some of the major obstacles to insurability, however, may be overcome through the proactive intervention of the public sector. Besides, the

general trend in OECD countries is towards some sort of co-operation between governments and the private sector in the management of natural disaster risks.

The public authority can play a fundamental role by:

- providing the requisite legal framework;
- subsidizing the cost of administering the disaster management scheme;
- subsidizing the cost of insurance to the beneficiaries;
- being a reinsurer of last resort.

The public authority as the insurer of last resort is in a better position to deal with the extreme loss potentials than are private insurance companies with limited capital and capacity.⁵ governments, moreover, have the power to enforce the adoption of appropriate risk mitigation measures and to make catastrophe insurance coverage mandatory, thereby spreading the risk throughout the entire society.

The private insurance sector, in turn, has the requisite technical expertise for providing:

- proper risk assessment and risk allocation mechanisms;
- expedite loss adjustment services;
- effective surrogate regulation.

The payment of losses through risk-based insurance policies is self-funded from premiums received. This mechanism makes insurance a reliable financial tool for managing and funding risk, because insurance specializes in reserving and investing collected funds for the purpose of claims payment. With respect to natural catastrophe risk, an insurance-based mechanism is more likely to have funds to cover losses over time than an *ex post* governmental aid disaster program, which may have to compete for funding with other programs that are subject to changes in the political climate.⁶ The solid experience of the private insurance sector in assessing risks and adjusting losses, moreover, may offer great advantages. Efficient and expedite claims settlements practices may lead to socially beneficial results. Risk-based insurance, finally, may be able to provide additional precautionary incentives for policyholders, through the mechanism of private surrogate regulation already described in Chapter 2.

The establishment of government-subsidized insurance-based schemes for disasters management is a common example of public-private partnership in OECD countries.

4. A comparative overview of different legal and regulatory frameworks

Complex governmental risk management strategies have been implemented in several legal systems. Some of the most significant institutional arrangements involving an insurance-based public-private partnership are discussed in this section. Comparative tables summarizing these arrangements are presented at the end of this section.

- **FRANCE: National Disaster Compensation Scheme (CAT NAT) and the role of the Caisse Centrale de Réassurance (CCR).** In France, a national disaster compensation scheme has been established by law in 1982. Law No. 82-600 of 13 July 1982 (*Loi relative à l'indemnisation des victimes de catastrophes naturelles*) provides for a compulsory natural disaster extension on all property damage policies purchased on the voluntary market.⁷ Coverage under the catastrophe extension is triggered when the state of natural disaster is declared by inter-ministerial decree; the damaged property must be covered by a “property damage” insurance policy and a causal link must be established between the catastrophe declared in the decree and the damage suffered by the property insured.⁸ Pursuant to a decree of 10 August 1982 (defining standard clauses), the catastrophe insurance guarantee must cover the cost of direct material damage suffered by the property up to the value stated in the policy and subject to the terms and conditions of the said policy at the time the risk first occurs. The natural disaster coverage is also extended to in all business interruption policies. In this case, it covers loss of gross profit and additional operating costs during the indemnity period specified in the policy. Claims are settled on the basis of the “damage” cover under the policy with the widest scope and indemnity is provided in the same way as under the basic cover. According to the rules of the scheme, the insured parties must retain a portion of the risk, by means of a statutory deductible that cannot be bought back even by means of another policy. Deductibles are compulsory – i.e. they apply even when the basic policy does not include them – and their amount is determined and updated by means of decrees issued periodically of the competent authority. Since 1 January 2001, a sliding scale has been introduced to vary these deductibles so as to encourage loss prevention measures. This scale applies to those districts, which do not yet have a prevention plan for foreseeable natural risks (PPR). In other words, when a state of natural disaster is declared in such a district as a result of the occurrence of a given peril (e.g. flood), a coefficient is applied to the applicable statutory deductibles based on the number of decrees already issued in such area, in respect of the same peril, since 2 February 1995 (date of creation of PPR's). The sliding scale ceases to apply as soon as a PPR is set up for the peril in question, but it will be reapplied if the PPR is not approved within five years.

As in the case of deductibles, the rates of additional premium for the compulsory catastrophe extension are set by decree. Since 1 September 1999, the rate of catastrophe premiums for property other than motor vehicles is 12% of the premium or contribution paid for the basic property coverage. This complex scheme is able to work effectively due to the fact that the Caisse Centrale de Réassurance (CCR), a state-owned company, entered into an agreement with the authorities that allows it to offer reinsurance cover with a **government guarantee** in the field of natural disasters. CCR does not have a monopoly in natural disaster reinsurance: primary carriers, therefore, are free to seek coverage from the reinsurer of their choice, and may even take the risk of not underwriting reinsurance. In any event, CCR remains the only company within its sector of activity which offers a whole range of reinsurance solutions with **unlimited cover**. This is, of course, a great advantage for insurers, since it gives them absolute security in the event of a major loss, be it a large-scale event such as a flood occurring every hundred years or a geological problem such as subsidence, which causes all kinds of damage. CCR thus provides a guarantee of solvency and security for insureds within the French natural disaster compensation scheme.⁹ CCR offers two reinsurance solutions, which are combined to provide **two-fold reinsurance cover** to primary catastrophe risk carriers. Under the first solution, known as “quota-share”, the insurer cedes a certain proportion of the premiums collected to the reinsurer and the latter, in return, undertakes to pay the same proportion of losses. Quota-share reinsurance ensures that the reinsurer truly follows the fortunes of the insurer, since the latter has to cede a percentage of each of the accounts in its portfolio to the reinsurer. Thus the risk of anti-selection is avoided. The second solution, known as “stop-loss”, covers the portion not ceded on a quota-share basis by the Insurer, in other words the Insurer’s retention. This is a non-proportional form of reinsurance because, contrary to the “quota-share” system, the reinsurer only intervenes if the total annual losses exceed an agreed figure, expressed as a percentage of the premiums retained. In particular, this type of reinsurance enables the insurer to protect itself against the frequency or accumulation risk, i.e. the risk of many claims occurring at the same time. Although most “stop-loss” reinsurance treaties contain a limit of indemnity, CCR’s cover in the field of natural disasters is unlimited thanks to the State guarantee from which it benefits. The deductible under the CCR treaty therefore represents the maximum amount which an insurer will have to bear in the course of a single underwriting year, however many losses occur.¹⁰ Pursuant to the provisions of the Insurance Code, the Natural Disaster Central Rating Bureau (*Bureau Central de Tarification des Catastrophes Naturelles*) is entrusted with several regulatory powers with respect to the governance of the CAT

NAT scheme. Articles R 250-2 and R250-3, for example, lay out the procedure for referring certain controversial matters to the Bureau, such as the refusal to grant coverage by at least two insurance companies and the failure of the insured to conform to the provisions of a disaster prevention plan.

- **SPAIN: Consorcio de Compensación de Seguros.** Set up in 1941 as a provisional body¹¹ to face the needs for indemnities resulting from the Civil War (1936-1939), the Spanish Consorcio de Compensación de Seguros was given its permanent status from 1954. After that date, the activity of the Consorcio focused on the coverage of the so-called extraordinary risks and it began to play a central role in the related indemnity system. Since the approval of its Legal Statute in 1990,¹² which came into force in 1991, the Consorcio lost its legal monopoly for covering extraordinary risks in Spain and it is no longer a self-running body of the Ministry of Economy and Finance, but a state-owned company – currently a public business entity – with full powers to act. The Consorcio has its own assets and liabilities, separate from those of the State, and its activity is governed by private law. This means that the new company, when doing insurance business, apart from being governed by the terms of its own Legal Statute, is subject, like any other private insurance company, to the legal rules laid down in the Private Insurance Ordering and Supervision Act and its enacting regulations, and to the Insurance Contract Act, while its activity is governed by private law. The aim of the Consorcio is to indemnify claims made as a result of extraordinary events, such as natural disasters or other events with heavy social repercussion, that occur in Spain and cause injuries and damage to people and assets in Spain, whenever any of the following conditions are met: a) the extraordinary risk is not specifically and explicitly covered by another insurance policy; b) the extraordinary risk is covered by another insurance policy but the company that issued this policy cannot face its obligations. To sum up, the Consorcio currently acts in the Spanish system of coverage of extraordinary risks in a subsidiary way, as it only pays out indemnities when the private insurance company does not cover the risks in question, or when it does cover them but is insolvent. In case of occurrence of an extraordinary event of the type included in the system, one is only entitled to indemnity when he has a policy in certain classes of insurance, which cover persons and assets located in Spain, and if the insured is up to date with payments of the premium receipts, which include the Consorcio's surcharge for covering extraordinary risks. On the other hand, whenever insurance cover of a certain type¹³ is taken out, the same assets covered for the same sums insured must be necessarily covered against extraordinary risks. In other words, the extraordinary risk coverage is compulsorily linked with a base policy. Contracting this policy with any

company operating in the market is an optional choice, but it is, however, a “sine qua non” condition for entitlement to an indemnity in the event of an extraordinary claim. In respect to the cover for natural catastrophes, a change was made in 1986 from a system of indemnities based on a prior official declaration of a disaster area which took the geographical area of the loss and the volume of losses into account to a system of **automatic indemnity**, which provides cover subject only to the prerequisite that the policies, the damage and the events giving rise to the loss meet the legally established parameters. Another qualitative change in the same year concerned the surcharge used to fund the Consorcio in order to face extraordinary claims: instead of charging a percentage on the premiums, a system of own rates is now applied on the sums insured in the policies. The Consorcio’s surcharge must be compulsorily incorporated into the premium charged for every policy of insurance in the mentioned classes, irrespective of whether the said policy provides for the coverage of extraordinary risks to be effected by the private Company, or whether this is excluded (in which case the Consorcio shall be responsible). This compulsory nature lies in the principles of “compensation” and “solidarity” that govern the Spanish system, without which it would not be possible to cope with the natural anti-selection of these risks. The surcharge of the Consorcio is the result of applying its own rate on the sums insured in the policies. With respect to property damage, the indemnity paid by the Consorcio solely covers **material** losses, regarded as being the destruction or deterioration of the property insured, and **direct** losses (not including, therefore, loss of profits), so damage caused directly by the event. It should also be pointed out, furthermore, that protection against extraordinary risks is entirely separate from protection against other risks provided for in the policy. In other words, the coverage of the extraordinary risks protects the same property or persons at least for the same sum insured. The main sources of the Consorcio’s funds for meeting its commitments in covering extraordinary risks are the aforementioned surcharges. Just like any other insurance company, the Consorcio applies current rules on the Solvency Margin and for setting up Technical Reserves. Besides this, given the special features of frequency and intensity of the risks that are to be faced there is a need for special funding capacity, based on an adequate and sufficient accumulation of resources and on broad compensation in time, which in the case of the Consorcio takes the form of a **stabilization reserve**. This is something rather like a loss fluctuation reserve, commonly used when insuring against disasters in many countries, which is accumulative -in some cases up to certain limits- and is tax exempt. In the Spanish system, it is a reserve with no accumulation top, which is tax deductible up to a certain limit set by law. But it should be borne in mind that, in actual fact, the aim is not to compensate

unexpected deviations, but rather to accept the certainty of cyclical points of losses which occur in a fortuitous manner, and to time the funding of their costs by means of a constant premium. Taking into account the special features of this cover and the very nature of the Consorcio as a state-owned company, it is essential that the Consorcio be backed by the Government guarantee in order to meet any indemnity obligations that overrun its financial capacity. However, the adequate reserves collection have enabled the Consorcio to meet its indemnity liabilities without ever having to resort to this Government guarantee.

- **USA: National Flood Insurance Program (NFIP).** The US Congress established the NFIP on August 1, 1968 – with the passage of the National Flood Insurance Act of 1968 –, in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods. The NFIP makes federally-backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994, signed into law on September 23, 1994. The NFIP is administered by the Federal Insurance and Mitigation Administration (FIMA) and the Mitigation Directorate (MT), components of the Federal Emergency Management Agency (FEMA), an independent Federal agency.¹⁴ The NFIP is a federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the Federal Government that states if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The NFIP, through partnerships with communities, the insurance industry, and the lending industry, helps reduce flood damage. The NFIP is self-supporting for the average historical loss year, which means that operating expenses and flood insurance claims are not paid for by the taxpayer, but through premiums collected for flood insurance policies.
- **CALIFORNIA: California Earthquake Authority (CEA).** California law requires all insurers to offer earthquake insurance with every homeowners policy. Established in 1996 to relieve pressure on private insurers, the California Earthquake Authority is a privately financed, state-run insurance

program that sells a “mini-policy” with a larger deductible and more limited coverage of external structures than conventional earthquake insurance policies. The State offers no guarantee: therefore, if losses from an earthquake drain the established fund, the CEA may run out of business and claims will be paid out on a pro-rated basis.

- **FLORIDA: Florida Hurricane Catastrophe Fund (FHCF).** In 1993, the State of Florida established the Florida Hurricane Catastrophe Fund (FHCF) to allow insurers to transfer a portion of their catastrophic risk. The Fund reimburses a fraction of insurers’ losses caused by severe hurricanes and it is funded by premiums paid by insurers that write policies on personal and commercial residential properties. An important provision limits the Fund’s obligation to pay losses to the sum of its assets and borrowing capacity. This fund is tax-exempt, enabling it to accumulate funds rapidly. The industry is responsible for losses up to a certain level; the premiums they pay for the reinsurance can be passed onto policyholders. In addition to premiums, these programs can use bonding and other financing arrangements if they have a shortfall. The policyholders, however, would have to foot the bill for the financing through assessments on their policies. If the funds are not adequate, claims are paid on a pro-rated basis so policyholders have no guarantee claims their losses will be covered.
- **HAWAII: Hawaii Hurricane Relief Fund (HHRF).** In 1993, Hawaii created a voluntary homeowner’s catastrophe fund in order to provide hurricane insurance for customers of insurers which would no longer voluntarily offer such coverage. The Hawaii Hurricane Relief Fund (HHRF), a state-run insurance company, is made up of premiums paid, loans from the federal government, bond proceeds, mortgage fees and insurer assessments. The Fund discontinued its operation by the end of 2000, in light of improved private market conditions.
- **NEW ZEALAND: Earthquake Commission (EQC).** The Earthquake Commission (EQC) is New Zealand’s primary provider of seismic disaster insurance to residential property owners.¹⁵ The EQC is a Crown Entity, wholly owned by the government of New Zealand and controlled by a board of commissioners. Crown Entities are not Government departments or state-owned enterprises but nevertheless belong to the Government and are subject to public sector finance and reporting rules. EQC administers the Natural Disaster Fund. The Government guarantees that this fund will meet all its obligations. It does this by securing New Zealand residential property owners against the cost of these disasters and by helping organize repair and replacement after the event. The main mechanism for this is the provision of seismic disaster insurance to property owners who insure against fire. All residential property owners who buy fire insurance from private insurance companies automatically acquire EQCover, the

Commission's seismic disaster insurance cover.¹⁶ EQCover premiums are added to the cost of the fire insurance and passed on to EQC by the insurance company. EQC's administration of the natural disaster insurance scheme involves: collecting premiums via insurance companies; processing and meeting claims by insured people; administering a disaster fund; investing the fund in accordance with Government directions; organizing reinsurance as a potential supplement to the fund; accounting to its shareholder (the Government). EQC also encourages and funds research about matters relevant to natural disaster damage and it educates and otherwise informs people about what can be done to prevent and mitigate damage caused by natural disasters.

- **JAPAN: Japanese Earthquake Reinsurance (JER).** Japan has had an earthquake program covering residential properties since 1966. The Earthquake Insurance Act entered into force in such year and it had been reformed several times since its enactment. In accordance with the promulgation of this law and following the launch of sales of residential properties earthquake insurance to be written in conjunction with dwelling and shop-owners comprehensive insurance policies, Japan Earthquake Reinsurance Company (JER) was established by 20 domestic non-life insurance companies. Under the Japanese earthquake insurance program, primary carriers sell earthquake policies with large deductibles on the voluntary market and then reinsure their risk 100 percent with JER, which, in turn, retrocedes part of the risk to the government and the private reinsurance market.¹⁷ Since coverage costs home owners considerable amounts of additional premiums and is not mandatory, not so many purchase it.¹⁸ JER is Japan's only specialized reinsurance company for residential properties earthquake insurance and, according to the relevant provisions of law, its solvency is supported by special arrangements with the Japanese government.
- **TURKEY: Turkish Catastrophe Insurance Pool (TCIP).** Following 1999 earthquake disasters occurred in the Marmara Region and Duzce, earthquake insurance has been made compulsory primarily for dwellings, through a Earthquake Insurance Program. The Turkish Catastrophe Insurance Pool (TCIP) was launched by the Turkish government in cooperation with the World Bank on September 27, 2000. Earthquake insurance premiums are ceded to the TCIP, which is managed by the Natural Disasters Insurance Council, DASK in the Turkish abbreviation. The TCIP was set up in fulfillment of the government decree-law as a separate state owned legal entity, with its Board and management, to provide compulsory earthquake insurance to all registered residential dwellings in Turkey. The pool provides earthquake coverage up to certain limits for a premium which varies across the country depending upon seismicity, local soil conditions, and the type and quality of construction. The TCIP's Board has representatives from the government,

Table 2. **Natural Catastrophe Risk and Insurance: a comparative overview of different legal and regulatory frameworks**

		Perils covered and triggers	Compulsory nature	Role of public and private sectors	Limits
FRANCE NATIONAL DISASTER COMPENSATION SCHEME (CAT NAT)	1982	NATURAL DISASTERS IN GENERAL. Coverage is triggered when the STATE OF NATURAL DISASTER is declared by inter-ministerial decree.	Law No. 82-600 of 13 July 1982 provides for a compulsory natural disaster extension on all property damage policies purchased on the voluntary market.	Primary disaster coverage is offered and managed by PRIVATE CARRIERS, as an extension to property damage policies. Private insurers can obtain full CATASTROPHE REINSURANCE from the Caisse Centrale de Réassurance (CCR), a state-owned company.	Thanks to the GOVERNMENT GUARANTEE, CCR is able to offer catastrophe reinsurance WITHOUT LIMITS.
SPAIN CONSORCIO DE COMPENSACIÓN DE SEGUROS	1954	EXTRAORDINARY RISKS. The event is covered if it occurred in Spain and caused injuries and damage to people and assets in Spain, provided that: (a) the risk is not expressly covered by the base policy; (b) the risk is covered by the base policy, but the company cannot face its obligations.	The extraordinary risk coverage offered by the Consorcio is compulsorily linked with a base policy. The Consorcio's surcharge is automatically included in the base policy's premium.	Extraordinary risk insurance is administered directly by the Consorcio, a state-owned enterprise, whose solvency is guaranteed by the State.	Financial capacity is UNLIMITED due to a STATE GUARANTEE, but coverage does not include loss of profits.
UNITED STATES NATIONAL FLOOD INSURANCE PROGRAM (NFIP)	1968	FLOOD LOSSES.	Not compulsory. The NFIP makes federally-backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage.	The NFIP is funded by the federal government.	Coverage limits offered under the NFIP depend on the community's level of qualification.
CALIFORNIA CALIFORNIA EARTHQUAKE AUTHORITY (CEA)	1996	EARTHQUAKE LOSSES.	California law requires all insurers to offer earthquake insurance with every homeowners policy.	The CEA is a privately financed, state-run insurance program.	The State offers not guarantee; if losses exhaust the CEA fund, claims will be paid out on a pro-rated basis.

Table 2. **Natural Catastrophe Risk and Insurance: a comparative overview of different legal and regulatory frameworks** (cont.)

		Perils covered and triggers	Compulsory nature	Role of public and private sectors	Limits
FLORIDA FLORIDA HURRICANE CATASTROPHE FUND (FHCF)	1993	HURRICANE LOSSES. The Fund reimburses a fraction of insurers' losses caused by severe hurricanes, declared by the National Hurricane Center.	Contribution to the Fund is compulsory for insurers that write primary coverage on personal and commercial residential properties.	The FHCF is tax-exempt. The private industry is responsible for losses up to a certain level.	An important provision limits the Fund's obligation to pay losses to the sum of its assets and borrowing capacity.
HAWAII HAWAII HURRICANE RELIEF FUND (HHRF)	1993	HURRICANE LOSSES.	NO.	The HHRF is a state-run insurance company.	The HHRF discontinued operations in 2000.
NEW ZEALAND EARTHQUAKE COMMISSION (EQC) NATURAL DISASTER FUND	1994	NATURAL DISASTER LOSSES. Including: earthquake, natural landslide, volcanic eruption, hydrothermal activity, tsunami and, in the case of residential land, also storm or flood.	Automatic earthquake coverage upon purchase of fire insurance from private market. Premiums are added to the cost of the base policy and passed on to EQC by the insurance company.	EQC, a Crown Entity, administers the natural disaster insurance scheme by: collecting premiums via insurance companies; processing claims; administering the disaster fund; organizing reinsurance.	The Government guarantees that the natural disaster fund will meet all its obligations.
JAPAN JAPANESE EARTHQUAKE REINSURANCE (JER)	1966	EARTHQUAKE LOSSES.	Not compulsory. Primary carriers sell earthquake coverage for considerable amounts of additional premiums and with large deductibles on the voluntary market and then reinsure with JER.	JER, a private entity was established by law in 1966. JER retrocedes part of the risk to the government and the private reinsurance market.	JER's solvency is supported by arrangements with the Japanese government.
TURKEY TURKISH CATASTROPHE INSURANCE POOL (TCIP)	2000	EARTHQUAKE LOSSES.	Yes. Since 2000, earthquake insurance has been made compulsory to all registered residential dwellings in Turkey.	The TCIP is a separate state-owned legal entity, managed by a Council. Local insurance companies act as distributors of the TCIP policies. Excess coverage could be obtained on a voluntary basis from the private market.	Per policy, Turkish lira equivalent of current exchange rate of \$25,000.

the private sector, and the academic community. The pool has no public sector employees as its management function has been contracted out to Milli Reinsurance, the oldest national reinsurance company. Local insurance companies act as distributors of the TCIP policies. Coverage in excess of the TCIP coverage could be obtained on a voluntary basis from private insurance providers. To issue policies, in addition to the insurance companies underwriting systems, the pool agents and the insurance companies can use an internet-based underwriting platform that will enable the TCIP to control its risk accumulations in real time and maintain the quality of underwriting. The TCIP operates as a catastrophe risk transfer and risk financing facility. Established as the national sole-source provider of earthquake insurance, it will raise the financial preparedness of Turkey for future disasters, reduce government fiscal exposure to major catastrophic events and will make liquidity readily available to insured homeowners affected by such future events. The TCIP is modeled after the California Earthquake Authority and New Zealand Earthquake Commission programs, which provide similar earthquake coverage for homeowners and rely mainly on international reinsurance and capital markets for their risk capital capacity.

5. Risk sharing through capital markets

Because of the current strains on the financial capacities of the international reinsurance market and the potentially enormous size of catastrophe risks, insurance companies, governments and corporations have recently sought to spread these risks to the capital markets. In this respect, the landscape of risk transfer alternatives has evolved significantly: governments, corporations, primary carriers, as well as global reinsurers today have the option of turning to the capital markets for supplemental catastrophe protection.

In light of the cyclical nature of the insurance business, when cost of reinsurance is very high, capital market solutions may become quite appealing. Catastrophe securities are a recent development in investing: by floating such bonds for specific risks over limited time periods in defined geographic regions, insurers and reinsurers reduce risk by transferring it to investors. Investors, in turn, have viewed the introduction of the insurance-linked security as an opportunity for the development of a new market, with the added attraction that so-called **cat bonds** are largely uncorrelated with other financial instruments. Investors – usually hedge funds or other major institutional investors – get a high rate of return, in exchange for the possibility of losing much of their principal or interest, or both, in the event of disasters.¹⁹ Catastrophe bonds entail almost **no credit risk**, since the money paid upfront by the investor and put in escrow, in a trust fund or invested in liquid securities and is therefore readily available. However, the use of physical trigger cat

bonds²⁰ entails a different risk, named **basis risk**. In contrast to traditional reinsurance, in fact, **this kind of coverage may not be a perfect hedge** for the insured portfolio, being only imperfectly correlated to the actual insured losses caused by the occurrence of the triggering event. In this respect, the reinsurance credit risk needs to be balanced against the indexed cat bonds basis risk.²¹ There is little evidence yet, however, of a major increase in the use of non reinsurance options like catastrophe bonds or weather derivatives.²²

These relatively new financial products have been made possible because of relevant improvements and developments in scientific studies, engineering analyses and information technologies. Today natural hazards risks and the potential losses of future disasters can be predicted with more accuracy than in the past: new risk assessments techniques have reduced the uncertainty associated with estimating the probabilities that certain disasters will occur in specific regions, while recent engineering studies have provided additional information on how structures and infrastructures perform under the stress of extreme environmental conditions.²³ Due to the growing knowledge of cat risk among institutional investors cat bonds have the potential to increase the amount of capital available for catastrophic risk, as well as alter the pricing of risk.²⁴

6. Regulation and catastrophe insurance

Regulatory policies may greatly affect the development of markets for disaster risk coverages and, consequently, the availability of effective catastrophe insurance.²⁵ Governments' policies often imposed significant cross-subsides from low-risk to high-risk areas and sometimes even imposed cross subsidies from non-catastrophe lines of insurance to the catastrophe lines. Such policies distort incentives and undermine the ability of market forces to make necessary adjustments and operate effectively in managing catastrophe risk.

Significant effects may also be generated by:

- **Regulatory constraints.** Regulation imposes further indirect costs on insurers in complying with regulatory requirements.
- **Market entry/exit rules.** Rules imposing limitations on the ability to enter/exit the market for certain risks may discourage the willingness of the insurance industry to undertake such risks.
- **Rules on the admissibility of ART.** Regulators must be aware that alternative risk transfer mechanisms can be essential when there is a shortage in reinsurance capacity.
- **Financial and fiscal issues.** Monitoring the solvency of insurance companies is fundamental in order to be able to rely on insurance as an

effective funding mechanism for natural hazards. Rules allowing for tax-exempt catastrophe reserves may also prove to be highly beneficial.

- **Regulation of claims practices.** With a view to assuring expedite payments, effective rules concerning settlement practices and procedures to be followed by the insurance companies upon occurrence of the insured event (i.e. the natural disaster) may turn out to be fundamental.
- **Antitrust and competition policies.** In some jurisdictions, the formation of catastrophe insurance pools aimed at raising adequate financial capacity and sharing data and information may be considered as incompatible with the antitrust and competition policies in force.²⁶

7. Integrated risk management strategies: catastrophe bonds and insurance can be coupled with incentives and other regulatory mechanisms to reduce disaster losses

In light of the above considerations, an effective disaster risk management strategy requires an integrated approach and the proactive involvement of all the relevant stakeholders, including:

- Homeowners and businesses at risk.
- Governments.
- Insurers and reinsurers.
- Investors in cat bonds.

The following points, therefore, appear to be quite important in the future development of catastrophe risk management strategies:

- The adoption of an integrated approach.²⁷
- The development of scientific risk evaluation techniques aimed at improving:
 - ❖ Risk predictability.
 - ❖ Expected loss estimates.
- The implementation of effective measures for structural mitigation and vulnerability reduction.²⁸

Enforcing building codes in hazard-prone areas would likely reduce future disaster losses significantly. Well-enforced building codes would reduce the magnitude of losses, enable insurers to provide additional coverage to property owners, and decrease the need for reinsurance and funds from other sources such as the capital market and state pools. It also would enable insurers to lower prices. At the same time, the costs of building code enforcement can be significant for the local community. As a result, it is important to redistribute some of the benefits from the reduction in exposure back to the local community pay for environment of codes. Thus, understanding the

interdependence among property owners, insurers, and state and local agencies is critical to designing workable solutions. Well-enforced regulatory measures, such as building codes, can complement insurance and other financial instruments by forcing the adoption of **cost-effective risk mitigation measures** (RMMs).²⁹ Incentives are needed since property owners often underestimate the risks from disasters:³⁰ as mentioned, empirical research have shown that individuals' and firms' decisions with respect to mitigating and insuring natural hazard risks do not conform to rational models of choice.³¹ In addition, effective mitigation measures may produce **positive externalities** by reducing other costs arising out of a disaster.

8. Conclusions

This section of the report presents some of the insurability problems associated with the natural catastrophe risk and offers an overview of several economic and institutional alternatives to the traditional insurance and reinsurance mechanisms. It also briefly discusses the implications of an **integrated approach to disaster management** based on insurance, prevention, mitigation, compensation and a close partnership between the public and the private sectors. On the basis of the above risk partnership, it seems that the international insurance and reinsurance industry is able to play a central role in the future management of natural hazards.

Notes

1. See: Swiss Reinsurance Company (2002), *Natural Catastrophes and man-made disasters in 2001*, Swiss Re SIGMA series 1/2002. Zurich, Swiss Reinsurance Company; Kunreuther, H.C. and R.J. Roth (ed.) (1998), *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*. Washington DC, Joseph Henry Press; Pollner, J. (2000), *Catastrophe Risk Management Using Alternative Risk Financing and Insurance Pooling Mechanisms: The Insurance Market and the Case of the Caribbean Region*. Washington DC: World Bank; Kunreuther, H.C. (2000), *Linking Insurance and Mitigation to Manage Natural Hazard Disaster Risk*, *Handbook of Insurance*, Georges Dionne (Ed.), Kluwer Academic Publishers, Boston; Froot, K. A. (ed.) (1999). *The Financing of Catastrophe Risk*. Chicago, University of Chicago Press.
2. See, *supra* Chapter 1 at § 2.b.
3. See Swiss Reinsurance Company (2002), *Natural Catastrophes and man-made disasters in 2001*, Swiss Re SIGMA series 1/2002. Zurich, Swiss Reinsurance Company.
4. See *e.g.*: Camerer and Kunreuther (1989), *Decision Processes for Low Probability events: Policy Implications*, 8 *Journal of Policy Analysis and Management* 1989, 565-592.
5. See Swiss Reinsurance Company (2002), *Natural Catastrophes and man-made disasters in 2001*, Swiss Re SIGMA series 1/2002. Zurich, Swiss Reinsurance Company.

6. See: Freeman, P.K. and Kunreuther, H.C. (1997), *Managing environmental risk through insurance*, Boston [etc.]: Kluwer, c1997 (Studies in risk and uncertainty: 9).
7. Pursuant to Article 1 of the Law 82-600: "Les contrats d'assurance, souscrits par toute personne physique ou morale autre que l'État et garantissant les dommages d'incendie ou tous autres dommages à des biens situés en France, ainsi que les dommages aux corps de véhicules terrestres à moteur, ouvrent droit à la garantie de l'assuré contre les effets des catastrophes naturelles sur les biens faisant l'objet de tels contrats. En outre, si l'assuré est couvert contre les pertes d'exploitation, cette garantie est étendue aux effets des catastrophes naturelles, dans les conditions prévues au contrat correspondant. Sont considérés comme les effets des catastrophes naturelles, au sens de la présente loi, les dommages matériels directs ayant eu pour cause déterminante l'intensité anormale d'un agent naturel, lorsque les mesures habituelles à prendre pour prévenir ces dommages n'ont pu empêcher leur survenance ou n'ont pu être prises. (...)". For the detailed legislative provisions currently in force see: Code des Assurances (Partie Législative) Titre II – Chapitre V: L'assurance des risques de catastrophes naturelles (Articles L125-1 to L125-6).
8. "The legislators did not want to limit the 1982 Law by creating a list of the natural phenomena covered. Nor did they want to create a list of exclusions. They limited themselves, therefore, to the idea of 'uninsurable damage' (this idea was then clarified by the Laws of 25 June 1990 and 16 July 1992). The following list is not, therefore, exhaustive: floods and/or mudslides, earthquakes, landslides, subsidence (collapse of land due to a sudden fall in the ground water level, after a drought for example), tidal waves, flows of water, mud or lava, moving masses of ice or snow." Les catastrophes naturelles en France. Natural disasters in France, CCR: June 2001.
9. See: Les catastrophes naturelles en France. Natural disasters in France, CCR: June 2001. See also: Guy Carpenter and Co., Inc. (2001), *The World Catastrophe Reinsurance Market: 2001*.
10. Les catastrophes naturelles en France. Natural disasters in France, CCR: June 2001.
11. The original name was: Consorcio de Compensación de Riesgos de Motín – Consortium for the Compensation of Riot Risks.
12. See: Law 21/1990 of 19 December 1990, amended by Law 30/1995 of 8 November 1995.
13. With regard to personal insurance: accident coverage taken out separately or as a complement to life insurance or pension plans or funds. With regard to property insurance: fire and natural perils, motor vehicles (damage to vehicle), vehicles running on rails, theft, plate glass, machinery breakdown, electronic equipment and computers, and damage to completed civil works.
14. See: www.fema.gov/nfip/
15. See: www.eqc.govt.nz/
16. Perils insured by the EQC catastrophe coverage are: earthquake, natural landslip, volcanic eruption, hydrothermal activity, tsunami and, in the case of residential land, also storm or flood.
17. See: Guy Carpenter and Co., Inc. (2001), *The World Catastrophe Reinsurance Market: 2001*.

18. See: Gastel, R. (ed.) (2002), *Catastrophes: insurance issues*, Insurance Information Institute, III Insurance Issues Update, April 2002 (available in LEXIS).
19. "A catastrophe bond (cat bond) is an instrument whereby the investor receives an above-market return when catastrophes do not occur, but shares the insurer's or government's losses by sacrificing interest or principal when catastrophes do occur. With cat bonds or other capital market instruments, insurers (and governments as insurers) can pay to transfer catastrophe risk to investors." Kunreuther, H.C., Linnerooth-Bayer, J. (1999), *The Financial Management of Catastrophic Flood Risks in Emerging Economy Countries*, paper presented at *Global Change and Catastrophic Risk Management*, Laxenberg, Austria: IIASA, June 6-9, 1999.
20. Examples of these triggers are: earthquake strength and wind speed.
21. "In contrast to an indemnity contract where the entity providing protection (e.g. the reinsurer) can become insolvent if it suffers catastrophic losses, the firm does not face any credit risk from an indexed-based cat bond. The money to pay for the losses is already in hand. On the other hand, such a cat bond creates basis risk. Basis risk refers to the imperfect correlation between the actual losses suffered by the firm and the payments received from the cat bond. Insurance sold to firms or excess-of-loss reinsurance to insurers has zero basis risk because there is a direct relationship between the loss and the payment delivered by the reinsurance instrument." Kunreuther, H.C. (2001), *Mitigation and Financial Risk Management for Natural Hazards*, *The Geneva Papers on Risk and Insurance*, Vol. 26, No. 2 (April 2001) 276-295.
22. Guy Carpenter and Co., Inc. (2001), *The World Catastrophe Reinsurance Market: 2001*.
23. See: Kunreuther, H.C., Linnerooth-Bayer, J. (1999), *The Financial Management of Catastrophic Flood Risks in Emerging Economy Countries*, paper presented at *Global Change and Catastrophic Risk Management*, Laxenberg, Austria: IIASA, June 6-9, 1999.
24. In 2002, for example, Swiss Re has received USD 255 million of four-year protection against a series of natural catastrophe risks. As part of the transaction, Swiss Re signed a financial contract with PIONEER 2002 Ltd. ("PIONEER"), a special purpose Cayman Islands exempted company and the issuer of the USD 255 million of securities. Subsequently, Swiss Re Capital Markets Corporation, acting as sole bookrunner, privately placed the securities with institutional investors. The proceeds from the offering fully collateralise PIONEER's financial contract with Swiss Re and will serve to replenish Swiss Re's capital should any of the specified natural catastrophes occur. Source: Swiss Re. In 2001 Munich Reinsurance Company announced the successful private placement of a total of USD 300 million of risk-linked securities, the largest ever to provide protection against US hurricane, Californian earthquake and European windstorm events, based on an innovative parametric trigger structure for a package of the three perils. Source: Munich Re.
25. See: Kunreuther, H.C. and R.J. Roth (ed.) (1998), *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*. Washington DC, Joseph Henry Press, especially at Chapter Eight (authored by Robert Klein).
26. In Italy, for example, the Antitrust Authority expressed serious concerns about a pending legislative proposal aimed at setting up a national disaster scheme based on the introduction of a mandatory disaster extension on all fire policies

and on the formation of a special catastrophe insurance pool. See: Decision AS168 of 12/04/1999 in Antitrust bulletin 13-14/1999.

27. "Based on an understanding of the vulnerability of the city or region and the decision processes of the key interested parties, one needs to develop a strategy for reducing losses and providing financial protection to victims of future disasters. This strategy will normally involve a combination of private and public sector initiatives which include insurance and new financial instruments as well as well enforced building codes and land-use regulations. These measures will differ from country to country depending on the current institutional arrangements and existing legislation and laws. In summary, a combination of building codes, reinsurance and indexed cat bonds can form a useful strategy for reducing losses to property owners as well as insurers and the investment community. The implementation of this strategy requires a concerted effort by both the public and private sectors. For example, the implementation of mitigation measures requires inspections by certified personnel. Banks and Financial institutions can play a role in this process by making their mortgage and related loans conditional on such an audit. Insurers can offer lower premiums for those adopting these mitigation measures." Kunreuther, H.C. (2001), Mitigation and Financial Risk Management for Natural Hazards, *The Geneva Papers on Risk and Insurance*, Vol. 26, No. 2 (April 2001) 276-295.
28. "In determining the vulnerability of a city or region one needs to know the design of each structure (e.g. residential, commercial, public sector) and infrastructure, whether specific mitigation measures are in place or could be utilized, and their location in relation to the hazard. (e.g., distance from an earthquake fault line or proximity to the coast in a hurricane prone area) as well as other risk-related factors. The ingredients for evaluating the vulnerability of a city or region to natural hazards are risk assessment and societal conditions. Ideally a risk assessment specifies the probability of events of different intensities or magnitudes occurring and the impact of the direct and indirect impacts of these events on the affected interested parties. Societal conditions include human settlement patterns, the built environment, day-to-day activities and the institutions established to deal with natural hazards" Kunreuther, H.C. (2001), Mitigation and Financial Risk Management for Natural Hazards, *The Geneva Papers on Risk and Insurance*, Vol. 26, No. 2 (April 2001) 276-295.
29. "Building codes mandate that property owners adopt mitigation measures. Such codes may be desirable when property owners would otherwise not adopt cost-effective RMMs because they either misperceive the benefits from adopting the measure and/or underestimate the probability of a disaster occurring. If a family is forced to vacate its property because of damage that would have been prevented if a building code had been in place, then this additional cost needs to be taken into account by the public sector when evaluating the cost-effectiveness of an RMM from a societal perspective. There are several key interested parties who can enforce building codes. Banks and financial institutions could require an inspection of the property to see that it meets the code before issuing a mortgage. Similarly insurers may want to limit coverage only to those structures that meet the building code. Inspecting the building to see that it meets the code and then providing it with a seal of approval provides accurate information to the property owner on the condition of the house. It also signals to others that the structure is disaster-resistant. This new information could translate into higher property values if prospective buyers took the earthquake risk into consideration when making their purchase decisions." Kunreuther, H.C. (2001), Mitigation and Financial Risk Management for Natural Hazards, *The Geneva Papers on Risk and Insurance*, Vol. 26, No. 2 (April 2001) 276-295.

30. "An alternative way to encourage consumers to adopt mitigation measures is to change the nature of their insurance coverage rather than reducing the premium. More specifically, the insurer could offer a lower deductible to those who adopt mitigation at the same or lower price than if they had decided not to invest in the RMM. Such a program is likely to be very attractive given the empirical and experimental evidence that suggests that consumers appear to dislike deductibles even though they offer considerable savings in premiums." Kunreuther, H.C. (2000), Insurance as a Cornerstone for Public-Private Sector Partnerships, *Nat. Hazards Rev.*, 1, 126-136.
31. Camerer and Kunreuther, "Decision Processes for Low Probability events: Policy Implications", 8 *Journal of Policy Analysis and Management* 1989, 565-592.

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