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Risk Awareness, Capital Markets and Catastrophic Risks

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Foreword

The growing impact of major disasters on OECD and non-member economies has stimulated a demand for an in-depth evaluation of possible strategies to reduce their large-scale damaging effects. Recent dramatic events, such as the earthquakes that struck China's Sichuan Province in 2008 and both Haiti and Chile in 2010, and the major flooding that occurred in Pakistan in 2010, have brought the financial management of catastrophic risks once again to the forefront of the public policy agenda globally.

In order to promote the development of sound policies, the OECD established an International Network on the Financial Management of Large-Scale Catastrophes. Under the guidance and intellectual leadership of a High-Level Advisory Board, the Network promotes the exchange of information and experiences among policymakers, industry, and academia in OECD and non-member countries.

This publication contains work conducted under the auspices of the International Network and its High-Level Advisory Board,[1] namely:

- *Stocktaking report on risk awareness and education on natural catastrophes*: The growing costs of catastrophes and awareness of their implications for economic growth and development have raised concerns over the level of awareness of catastrophe risks and risk mitigation tools, including insurance schemes that reduce financial exposures. This report contains a stocktaking of country efforts to raise awareness and education regarding natural hazard risks and risk reduction measures, identifies good practices, and advances policy recommendations on awareness and education on catastrophe risks. This report led to the development of a *Policy Handbook on Natural Hazard Awareness and Disaster Risk Reduction Education* (2009), which does not appear in this volume but is available on the OECD website.

- *Catastrophe-linked securities and capital markets*: While traditional insurance and reinsurance markets provide a key mechanism for the transfer of catastrophe risks, capital markets are increasingly becoming a source of risk capital. Catastrophe-linked securities provide risk management tools for insurers and reinsurers as well as for firms and governments. The OECD has prepared a report that explores the nature and growth of these securities and recommends actions for policymakers interested in furthering their growth.

This publication has been prepared with the assistance of Timothy Bishop and Cécile Vignial from the OECD Financial Affairs Division, and with technical support from Angélique Servin and Edward Smiley.

[1] For earlier work on large-scale catastrophes conducted under the International Network, see *Policy Issues in Insurance*, Vol. 12, OECD, Paris. For further information on the International Network and its High-Level Advisory Board, see *www.oecd.org/daf/fin/catrisks*

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Part I

Stocktaking Report on Risk Awareness and Education on Natural Catastrophes*

The growing cost and frequency of natural catastrophes and their implications for economic growth and development have led to a concern over the level of public awareness and education relative to large-scale catastrophes and disaster risk reduction measures. Given the increasing impact of human activity on the scale and costs of catastrophes triggered by natural hazards, systematic promotion of public awareness and education of risks and risk reduction measures, including financial loss-sharing and risk transfer tools, is increasingly acknowledged as an important component of national and international strategies to reduce vulnerability and losses from catastrophic events.

This report presents a stocktaking of selected country efforts to raise public awareness and education of the impact of natural hazards and to enhance awareness and education regarding risk mitigation measures, as well as financial coverage and protection. It covers the public, education, private and civic sectors of 13 selected OECD and emerging economy countries.

The stocktaking suggests that, despite the presence of risk awareness and risk reduction education in many countries, there remains significant scope for enhancement. Promoting awareness and education of natural catastrophe risks and, in particular, risk reduction measures can encourage voluntary risk reduction activities, as well as strengthen public support for compulsory risk reduction measures such as land use planning, building codes, environmental stewardship and, where applicable, insurance schemes. The re-direction of focus from response to preparedness, risk reduction and financial should be accelerated.

* This report was prepared by Risk RED and in particular by Drs. Rebekah Green and Marla Petal. The report and the policy recommendations reflect the views of the authors and is released under their responsibility.

Summary

The growing cost and frequency of natural catastrophes and their implications for economic growth and development have led to a concern over the level of public awareness and education relative to large-scale catastrophes and disaster risk reduction measures. Public awareness and education of disaster risk reduction are, in particular, increasingly acknowledged as important components of effective risk management of natural catastrophes. The financial component of disaster risk management and mitigation strategies, involving risk transfer and compensation strategies, is also recognised as being important for reducing the financial impact of catastrophes on individuals, businesses, and governments, and permitting more rapid economic and social recovery. As such, systematic promotion of public awareness and education of risks and risk reduction measures, including financial loss-sharing and risk transfer tools, is an important aspect of national and international strategies to reduce vulnerability and losses from catastrophic events.

It is recognised in many OECD and non-OECD countries that public awareness and education of natural catastrophe risks must be enhanced. Ongoing education, development, and implementation of related risk reduction measures should be supported. Given the increasing impact of human activity on the scale and costs of catastrophes triggered by natural hazards, these efforts are important for reducing the physical, economic, and social costs of natural catastrophes. In some cases, measures can also help to prevent their occurrence. Risk awareness and education efforts must also take place at every level of society – at the individual, business, civil society, and government levels. Effective and efficient risk mitigation strategies are often beyond the means and control of individuals and must be undertaken by a wide range of players, including governments, industry, educational institutions, the civic sector, and other stakeholders.

In recognition of the importance of public awareness and education of natural catastrophe risks and risk reduction measures for the effective management of large-scale disasters, the OECD commissioned a stocktaking of selected country efforts to raise public awareness and education of the impact of natural hazards and to enhance awareness and education regarding risk mitigation measures, including financial coverage and protection. The stocktaking covered the public, education, private and civic sectors of 13 selected OECD and emerging economy countries. Hazard-prone OECD countries were selected for the stocktaking, including Iceland, Italy, Japan, Mexico, New Zealand, Portugal, Turkey and the United States. Less hazard-prone countries were added for comparison purposes, including the United Kingdom, Spain and Canada. Finally, the two largest emerging economies outside the OECD, namely China and India, were included both for their population size and the diversity of the hazards that each face.

All of the countries surveyed had some risk awareness and preparedness information that is distributed or made available to the general public by civil defence or other ministries. Memorials and museums located at past disaster sites, hazard resistant construction seminars and materials, and mock evacuations and disaster drills were also

present in many countries. Some countries have risk education in their national curriculum, while others have developed voluntary programs for risk awareness and risk reduction education in the schools. Some insurance companies and consortiums are directly targeting the public with mass marketing campaigns and information dissemination. There are also examples of large corporations providing or funding risk reduction education for the general public and their employees. Within the growing global awareness of the importance of community risk reduction, the International Federation of Red Cross and Red Crescent Societies and many national civic organisations have also recently begun to include risk reduction education as part of their strategies. The United Nations, through its International Strategy for Disaster Reduction (UNISDR), has been active in internationally promoting better awareness and education of disaster risks and especially disaster risk reduction strategies. International efforts have focused on increasing awareness of national governments and policy makers regarding the risks facing their country and the ways they can reduce catastrophic losses.

Despite the presence of risk awareness and risk reduction education in many countries, there remains significant scope for enhancement. Many government-sponsored and civil society programs continue to put heavy emphasis on emergency response and citizen response-preparedness. While important, this focus often fails to emphasise the individual and collective actions that can be taken prior to a disaster and may even promote a sense of public helplessness. As evidenced in this stocktaking, a re-direction of focus from response to preparedness, risk reduction and financial protection is occurring, although the change is often slow.

Awareness and education efforts in all sectors could be improved by promoting land use planning, building codes, and insurance schemes as a means of minimising or spreading risk. Furthermore, most countries assessed do not include risk awareness or risk reduction education as a fully-integrated part of school education. While innovative education exists for school age children and their families, it is often implemented in an ad hoc and voluntary way, reducing its impact. Within the private sector, insurance and financial education programs may benefit clients by including or further emphasising risk awareness and natural catastrophe insurance education. Regardless of target group or sector of origin, all risk awareness and risk reduction education programs should seek to be tailored to the particular hazards, vulnerabilities and capacities of its citizens, and improved through evidence-based monitoring and evaluation.

This initial stocktaking suggests that promoting awareness and education of natural catastrophe risks and, in particular, risk reduction measures can encourage voluntary risk reduction activities, including such key measures as safe construction, retrofitting and household preparedness. As part of a broad national risk reduction strategy, it can also strengthen public support for compulsory risk reduction measures such as land use planning, building codes, environmental stewardship and, where applicable, insurance schemes. Raising public awareness regarding natural catastrophic risk and risk reduction strategies is a key component in the promotion of a culture of safety within a nation's borders and beyond. Risk awareness and risk reduction education is a foundation and pre-requisite for effective catastrophic risk management and disaster risk reduction.

Introduction

On December 26, 2004, tens of thousands of citizens in countries surrounding the Indian Ocean, together with thousands of foreign visitors, felt the shaking of an earthquake. Many were unaware of the potential of a devastating tsunami following such seismic events. Much of the affected coastal construction was vulnerable to seismic vibration and tsunami inundation; during the preceding decades, coastal mangrove forests, which could have reduced the impact of a tsunami wave, had been systematically destroyed. At the cessation of shaking, most people did not immediately evacuate to higher ground. More than 250,000 people lost their lives in the tsunami that followed.

Less than a year later, thousands of New Orleans residents did not or could not leave when public evacuation announcements were made regarding Hurricane Katrina. After the hurricane passed, they were trapped when ill-conceived, under-funded and poorly maintained levees were compromised and the city flooded.

In 2007, the British Isles were overwhelmed by a series of record rainfall and flood events. Commissioned studies following the extensive flooding showed that most people perceived flood risk to be lower than it actually was. When their houses flooded, most residents did not know how to best protect themselves and their property (Pitt 2007).

Today, Japanese and United States residents continue to balk at the perceived high cost of earthquake insurance. Others are surprised to find that past, and even some present-day, building codes do not mandate key hazard resistant features (Tanaka 2005).

Across the globe, citizens from a diverse range of countries are exposed to cyclones, floods, earthquakes and other natural hazards. Most citizens and policy makers are insufficiently aware of the complex risks to which they are exposed. They lack in-depth understanding of the various risk reduction measures they might adopt to reduce their losses. All are drawn unwittingly into amplifying the magnitude of disasters.

Both the United Nations and the Organisation for Economic Co-operation and Development (OECD) report that the economic and human impact of disasters has risen in recent decades (UNISDR 2004). The 20 most costly catastrophes for the insurance industry have all occurred since 1987 (Kunreuther, Meyer, and Michel-Kerjan 2007). Scientific assessments of global climate change suggest that hydro-meteorological hazards such as drought, flash flooding and cyclones may be increasing in both frequency and average intensity. Global population growth and increasing urbanisation in floodplains, on hillsides, and along vulnerable coastal and seismic zones, puts a growing number of human lives and assets in hazard-prone locations. As living standards rise, better construction has reduced the damages from disasters, yet in some areas has also led to increased asset exposure.

The growing costs of catastrophes and awareness of their implications for economic growth and development have led to a concern over public awareness of catastrophe risks and risk mitigation tools, including insurance schemes that can reduce physical and

financial exposures. When ill prepared, cities, regions, and countries can be devastatingly impacted by disasters. Major disasters have economic and social repercussions throughout the region in which they occur, and can affect regional stability and the global economy. Humanitarian responses can only marginally address these issues. The systematic promotion of public awareness and education of risk and risk reduction strategies, including financial loss-sharing and risk transfer arrangements, is increasingly seen as a foundation and pre-requisite for effective catastrophic risk management and disaster risk reduction.

Recognising these trends, the United Nations declared the 1990s to be the International Decade for Natural Disaster Reduction (IDNDR). This was followed by the commitment of 168 nations to the *2005-2015 Hyogo Framework for Action: Building the Resilience of Nations and Communities to Disasters*, led by the ongoing, UN-led collaborative International Strategy for Disaster Reduction (UNISDR). Priority Three of the *Hyogo Framework* highlights the importance of public education. The goal is "to build a culture of safety and resilience at all levels through the use of knowledge, innovation and education". For disaster reduction to be achieved, governments must enhance public awareness of risks and support ongoing learning, development, and implementation of risk reduction measures (Davis, Hosseini, and Izadkhah 2003).

These trends have also prompted OECD members to be increasingly concerned about the considerable and long-lasting damage that major natural hazards might inflict on global economies and societies. In particular, the financial management of large-scale catastrophes has become a priority topic in the policy agenda of governments in OECD member and non-member states. The OECD has undertaken substantial work in this field over the last years.

In 2003, the OECD International Futures Programmes carried out a major project to define emerging risks in the 21st Century. In parallel, the OECD Insurance and Private Pensions Committee, as well as the OECD Committee on Financial Markets, debated and analyzed the role and capacity of insurance and financial markets to manage and mitigate the losses from natural catastrophes. These efforts focused on implications both for policy makers and insurance and financial market players. This analytical work led to two publications (insurance and expanding systemic risks; the role of insurance in the management of environment-related risks (OECD 2003a, 2003b)). It also led, in 2004, to the organisation of a global *OECD Conference on Catastrophic Risks and Insurance* that involved non-OECD countries, including China, India and Indonesia. The proceedings and main policy recommendations drawn from this conference were published in 2005 (OECD 2005a).

As a follow-up to this first sharing of experiences, knowledge, and expertise, and in response to the increasing impact of large-scale catastrophes in both OECD and non–OECD countries, the OECD launched an *International Network on the Financial Management of Large-Scale Catastrophes* in 2005. The *International Network*, established under the aegis of the Insurance and Private Pensions Committee and the Committee on Financial Markets, is intended to bring together interested experts from OECD and non-OECD countries to promote the exchange of information and experiences on the financial management of large-scale natural catastrophes and the development of more effective financial tools and risk mitigation strategies. The *International Network* operates under the strategic leadership of a High-Level Advisory Board, composed of selected high–level experts and executives from OECD and emerging market economies.

The first conference organised under the auspices of the *International Network* took place in Hyderabad (India) in February 2007.

One of the conclusions of the conference was that risk awareness and literacy are essential for disaster preparedness and can help in sustaining financial risk mitigation tools, such as voluntary or mandatory insurance schemes. The Advisory Board to the Network considers it important to promote awareness at all levels of society, especially top-level government decision-makers and elected officials, and to initiate action as promptly as possible. Enhancing risk awareness and education requires a long-term, sustained effort. Some OECD member countries have identified risk awareness and education as being deficient in their countries and as requiring increased attention and support.

The OECD has also undertaken work on the related issue of financial education, which presents similar issues and challenges. A comprehensive project on financial education was initiated in 2003, culminating in an OECD Recommendation on principles and good practices in 2005 (OECD 2005b). G8 leaders endorsed the work of the OECD on financial education in 2006. Further work has since been undertaken, including a comparative report and good practices that will be published on the issue of awareness and education of risks and insurance (OECD, 2008). The issue of financial education has also been pursued in the context of private pensions.

Given the importance of promoting awareness and education of disaster risks and risk mitigation strategies in OECD and non-OECD countries, the OECD decided to commission this stocktaking report. The aim of the report is to conduct an initial stocktaking of country efforts to raise awareness and education regarding natural hazard risks and related risk reduction measures, including financial coverage and protection mechanisms. This stocktaking encompasses selected OECD member countries and emerging economies. It identifies good practices and serves as the basis for policy recommendations on awareness and education of risks and risk reduction as a means for strengthening national strategies for catastrophic loss reduction. In particular, it addresses these issues in the context of developed and emerging market countries where financial losses from catastrophes have risen rapidly, even as causalities have stabilised or even fallen. In these countries, physical mitigation and financial loss reduction tools have become increasingly important in national-level strategies for catastrophic loss reduction.

The stocktaking and policy recommendations contained hereinafter are meant to complement UNISDR's efforts to support and promote risk awareness education and disaster risk reduction programs globally. The UNISDR's efforts have been particularly dedicated to mainstreaming disaster risk reduction globally, but especially within development goals of low-income countries.

In this regards, the OECD project is more directly privileging a governmental-level approach addressed primarily to OECD countries and major emerging economies. In the context of the *International Network*, the project also recognises the important role that the insurance sector can play in raising awareness of risks and related risk mitigation strategies, possibly in partnership with the government and/or the local community.

Chapter 1

Analytical Framework

1.1. Definitions

The management of large-scale catastrophes has emerged from combined concerns of earth science, engineering, economics, civil defence, public safety and environmental protection over the past 30 years (McClure 2006; Petal 2008; Ross 1989). Whereas in the past, "natural disasters" or "natural catastrophes" were thought of as one-time occurrences caused by hydro-meteorological or geological events, they are now beginning to be recognised as the combined result of human activity and the natural environment.

Box 1.1. **Key Definitions**

(UNISDR 2004, except*)

Natural hazards* Natural hydro-meteorological or geophysical processes or phenomena that may give rise to a disaster if mitigation measures are not undertaken.

Vulnerability The conditions determined by physical, social, economic and environmental factors or processes that increase the susceptibility of a community to the impact of hazards.

Risk The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions.

Disaster A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.

Disaster risk reduction (disaster reduction) The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development.

Resilience The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.

Public and government awareness The processes of providing information to the general population and policy makers, and increasing levels of consciousness about risks and how people can act to reduce their individual and collective exposure to hazards.

Culture of safety* A widespread consciousness of hazards, risks and vulnerability and the understanding and ongoing adoption of measures for disaster prevention, risk reduction, and community resilience.

With a deepening understanding of catastrophes and the recognition that their severe impacts have root causes in human decisions, has come an understanding that the magnitude of disasters can be significantly reduced. They can be mitigated by actions that prevent and reduce impacts, give prior warning, and spread financial risk. As such, there are *natural hazards* and *natural phenomena* but not "natural" disasters or catastrophes. The goal of disaster/risk/emergency management has begun to shift from relief-centric response to disaster risk reduction and prevention. The need for large-scale emergency response can now be seen as a measure of human failure to reduce risk. With this growing consensus regarding the nature and origin of disasters, a common understanding of key terms is emerging (UNISDR 2005; Wisner et al. 2004).

Hazard, vulnerability and risk

Crucial to a discussion of the management of large-scale catastrophes are the concepts of hazard, vulnerability, and risk. *Natural hazards* have historically referred to natural processes or phenomena that can potentially cause harm to humans or the natural or built environments upon which they rely. These phenomena can include geophysical events (such as earthquakes, landslides, and volcanic eruptions) and hydro-metrological events (such as tropical cyclones, tornados, floods, temperature extremes and wild fires).

Many of these hazards have at least some origin in human behaviour. Global warming, a human-triggered meteorological phenomenon, may become a significant hazard in the near future, both increasing global temperatures and altering the frequency and intensity of hydro-meteorological hazards. The destruction of rainforests can worsen flash flooding and the destruction of mangroves can reduce environmental buffers to storm surge and high winds. While the term "natural hazards" is losing salience as we become more aware of how humans affect the natural environment, it is still often used to distinguish hazards with an environmental trigger from those hazards that are triggered by technological accidents or terrorist activity (Cutter 2002).

While hazard events are a frequent and permanent condition of the biosphere, the effects of such events on humans are dependent upon the actions of the society in which the event occurs. *Vulnerability* to natural hazards refers to the physical, social, economic and environmental conditions that increase susceptibility of a community to the impact of hazards. *Risk*, or the probability of loss, refers to the disastrous consequences expected from a hazard event. Conventionally risk is expressed as a function of hazard and vulnerability, or Risk = Hazard *x* Vulnerability (Wisner et al. 2004).

Disaster risk reduction

A *disaster* is defined as a disruption in social functioning with human loss and damages great enough that the affected community needs outside help to cope with and recover from the event. Reducing the devastating impact of natural hazards can be achieved through human actions that limit asset exposure to the natural hazard or decrease human vulnerability to it (Bankoff 2003; Pelling 2003; Wisner et al. 2004). This process is termed *disaster risk reduction*.

Box 1.2. **Examples of Disaster Risk Reduction Strategies**

Land use planning: e.g. restricted zoning along seismic faults, in landslide prone areas, and coastal zones, development buffers in areas of fire hazard.

Building codes and enforcement: e.g. increased strength requirements for buildings in seismic zones, specifying wind resistant facades in areas of high winds.

Environmental stewardship: e.g. protection and restoration of protective environments such as wetlands and mangroves to reduce cyclone impact on human settlements

Structural and non-structural mitigation: e.g. strengthening weak structures, properly securing non-structural building elements and building contents, raising flood prone structures

Early warning: e.g. tsunami warning and response systems, hurricane forecasting that trigger preparedness activity or evacuation.

Response- preparedness capacity building: e.g. hazard drills, stocking of emergency supplies, emergency response training.

Financial coverage of risk: e.g. Household and business insurance, reinsurance, compulsory insurance schemes, insurance pools, alternative financial market solutions, public-private ex-ante financial schemes, etc.

To reduce the impact of natural hazards, communities benefit from knowledge of the nature, frequency and potential severity of the physical phenomena that may affect them. It is more important, however, that a community understands its particular vulnerabilities and capacities with respect to the hazards it faces. This includes recognising who is likely to be exposed to a hazard, what human and physical resources might be damaged by such an event, and what community strengths may be drawn upon to develop effective resilience against the hazard. Finally, and most importantly, communities need to learn the specific preventative measures they can take to reduce their vulnerability to hazards.

Towards a culture of safety

As the members of a society begin to understand the natural hazards they are likely to face, their own vulnerabilities to such hazards, and their capacity to reduce the impact of these hazards, they begin to understand that catastrophic loss is not inevitable. Societies can begin to move away from a culture of reaction – one where disasters are seen as inevitable and resources are focused exclusively on emergency response – to one of prevention and safety. When there is a *culture of safety* -- also referred to as a culture of prevention or a culture of risk -- the focus is on reducing the risk of human, infrastructure and financial losses both before a hazard event occurs and in redevelopment following a disaster. There is a society-wide understanding of risk reduction strategies that leads to the adoption of ex ante and ex post strategies through policies, regulations, incentives and individual action.

Past interventions at the national and international level have achieved a culture of safety in arenas outside of natural hazard risk. For example, childhood vaccination campaigns have been slowly changing public perception of disease prevention and have led the way to vaccination requirements in wealthy countries and disease irradiation campaigns globally. This has dramatically decreased losses resulting from a host of crippling and deadly diseases. In the United States, the safety-belt campaign has been

successfully promoted as a means of reducing fatalities in automobile accidents. Public awareness campaigns led to the adoption of safety-belt usage laws and enhanced car manufacturer regulations, bringing safety-belt usage from 11 percent in 1980 to 82 percent in 2005 (NHTSA 2005). These campaigns were multi-decadal, achieving first public awareness, then voluntary behavioural change, and finally institutionalisation through policy adoption.

To achieve the successes seen in other national and global campaigns, the push for disaster risk reduction and a corresponding culture of safety will need to be an on-going and sustained effort over multiple decades and across all sectors of society (Anderson 2005; Johnston et al. 2005; Mileti et al. 2004). A fundamental first component of this effort is awareness and education on natural hazard risks and disaster risk reduction strategies.

1.2. Importance of awareness and education of risks and risk reduction

Although public education regarding disasters has historical roots that can be traced back further, concerted efforts began less than 30 years ago (Lidstone 1996). Initial efforts were limited to hazard awareness and response preparedness. More recently, two complementary efforts have gradually begun to emerge - risk awareness and risk reduction education.

Risk awareness education

Awareness and education of natural hazard risks, hereinafter called *risk awareness education*, seek to impart knowledge regarding local hazard phenomena and the damaging effects these hazards may have on a society. Risk awareness education encompasses understanding natural and biological mechanisms that may create hazards and the human vulnerability to these hazards. During the International Decade for Disaster Reduction (IDNDR), risk awareness education became part of various geography and science classrooms and many public risk awareness programs were created in economically developed nations. Since then, desktop publishing and the widespread use of the internet have significantly expanded the outreach of these early efforts. At the national policy level, OECD's broad work on good practices to enhance risk awareness and education on insurance issues has also promoted stronger risk awareness and insurance education programs in both the insurance and public sectors for a range of catastrophic and non-catastrophic risks (OECD 2007).

Risk reduction education/capability

Awareness of hazards and vulnerability (and thus of natural hazard risks) will not, by itself, produce risk reduction behaviour. An emphasis on natural hazards and risks can unwittingly impart a message that nature is too powerful and that there is nothing anyone can do to prevent disasters. A focus on the destructive forces of natural hazards or an overarching focus on emergency response can heighten a sense of fatalism in a population, reducing the development of a culture of safety (Finni 2004; Lehman and Taylor 1988; Mulilis and Duval 1995).

Awareness and education of disaster risk reduction measures - or *risk reduction education/capability* – are necessary and crucial component of a culture of safety. Risk reduction education seeks to educate and engage citizens in undertaking effective

preventative and mitigation measures that can reduce exposure and vulnerability to natural hazards. Knowledge of efficient and effective risk reduction strategies and measures, including possible financial risk-sharing and risk-transfer arrangements, is an important element of public risk reduction education for individuals, businesses, civil society, and governments.

Risk reduction education generally increases public knowledge and support for four broad spheres of action (Krischenbaum 2002; Petal 2004):

1. *Assessment and planning.* The identification of natural hazard risks, human vulnerability and capacity mapping are assessments that can lead to risk reduction planning, such as land use planning, early warning, business continuity or household preparedness planning. Setbacks, buffer zones, property management and building placement have all been used as strategies for reducing exposure to natural hazards.

2. *Physical protection.* Physical protection strategies are primary prevention strategies, and while they do not eliminate hazard exposure, they reduce casualties and property loss associated with that exposure. Measures include the use of building codes, retrofitting programs, and non-structural guidelines for securing physical assets. Fire and flood retardant material usage, clear exit paths, and adequate street widths to ease access for emergency services are also examples.

3. *Response-capacity.* Building emergency response capacity, while not a primary prevention strategy, can limit loss during and immediately following natural hazard events. Examples of this include early warning, evacuation plans, "community emergency response" skills, and emergency provision stockpiling. In the post-emergency state, strategies for efficient claims handling by insurance and reinsurance agencies can help reduce confusion and speed recovery.

4. *Environmental stewardship.* Risk reduction measures increasingly include the maintenance and enhancement of environmental systems that can buffer or minimise impacts from natural hazard events. Restoration of natural buffers can include planting mangroves to better protect coastal areas from storm surge, improving land cover to reduce landslide risk, and restoring wetlands to act as reservoirs for flood waters. Consensus is also building for stronger policies to reduce green house gas emissions and slow global climate change.

Risk reduction education also has the capacity to enhance awareness and use – at the individual, industry, and governmental level -- of financial protection tools that can facilitate physical and economic recovery from hazard events (OECD 2005a). These tools include private insurance and reinsurance markets, dedicated catastrophe insurance and reinsurance programs and reinsurance arrangements, insurance pools, and alternative financial market solutions (e.g. catastrophe bonds).

1.3. Framework for understanding risk awareness and risk reduction education

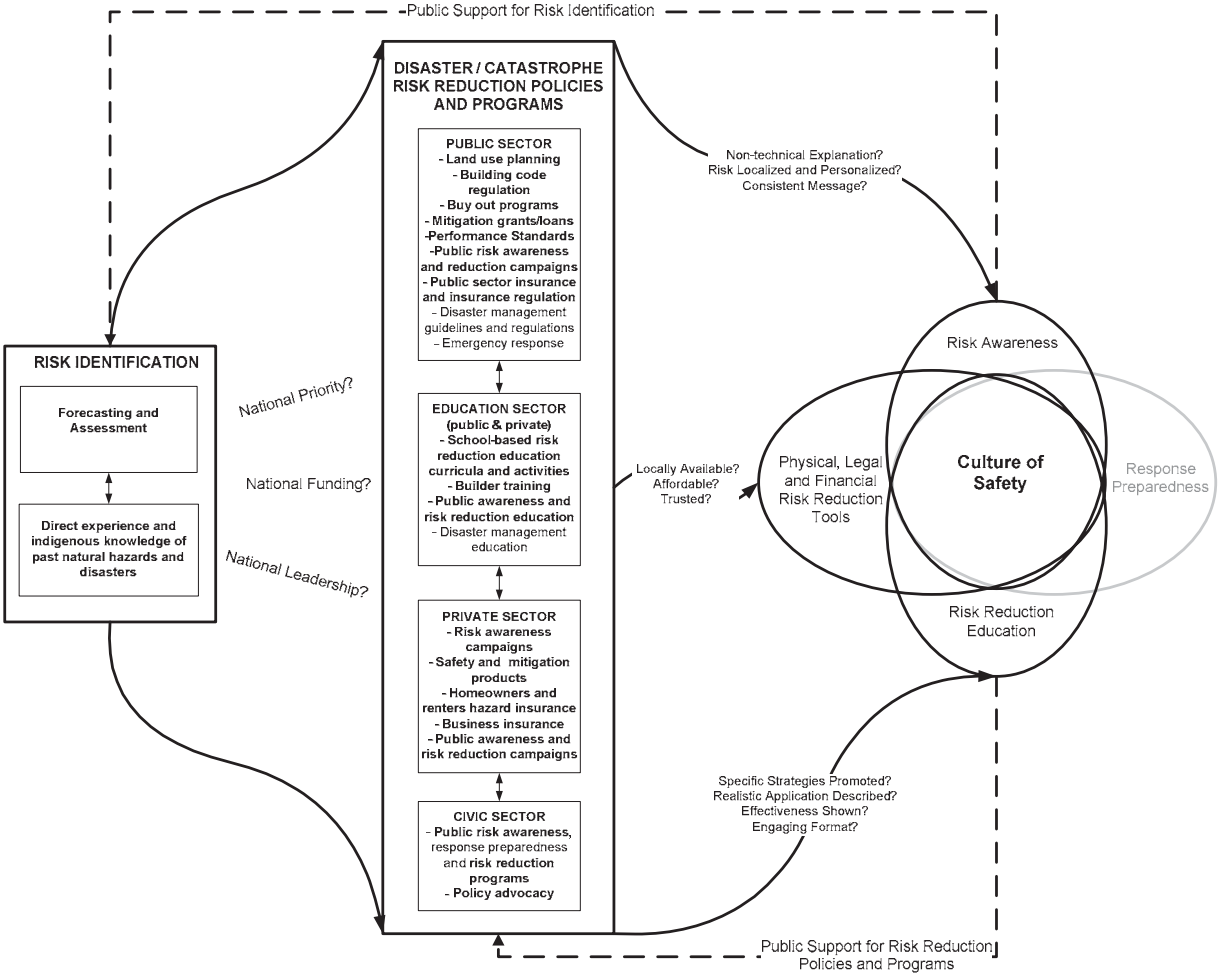
Figure 1.1 illustrates a framework whereby a culture of safety is developed. Risk awareness and risk reduction education start with a community's experience and interaction with its natural environment. This begins with the identification of natural hazards and the disasters they may trigger - whether through direct experience, historical knowledge, or probabilistic estimates of future events. Typically, in complex societies, the identification and quantification of natural hazard risks are carried out by public and

private agencies, based upon the degree to which risk management is prioritised and funded by the national government and supported by the public.

The general public typically comes to understand hazards, risk, and risk reduction strategies as the risk information is filtered through the public, private, civic and education sectors. The roles of each sector in supporting and developing risk awareness and risk reduction are listed in Figure 1.1. Strategies that focus on risk awareness and risk reduction education prior to a hazard are highlighted in bold text, including land use planning, codes and mitigation. Strategies that can decrease the likelihood that the hazard event will become a disaster, reduce the need for and dependence on emergency responses, and promote the spreading of financial risks are also listed in bold. Those activities that can lead to safer actions during a hazard event are listed beneath in plain text. These secondary loss-reduction activities are of vital importance when physical and financial loss reduction strategies have not, or cannot, completely prevent loss.

Risk information that is properly filtered through programs and policies can help to support the development of a culture of safety. A community that possesses a culture of safety is one that is aware of risks, has knowledge of mitigation strategies, and actively employs these strategies in an effort to not only manage risk, but reduce it.

Figure 1.1. **From Natural Hazard Risk Identification to Implementation of Countermeasures**



Four components underpin the successful attainment of a culture of safety:

- First, programs and policies endeavour to raise *awareness* -- among individuals and policy makers -- of the risks posed by natural hazards. This risk awareness education at all levels of society is directly linked to the degree that **risk information is provided in a non-technical, personalised, and consistent manner**.
- Secondly, programs seek to educate individuals, businesses, civic organisations, and government representatives about the range of *risk reduction tools and strategies* that can be employed to reduce physical and financial exposure to hazards. Risk reduction education strategies will be most easily accepted when the promoted **risk reduction strategies are specific and realistic for local conditions and disseminated through an engaging format**. Trust in the efficacy of these risk reduction strategies will increase when the effectiveness of these strategies is also promoted.
- Thirdly, governments, businesses and households must have *access to physical, legal, and financial tools* for addressing natural hazard risk. These tools are more likely to be adopted when they are **locally available, affordable, and are of sufficient quality** so as to engender public trust in their effectiveness.
- Finally, policies and programs support individual, organisational and community *response capacities*. This serves to reduce losses when risk reduction tools are insufficient. (Because response preparedness is beyond the scope of this report, this aspect of disaster risk reduction has only been included in the stocktaking effort when it is integrated into risk awareness and risk reduction education.)

The first three components - risk awareness education, risk reduction education, and the availability of risk reduction and protection tools – help create an environment that supports the implementation of risk reduction strategies and the pooling of financial risk. These components, along with adequate disaster response capacity, form the foundation of a culture of safety.

How it can work

In countries where risk awareness and risk reduction education have been ongoing and sustained, changes in perception and behaviour have been achieved, especially when multi-decadal public education campaigns have been in combination with the development of efficient risk reduction tools. For example, the institutionalisation of annual earthquake drills, student risk reduction education, and a corresponding public media campaign was seventeen years in the making in Iran (Izadkhah and Davis 2006). In the United States, efforts to raise awareness about how strict building codes can limit damage from hurricanes are several decades old. While significant progress has been made, it was only following Hurricane Katrina that some Gulf Coast states adopted international construction standards in coastal jurisdictions (ICC 2006).

Successful risk awareness and reduction education programs are ones that have been sustained, repeated, and consistent across the public, education, private and civic sectors. They are carried out through parallel and collaborative action of governmental bodies, insurance sector representatives, corporate leaders, civil society organisations, and educational institutions.

Many governmental bodies have set disaster risk reduction strategies and priorities, as well as written and enforced important legislation regarding land use planning and building codes. Some have created incentives for risk-wise behaviour in the general public and played a leading role in promoting disaster risk awareness and risk reduction education in communities within and beyond their jurisdiction. Some governments have partnered with the civic and education sectors to facilitate, support, disseminate and fund education initiatives, set guidelines for educational curricula, and institutionalise risk awareness and risk reduction education within national curricula. Where the public has failed to take risk reduction steps voluntarily, many governments have set policies for mandatory risk reduction measures and encouraged public acceptance of these measures.

Insurance companies and industry consortia (private and public sector) have had an important role to play in designing and providing appropriate, effective, accessible and affordable tools to protect households and the economy against the financial consequences of large-scale disasters. These products attempt to provide incentives for individuals and businesses to adopt risk reduction measures. Some insurance companies and industry consortia have worked with the civic, private and education sectors to also educate current and potential policyholders about risks, risk insurance, and risk reduction measures. Significantly, many companies in the insurance and reinsurance industry have played a key role in developing risk mapping and risk modelling, sometimes in partnership with the public sector.

The corporate sector has also played an important role in risk awareness and risk reduction education. Many businesses have developed continuity planning, serving as a role model for similar processes throughout society. Through internal and community service initiatives, companies have also encouraged risk reduction and preparedness in their communities and funded civic sector risk awareness programs. Through innovation and technology development, they have supplied communities with the tools to carry out effective risk reduction. For those businesses involved in the production and maintenance of the built environment, adoption of physical protection measures has directly impacted the physical vulnerability of a community as well as public understanding.

The civic sector has played a key role in educating communities about risks and risk reduction strategies, often acting as a liaison between scientific and local community-based implementation efforts. Community organisations have offered indigenous leadership, social networks, and often provided much needed energy to reach out to and engage community members (Victoria 2005). They have also acted as a catalyst to bring communities together to support and even demand risk reduction strategies and tools from both the private and public sectors. Partnering with the public, private and education sectors, they have worked to produce and disseminate important risk awareness and risk reduction education material.

The formal education sector, whether government-sponsored, community-supported, or privately funded, has often taken up the task of imparting awareness of risks and risk reduction to students of all ages. Yet, this sector has often lacked a clear mandate, resources, training and teacher support to enable teachers and administrators to fully incorporate risk awareness and risk reduction into formal and informal education.

Through long-term strategic plans, each sector can seek ways to enhance their impact through partnership collaboration and by building upon the efforts and lessons learned across all sectors, jurisdictions and boundaries.

1.4. Challenges to risk awareness and risk reduction education

Risk awareness and risk reduction education play key roles in catastrophic risk management. Yet the complexity of learning and adopting risk reduction measures suggested by the "transtheoretical model of learning" indicates that there are significant challenges. The transtheoretical model of learning proposes that when challenged with a call to action, people go through a series of steps. These steps include pre-contemplation, contemplation, preparation, action, and finally maintenance of preparation (Velicer et al. 2006). Risk awareness and reduction education must scaffold this process of change and build a sense of personal and collective efficacy, avoiding past strategies that focused public understanding on post-event emergency response.

The research described below details some hindrances to effective risk awareness and risk reduction education. These challenges suggest reasons for both the limited number of programmes and the perceived marginal efficiency of these programmes. Unfortunately, these challenges have often been used as excuses for inaction.

Limited knowledge

At a basic level, knowledge of hazards is often limited due to the low probability of these events. It has only been in the past century that many geophysical and hydro-meteorological hazards have been scientifically understood and quantitatively measured. Despite the rapid advancements in the field, great time lapses between events and potential multi-decade and even multi-century variation make precise prediction of events difficult and often impossible. The field of risk assessment is often fraught with uncertainty that, while often quantifiable, is difficult to express in non-technical terms to policy makers and the general public.

Understanding terminology

The use of advanced mathematical concepts of probabilities to express risk is notoriously problematic in risk awareness and reduction education. While probabilities, recurrence intervals, and frequencies often help quantify uncertainty in the scientific community, they are difficult concepts to convey accurately beyond this community. Evidence suggests that individuals do not seek out information on risk probabilities when making decisions (Camerer and Kunreuther 1989). Instead, people rank risks relative to one another, although they often fail to accurately calibrate their rankings (Kunreuther, Meyer, and Michel-Kerjan 2007).

People are more able to understand and incorporate probabilistic concepts when presented as concrete comparisons with other familiar hazards (Kunreuther 2001). It is easier for people to think in terms of the chances of an event occurring in "my lifetime" or "my children's lifetime" than in probabilities of occurrence within a set timeframe. Even so, probabilistic expressions of risk often have little immediacy to risk reduction strategies and possibly even negative impact on risk-wise behaviour (Gupta 2002; Paton, Smith, and Johnston 2005).

Use of scientific or technical terms is also problematic when presenting risk reduction strategies to policy makers and the public. Research conducted by *State Farm* for the *Institute for Business and Home Safety* suggests that explanations using the term "mitigation" may be less effective than those that stress "protection." Positive, non-

technical terms such as "disaster protection", "disaster safety", "family protection" and "community safety" are more effective when communicating with the public.

Risk perception

Even when risks are accurately portrayed in multiple, non-technical ways, they are understood and personalised differently across populations (Hurnen and McClure 1997). Research in the United Kingdom has shown that Environmental Agency flood warnings issued about specific water courses were not effective for many residents who understood their local geography in terms of neighbourhoods rather than in terms of hydrological systems (Pitt 2007).

Risk perceptions also vary across geography and populations, making it important that risk awareness and risk reduction education efforts are tailored and specific. For instance, perceptions of environmental risk vary across ethnic groups within the United States (Vaughan and Nordenstam 1991). Risk perception may also be strongly affected by political and economic structures of a country (Vari and Kemp 1991). Social factors such as social status, professional, political and religious affiliations can further alter risk perception (Rohrmann 2000). Women are also more likely to perceive hazard events as serious, to apprehend information about risk reduction strategies and to act upon them (Cutter 1994; Fothergill 1996). Families with small children, elderly or disabled populations, and minority language speakers among others may have vulnerabilities, needs or protection strategies that differ from a wider population. Differences in risk exposure, vulnerability and perception are taken into account in effective risk awareness and reduction education programs.

Individual bias

Research has also shown that individuals are affected by a series of biases when assessing risk and deciding whether or not to act. Of considerable concern for risk awareness and risk reduction education is the pervasiveness of "optimistic bias." People generally anticipate risks, but believe that others will be more severely affected than themselves (Weinstein 1980). More accurate judgment concerning low-probability, high-consequence events seems to be directly related to a subject's ability to easily retrieve memories or examples of such events (Slovic 2000). "Anchoring biases" – where people do not adequately alter initial assessments of risk based upon new information - also affect people's understanding of natural hazard risk (Tversky and Kahnemann 1974). When dealing with low-probability, high-consequence hazards, people tend to believe "it can't happen to me" before they experience a disaster, thus, failing to consider the heavy consequences. Following a direct experience of a hazard event, people may move to the opposite extreme, believing "it will happen to me" even though probabilities remain low (Kunreuther 2001).

Biases regarding disasters are also propagated through media portrayals of events and common myths about disasters. The media tends to sensationalise very small probability events and high consequence hazards (Evans, Frick, and Schwing 1990; Whittaker 1986) to the exclusion of more frequent, smaller, or chronic disasters. Common disaster myths are pernicious, even within trained emergency response personnel. Disinformation contained in media reports of health risks after a catastrophe, reports of public panic and looting, and even erroneous attribution of causes of casualties confuse people and decrease a sense of control (Alexander 2007). Particularly disempowering are myths that

victims of hazard events will be quickly saved by national or international rescue. Persistence of these myths among the public, in the media and even within the emergency response community can work against the development of a culture of safety. These myths must often be addressed in order to effectively teach risk reduction strategies and promoting self-efficacy.

Over-emphasis on hazards, destruction and emergency response

One of the greatest challenges to effective risk awareness and risk reduction education is the leap that is typically made from educating the public about natural hazards and their risks to promoting response preparedness. Often bypassed is an understanding of personal and communal vulnerability to hazards and the range of possible coverage alternatives and risk reduction measures. While some programs have successfully increased public knowledge about the hazards, they have not fully explained the associated risks or consequences, and have not delineated what can be done to reduce them.

Box 1.3. **Risk Awareness Versus Risk Reduction Action**

Many studies of risk perception show that awareness of hazards does not automatically lead to desired risk reduction or preparedness activities.

- In a nation-wide study of public attitudes in the United States, 20 percent of the respondents felt that a severe hazard event would directly harm their household in the next five years. While approximately 75 percent had seen information about how to protect themselves from natural hazards, fewer than 40 percent of the survey respondents had any disaster preparedness kits in their households and only a quarter felt very prepared for a natural catastrophe (Insurance Research Council (IRC) August 2006).
- In 2006, the Icelandic Civil Defence conducted risk awareness town meetings and a full day of risk awareness education and evacuation drills for volcanic flood hazard. They were successful in raising awareness about this natural hazard and evacuation procedures. In follow-up research, 100 percent of the residents surveyed could accurately describe how and why volcanic flooding could occur; 95 percent were aware of evacuation procedure. They were less successful in getting the public believe that they might be affected by such a hazard event, a pre-requisite to taking action to reduce risk. Only 50 percent of the same residents really believed their region could be affected by volcanic flooding (Bird, 2008).
- The Association of British Insurers (ABI) recently commissioned a survey of public attitudes to climate change risk, including flooding. The overwhelming majority of the 2012 respondents (85 per cent) identified flooding as a risk affecting the UK, but only 16 per cent considered themselves at risk. Another study by Harries found that only 39 per cent of previously flooded England and Wales residents had taken any action to prepare for floods. A much smaller percentage, only 6 per cent, of people without prior flood experience took any action (Pitt 2007).

For a culture of safety, risk awareness must be combined with risk reduction education that promotes effective and appropriate strategies for reducing risk prior to a disaster.

Not only is hazard risk awareness insufficient for risk reduction action (McClure 2006), but undue focus on hazards can even hamper risk reduction activities. Efforts to "scare" people into action have proven counter-productive. Excessive exposure to images of damage and destruction tends to increase people's anxiety level and lead to avoidance and denial (Finnis 2004). Focus on destruction and risk can also divert

attention from problem-solving and push people towards emotion-focused disempowerment (Finnis 2004; Lehman and Taylor 1988; Mulilis and Duval 1995).

To help people move from risk awareness to risk reduction behaviour, education programs must find ways to make specific information accessible to the target audience. When individuals can refer to a specific list of precautionary measures, they are more realistic in their assessment of their level of risk and more likely to take action (Weinstein 1980). Similarly, people must personalise the probable consequences of disasters before they will act (McClure 2006; Palm and Hodgson 1992).

For education efforts to be successful, people also must believe in the effectiveness of risk reduction strategies (Lindell and Perry 2000; Mulilis and Duval 1995). Theories of planned behaviour suggest that people's beliefs regarding social pressure and their own ability to be effective have an important impact on their decision to act to reduce their risks (Ajzen 1991). Studies show that people are more likely to believe in the effectiveness of risk reduction behaviour when a description of why this behaviour will be effective is clearly presented (McClure 2006).

Disincentives to increasing risk awareness

Mitigation is clearly efficient (Kelman 2007), yet both policy makers and the public are often entirely unaware of the tremendous cost-benefits of risk reduction. When addressing the United Nations General Assembly in 1999, Secretary General Kofi Annan cautioned that "building a culture of prevention is not easy. While the costs of prevention have to be paid in the present, its benefits lie in a distant future. Moreover, the benefits are not tangible; they are the disasters that did NOT happen" (Annan 1999). Significant challenges to risk awareness and risk reduction education are the disincentives to the adoption of risk reduction measures at the individual, community and public sector level.

Decision-makers are faced with a "politician's dilemma" when choosing to fund risk reduction measures or advocate for policies that impose regulatory measures to limit exposure to hazards. Short political time-horizons often mean that rapidly responding to a disaster is perceived as more advantageous than investing in long-term disaster risk reduction (Kunreuther, Meyer, and Michel-Kerjan 2007). Though studies indicate that funds spent on pre-disaster risk awareness and risk reduction measures save seven times this amount in post-disaster aid (Kelman 2007), these aspects of catastrophic-loss management are often underappreciated in high risk regions. When measures are adopted, it is hard for politicians to capitalise on the disaster that does not happen. On the other hand, heightening public awareness of risk can lead to public outcries demanding action and pressure to spend limited funds on risk reduction measures that may have little immediate benefit. For these and other reasons, past political and humanitarian engagement has focused primarily on post-disaster response.

The general public often resists learning about natural hazard risks of which they have little or no direct experience. They avoid investigating options for physical and financial protection and rarely adopt even cost-effective measures voluntarily. Individuals may underestimate the likelihood of a future disaster, or perceive mitigation measures as too costly by benchmarking these costs to less expensive home repairs. It is often seen to be easier and more advantageous to postpone investment in voluntary risk mitigation and catastrophe insurance. Due to the low-probability of most natural hazards, this procrastination rarely results in immediate and severe consequences (Kunreuther, Meyer, and Michel-Kerjan 2007). Given the many competing choices available, people are often

unwilling to "delay gratification" and invest in insurance policies, retrofitting and other risk reduction strategies where gratification may not be experienced for years, or even ever.

Those who have directly experienced the loss and hardships associated with post-disaster recovery are often the most eager to learn about future hazards and engage in risk reduction behaviour (Helweg-Larson 1999). Those who experience hazard events and escape with little damage may end up reinforcing the advantages of *not* investing in risk mitigation measures. Low-probability, high consequence risks have proven to be particularly poor at positively reinforcing voluntary adoption of risk reduction measures, even when such adoption is individually and socially optimal over a long time span (Kunreuther, Meyer, and Michel-Kerjan 2007).

The public also faces what has been termed the "Samaritan's dilemma" when deciding whether to invest in risk reduction measures or purchase insurance to cover natural hazard risks. They often believe that *ex post* assistance will exist for those who have not adequately protected themselves. Some risk awareness and reduction education campaigns can cause the public to believe that the agency sponsoring or promoting the education is doing something to protect them (McClure 2006). Post-disaster humanitarian and financial assistance to individuals unable to adequately protect themselves reinforces the assumption that aid will be provided in the future and that individual action is unnecessary. Risk awareness and risk reduction education must carefully delineate public and individual responsibilities for risk reduction to counteract this Samaritan's dilemma.

As evidenced in the national and regional actions described in the stocktaking below, a re-direction of focus from response to preparedness, risk reduction and financial protection is occurring, although the change is often slow. Despite the significant challenges, risk awareness and risk reduction education is a necessary pre-requisite to building support for and application of community-wide risk reduction measures. There is a need to focus limited resources on raising awareness and improving knowledge of risk mitigation and financial protection tools to the risks that are most likely to cause significant human, physical and financial losses. Risk awareness and risk reduction education priorities should be risk-based, tailored to the hazards of the region and the particular vulnerabilities and capacities of its citizens.

Chapter 2

Stocktaking

2.1. Scope of stocktaking effort

In order to better understand the current state of risk awareness and risk reduction education worldwide as a basis for policy recommendations to support and improve these efforts, the OECD commissioned a 13-country stocktaking of risk awareness and education programs.

The thirteen countries selected for this stocktaking effort include many of the most hazard prone OECD countries. Hazard prone OECD countries selected for the stocktaking included Iceland, Italy, Japan, Mexico, New Zealand, Turkey and the United States. Other, less hazard-prone countries were added for comparison, including Canada, Portugal, Spain and the United Kingdom. Finally, the two largest emerging economies outside of OECD, namely China and India, were included both for their population size and the diversity of the hazards that each face. While far from an exhaustive evaluation, these countries vary in geographic size, GDP, and hazard exposure. A comparison of the countries can be found in Table 6.1.

The stocktaking of risk awareness and risk reduction education described in this report focuses on programs that address risk reduction prior to the occurrence of a hazard event. This stocktaking also included awareness programs that encourage public understanding of the role of risk insurance in covering losses from catastrophic events and in smoothing the recovery period. Science education programs about hazards in general were not included. Importantly, emergency response training programs were *not* included in the scope of this report unless they include a substantial public education focus on risk awareness and risk reduction. This is consistent with the growing emphasis on risk reduction, prevention and resilient development within the international community. Nonetheless, many of the programs reported here continue to place major emphasis on public education for response preparedness, and have considerable scope for improving risk reduction education.

For each country included in this stocktaking effort, major natural hazards were identified. These hazards included geophysical hazards – geological fault activity, debris flows, volcanic activity, tsunami and hydro-meteorological hazards - tropical cyclones, floods, storm surges, severe storms, avalanches, wildfires, and temperature extremes. It should be noted that while the effects of climate change are often tracked at the international level, there is also a growing need for climate change risk awareness and risk reduction education material at a more local level.

For each country selected, a stocktaking of risk awareness and risk reduction education was carried out. This stocktaking looked at efforts in the public, education,

private, and civic sectors as well as cross-sectoral partnerships and international efforts. The primary focus was on programs, campaigns, and educational material aimed at increasing awareness of large scale natural hazards and risk reduction measures, including strategies for financial loss-sharing and risk transfer. Most of these campaigns and materials were targeted at the general public, though care was taken to also include programs that targeted knowledge disseminators and policy makers whose decisions or opinions would likely affect a community's vulnerability to natural hazards.

Table 6.1. **Natural Hazard Disasters (NHD) by Country**

(ranked by number of casualties in ten largest recorded disasters 1900-2007*)

Country	GDP (ppp)/ per capita 2006 USD	Population (est. July 2007)	Examples of Major Hazards	Recorded Number Killed in ten largest recorded NHD	Estimated Number Killed per 1 000 population	Recorded Number affected in ten largest recorded NHD
OECD Countries						
Japan	$33 100	127 433 494	Earthquakes, typhoons, tsunamis, volcanic activity	178 286	1.4	15 763 481
Italy	$30 200	58 147 733	Landslides, mudflows, avalanches, earthquakes, volcanic eruptions, flooding	137 977	2.4	3 708 535
Turkey	$9 000	71 158 647	Earthquakes, drought, floods	78 491	1.1	7 044 870
Canada	$35 600	33 390 141	Severe storms, earthquakes, flooding	51 417	1.5	2 255 000
United States	$44 000	301 139 947	Hurricanes, earthquakes, tornados, wildfires, flooding, debris flows, tsunamis	16 603	0.1	11 668 065
Mexico	$10 700	108 700 891	Earthquakes, hurricanes, tsunamis, volcanic activity	16 512	0.2	9 448 465
Spain	$27 400	40 448 191	Drought, extreme temperature	16 408	0.4	6 820 350
New Zealand	$26 200	4 115 771	Earthquakes, volcanic activity, landslides, floods	7 210	1.8	39 156
United Kingdom	$31 800	60 776 238	Winter windstorms, floods	4 672	0.1	859 512
Portugal	$19 800	10 642 836	Extreme temperatures, earthquakes	3 340	0.3	202 710
Iceland**	$38 000	301 931	Earthquakes, volcanic activity	51	0.2	5 768
Non-OECD Countries						
India	$3 800	1 129 866 154	Droughts, flash flood and monsoon, severe storms, earthquakes	8 873 000	7.9	1 287 500 000
China	$7 700	1 321 851 888	Typhoons, floods, earthquakes, drought	8 409 000	6.4	1 356 489 476

*Top ten recorded disasters, associated causalities and number affected based upon events listed in the EM-DAT database (CRED 2007) as queried Feb 29, 2008. In country records of population, hazard and exposure may be more accurate. See the EM-DAT database documentation for further details on compilation of disaster loss and statistics.

**Earliest Icelandic record in 1974.

The assessment focused not only on the existence of risk reduction education efforts, but on content depth, distribution mechanisms, and the achievements of these programs. To a limited degree, programs were evaluated as to their strengths and weaknesses, the appropriateness of their methods and message for vulnerable populations, and their effectiveness. Opportunities for improvement were also noted.

The stocktaking effort was achieved primarily through interviews with key personnel in each country, review of scholarly articles, and an assessment of material available on the internet. The stocktaking was limited to information that could be easily accessed through these methods, thus, restricting the assessment primarily to programs and materials produced and distributed at the national and regional levels. As such, this is not an exhaustive assessment of all programs in the countries selected. In particular, it does not capture many of the local, grassroots efforts that can have a vital impact on any nation's risk awareness and reduction.

This stocktaking represents a thorough, initial overview of large-scale efforts in the countries selected and is a solid basis from which to evaluate the current state of risk awareness and risk reduction education. It is also a strong foundation from which to develop policy recommendations for enhancing these programs in the future. However, it does not constitute a substitution for a more in-depth stocktaking at the individual country level.

2.2. Review of programmes and assessment by sector

The stocktaking found some risk awareness and risk reduction education in all countries surveyed. In general, these education efforts were minimal in countries that experienced severe natural hazards infrequently. Countries that experienced more frequent and severe natural hazards tended to have more advanced programs. However, the emphasis, location, and systemisation of risk awareness and risk reduction education programs within countries well-versed in natural hazards varied markedly. Variation across countries and good practices are discussed below in five broad groupings: the public, education, private and civic sectors, as well as international efforts. It should be noted that many efforts are the result of cross-sectoral collaboration.

The public sector and public sector led partnerships

Public awareness campaigns and events

The most systematic public education efforts are often built around widespread campaigns. The chief features of these campaigns are a series of messages and materials which are distributed through a wide variety of print, radio, television and internet outlets, as well as sometimes through performing and cultural arts. Mascots, appealing graphics and iconography and positive messages to take action are typically part of these campaigns. They involve mass distribution of messages and are typically partnerships between government, civic organisations, mass media outlets, and private sector sponsors.

The *Firewise Community Program*, supported by a multi-agency collaboration in the United States, uses workshops, conferences, printed and online material to promote wildfire risk reduction. The campaign promotes environmental stewardship, land use planning, building codes and individual preparedness as a means of reducing risk. It

targets a range of individuals, including individual homeowners, fire-fighters and policy makers. In Turkey, a new policy requiring *Turkish Mandatory Earthquake Insurance* has been promoted through a mass media campaign that has included billboards, television advertisements, the use of celebrities and more traditional printed educational material (Turkmen 2007). In California, partnerships between the public sector and research institutions have resulted in a strong and sustained earthquake risk awareness and preparedness *Putting Down Roots in Earthquake Country* campaign. While public campaigns are typically multi-agency and multi-sectoral, occasionally they are primarily the work of one governmental agency. New Zealand's Ministry of Civil Defence and Emergency Management implements the broad mass-media education campaign, *Get Ready, Get Thru.*

Some national, regional and city governments have promoted natural hazard risk awareness and preparedness through official days, weeks or months, observed on an annual basis. Examples include Canada's *Emergency Preparedness Week*, a collaborative effort between the *Public Safety Council* and regional governments (Obonsawin 2007), the United States' newly launched *National Preparedness Month*, Japan's *Disaster Preparedness Day*, and the *National Day for Disaster Reduction* in India (Kuberan 2007). In the Marmara region of Turkey and Orissa State in India, regional events mark the anniversaries of major disasters. An earthquake anniversary in Turkey has been used as the catalyst to create a *Disaster Education Week* for primary schools. Disaster preparedness materials are sent home to families. Students also compete in related contests, engage in evacuation drills and are visited by civil defence officers (Turkmen 2007). Internationally, the UNISDR has designated the second Wednesday of October as *International Day for Disaster Reduction*.

Activities associated with these official periods include the printing of preparedness material, media promotion of awareness, public school activities, commemorative events and drills. When in connection with anniversaries of past disasters, such as *Japan's Disaster Preparedness Day and Evacuation Drill*, these official periods have compelling meaning and often generate significant media coverage that can spur individuals and communities to seek out information about hazards and risk reduction measures. Sustained and repeated campaigns can also generate similar activity, while continuing to remind the public of natural hazard risks and risk reduction. In the public sector, these periods can also be a time for scrutinising of past efforts and planning for the future.

Some events of this nature suffer from fragmentation and tokenism, and lack sufficient depth or length. To be effective, preparedness campaigns should ensure that the public receives consistent messages repeated over an extended period of time and from multiple sources. Preparedness events must be repeated annually, so as to create public recognition, anticipation and to reinforce what was learned during previous events.

Distribution of public education material

In some countries, the mass distribution of printed material has been used as a risk awareness and risk reduction education strategy. These brochures typically outline major hazards, appropriate emergency responses, and strategies for reducing risks. The United Kingdom and Iceland have achieved complete coverage, mailing such brochures and booklets to every household. The United Kingdom's *Preparing for Emergencies* booklet was mailed to 25 million households. Other countries, such as the United States and Italy, have targeted smaller regions for specific hazards using newspapers or utility bills for the

mass distribution of messages. Many countries have printed information packets available on request, typically at no cost to the recipient.

Mass mailing can raise awareness about hazards and be valuable references for the public. In the United States, a study of the effectiveness of a mass-mailed pamphlet found that residents had received information via other mass media outlets, but liked having a physical document to which they could refer. Another assessment of similar measures found that a weekend newspaper inset led to behaviour change. Respondents noted that they chose to take action because the insert clarified local risks, gave specific risk reduction measures and reinforced information they had heard elsewhere (Nathe et al. 1999). These studies highlight the potential effectiveness of mass distributed education materials when they aim to increase understanding of specific, local risks and list explicit risk reduction strategies.

One concern of the mass distribution of printed material is that it will be eventually discarded or become outdated. Distribution is also costly; the United Kingdom's effort costing £8.3 million. Moreover, these programs are one time endeavours and are not often repeated or updated. British residents and scholars interviewed doubted any lasting impact had been achieved through the mass mailing campaign in the United Kingdom, many noting that the heavily terrorism-focused booklets were quickly discarded.

More useful have been targeted attempts to directly contact those at risk in time for protective action to be taken. The United Kingdom's Environmental Agency has instituted a voluntary Flood Warnings Direct service. When an area experiences rising flood waters, the service sends a warning message via telephone, email, or text message to residents of the affected area. Sign-up for this service has remained below 50 per cent - even in high risk areas - yet research has shown that over 75 percent of those who receive such warnings take action. Services such as these need further public promotion as effective risk awareness tools for hazards with slower onset. Increased effectiveness may also be achieved by linking warning services to effective support venues that provide additional risk information and guidance on protective action during emergencies.

Box 2.1. **Sponsorship of Research on Risk Awareness**

The national government of New Zealand funds the research group *Resilient Organisations* to research lifeline infrastructure and business organisations. The research builds tools and techniques for organisational and business continuity in the case of natural hazard events. It looks at organisations and their capacity to understand the hazards that can potentially impact them, what vulnerabilities are present that increase their chances and the degree of impact, and their adaptive capacity, or actions they can take in order to be resilient in the wake of such events.

The *National Science Foundation* of the United States, through the *Natural Hazards Center*, funds small quick response grants for research immediately following hazard events and disasters. These grants are often used to further research on public perceptions of risk and risk reduction.

The *International Federation of Red Cross/Red Crescent Societies* sponsors young research and action by young professionals in developing and emerging economy countries. This research, administered through the *ProVention Consortium*, supports many innovative public risk awareness projects and community-based promotion of risk reduction. Some projects help develop risk assessment capacity or study the effectiveness of current risk awareness and risk reduction education programs.

A program in Iceland has found an innovative means of ensuring longer retention of their brochures. There, each family is given an emergency preparedness placard. One side gives clear information about risks and instructions on emergency evacuation procedures. The other side is a sign to be hung in the window of all homes after a family has successfully evacuated. Researchers interviewed noted that Icelandic residents have retained these placards in convenient locations and are aware of their use and content.

Simulations and drills

Civil defence and other ministries have also used community meetings, mock evacuations and disaster drills as a means of raising awareness. During recent earthquake drills across Japan, exercises included the evacuation of tourists and commuters in Tokyo using watercraft. A presidential address and media discussion following this event helped leverage wider public awareness. Mock evacuations in Italy have been carried out, notably on Mt Vesuvius. One such effort in Italy practiced evacuation of elderly residents of nursing homes, helping responders, home staff and residents to practice evacuation of this special needs population. Mock evacuation drills in Iceland are preceded by a promotional campaign and well-attended community meetings to discuss hazards, probable losses and emergency procedures. Evidence following these meetings suggested high hazard awareness. *The Earthquake Country Alliance*, a public-private partnership, is planning a large-scale effort in Los Angeles, California which will include not only response exercises for service personnel and administrators, but a widespread awareness campaign in schools, in the media and on the internet.

Mock evacuations and drills can be an engaging method of raising risk awareness across a wide cross-section of the population. Drills in schools are a basic way of sensitising children to risks. Fire, earthquake and general evacuation drills at school are common in most regions within the countries assessed.

It has been well-researched that practicing response skills regularly is significantly responsible for protective action during an emergency. Public inclusion in simulations and drills can also stimulate people to consider their own risk and preparedness. Despite this, mock evacuations and drills tend to focus public attention on protective actions people should take during a hazard event and emergency response. These exercises often do not highlight risk reduction steps that can reduce losses *a priori*, and may even convey the wrong impression that response preparedness is synonymous with risk reduction. To capitalise on the extensive resources used for such mock events, increased public risk awareness and reduction education should be in place both prior to and following these drills. Media coverage should also be drawn towards the benefits of preventative actions which minimise the need for emergency response.

Informational websites

All countries surveyed had some risk awareness and preparedness information on governmental websites. These websites were typically located in ministries of civil defence or protection, emergency response or in agencies tasked with forecasting, measurement or research on the biophysical forces responsible for natural hazards.

Websites often display a slant towards the mission of the agency under which they are housed. Websites housed in civil defence and response ministries often focus heavily on event response and emergency planning for post-event preparedness. Some, such as *Spain's Civil Protection Agency* website, have links to access national documentation of

disasters, hazard information, agreements and plans. Easy access to these types of documents can support and enhance risk awareness and reduction education of local government agents and decision makers. Websites linked with forecasting and scientific research contain high quality and accurate information regarding hazards, though occasionally are too technical to be useful for the general public or administrators.

In Japan, local fire departments offer fire prevention materials and protective advice for earthquakes. Some websites, such as *Mexico's Civil Protection Agency* website, also have up-to-date bulletins about developing natural hazards such as tropical cyclones, severe weather and volcanic activity. Some websites, such as *Italy's Civil Protection Ministry* and the *British Columbia Provincial Ministry* in Canada have interactive pages specifically geared towards children (Obonsawin 2007). New Zealand's *What's the Plan, Stan?* and the United States' *Ready Kids*, each out of their respective civil defence units, are notable examples of a well-thought out and thorough child-centred risk awareness and risk reduction education programs. These programs promoted youth learning through the use of animal mascots and engaging games.

Most websites linked to civil protection, emergency response and forecasting also have some information on individual and household actions. Yet, this information is often underdeveloped. Material on how to reduce risk at the individual, business and community level is often cursory and consists of a generalised list of bulleted actions. These bulleted lists are often not integrated with appropriate and specific risk awareness material or descriptions of risk reduction effectiveness, both necessary components of effective risk reduction education. Unfortunately, some websites continue to promote civil defence and emergency response as the primary focus through text and pictures, rather than focusing on reduction activities aimed at preventing or lessening the impact of natural hazards.

In cases where governments have mandated public education and outreach, the quality and quantity of risk awareness and reduction education material is significantly greater. Many agencies in the United States have mandates regarding funding for public education and dissemination of research findings. Many of these websites are devoted specifically to education and awareness material that targets a range of audiences including children, minority language speakers, policy makers and knowledge disseminators. In New Zealand, national agency websites dealing with natural hazard risk include significant public education information for adults and children. Their *National Institute of Water and Atmospheric Research* includes pages on climate change, its affects on weather in New Zealand and steps the public can take to reduce greenhouse gas emissions. However, even these campaigns often miss opportunities to better explain community level risk reduction strategies, such as building code regulations, land use planning, insurance and mandatory mitigation.

Several public sector informational websites offer advice to travellers about political conditions, health threats and current crisis in foreign countries. Some countries such as the United States and Canada also provide information on natural hazards, though little is given on pre-trip preparedness or risk–wise behaviour. The United Kingdom's *Know before You Go* campaign is a notable exception. Though focused on accidents and personal safety, it uses television advertisements and website information to promote travel insurance. Other links on the foreign office site give specific information about natural hazards. A privately developed website, *How Prepared are You,* developed by a geography teacher in England, educates children travelling abroad with their families.

Some countries such as Italy and Iceland are currently developing educational material for tourists. In these countries, pamphlets and signs explaining local hazards, early warning and evacuation procedures are located in high tourist areas and translated into multiple languages. Just as many governments require fire escape information in hotel rooms, countries can also require similar information for other risks in regions of high natural hazard risk.

Risk mapping and assessment

Many countries assessed had performed hazard and risk mapping. These risk maps and assessments are crucial tools for urban planning and emergency response. There is often strong public and governmental support for creating hazard and risk maps after extreme events, such as the initiation of new flood risk mapping in the United Kingdon following the 2007 floods (Pitt 2007). In addition to their utility for policy and response, risk mapping can also serve important risk awareness and risk reduction education tools.

When well publicised, risk maps and assessments can be tools for raising risk awareness among policy makers and the public. When properly disseminated and explained, these maps can help the public and local policy makers better understand risks. The maps can also help better explain risk mitigation prioritisation. For example, risk maps can increase understanding about the allocation of flood defences or land use restrictions or expense allocations for infrastructure strengthening.

In Canada, Iceland, Japan, the United Kingdom and the United States, national and local public agencies have developed natural hazard maps and made them available to the public through the internet. Map Modernization, a multi-year United States initiative to update flood hazard maps, is making digital maps available to the general public. Local jurisdictions are also developing risk maps by combining the hazard maps with infrastructure, settlement, and demographic information. In the United States and the United Kingdom, policy makers and the general public can retrieve flood hazard maps by town or postal code through the *Floods.gov* and the *Environmental Agency* website respectively. The United States' National Oceanic and Atmospheric Agency has also recently created an interactive web mapping tool for Hawaiian residents to view tsunami risk maps for their individual addresses.

In New Zealand, risk modelling is being carried out through public and education sector partnerships and results are also publicly available. Detailed microzonation maps of seismic hazard and infrastructure vulnerability have been developed for major urban areas of Turkey and are available on municipal websites and through published reports (Turkmen 2007). The *University of Iceland* and the *Icelandic Meteorological Office* have developed detailed avalanche risk maps that itemise annual individual avalanche risk by geographic location. In order to explain avalanche risk zoning to the public, the maps are accompanied by comparisons with other common societal risks (Arnalds, Sigurodsson, and Jonasson 2004). In Portugal, while hazard mapping has been conducted for wildfire, flood and seismic risk, this information is mainly available to public agencies associated with managing the hazard. Italy regional administrations are currently engaging in a multi-year, multi-hazard risk mapping process that maps hazards overlaid upon infrastructure and human exposure. A public education component may be included near completion of the project.

National level risk mapping can be a process that raises risk awareness among the general public and local administrations. In Canada, a regional program has developed

the *Hazard, Risk and Vulnerability Tool,* available on-line, to guide local agencies in community risk mapping and response preparedness.

Disaster parks and museums

In many countries, locations of past disasters and sites of visible geophysical hazards are effectively being used as risk awareness tools. A mangled bridge destroyed in an Icelandic flash flood has been turned into an outdoor exhibit; a major fault scar in China is planned as an outdoor earthquake museum. A similar such visible fault in New Zealand has become a walking trail and interpretive earthquake park after development was denied by the local tribunal. The museum commemorating the eruption of Mt. Vesuvius in Italy is world-famous for its graphic depiction of the potential for catastrophic loss in the vicinity of active volcanoes.

While interpretive sites are often limited in geographical impact, appropriate sites are plentiful in most communities and can be an immediate and local reminder of hazards and risk reduction. Educational sites can be incorporated into areas where land use regulations restrict development due to natural hazard risk. They can help reinforce the necessity and importance of zonation laws, a risk reduction strategy often not well understood by the general public. To be effective, they should include not only easy to understand descriptions of the hazard, but specific strategies for reducing risk at the individual, household and community level.

Museums can also be effective tools for risk awareness and risk reduction education. The *Shizuoka Prefectural Earthquake Preparedness Education Center* in Japan teaches visitors about earthquake risk and secondary risks such as tsunami and fire that may be triggered by earthquakes. The centre has interactive rooms where visitors can experience a simulated earthquake, watch a model tsunami, and use fire extinguishers to put out images of fires. The activities and educational material are presented in a way that both entertains and educates, promoting individual and collective action to reduce risk.

Online museums sponsored by the national government can help extend the reach of natural hazard museums, targeting youth and others with internet access. *Awesome Forces*, an online educational resource for children, produced by the Museum of New Zealand, and the *Virtual Earthquake Museum of China* both have engaging games, historical lessons, quizzes and other material to raise natural hazard risk awareness and teach risk reduction measures. The *Shizuoka Prefectural Earthquake Preparedness Education Center* extends its impact through an engaging museum website, including videos that show visitors experiencing many of the museum's interactive activities.

Training courses

Low and moderate income countries, such as India, Mexico and Turkey, often have additional challenges when implementing risk awareness and risk reduction education due to high levels of unauthorised construction. Risk awareness and knowledge of hazard resistant construction among construction workers, self-builders, and construction professionals is a crucial aspect of risk awareness and risk reduction education in these countries. In India, the *National Programme for Capacity Building of Engineers and Architects in Earthquake Risk Mitigation* has trained 20,000 professionals in seismic resistant construction and new building code requirements. The *Indian Housing and Urban Development Cooperation* and the *Ministry of Rural Development*, as well as non-governmental agencies, have instituted mason training programs (Kuberan 2007).

Seminars and courses within trade schools have been piloted in Turkey (Petal *et al*. 2006). Both countries have posters that teach risk reduction techniques to rural and urban poor whom are likely to engage in informal construction. They have also instituted certificate training courses for construction workers in some areas.

Extensive funding from international aid organisations has also helped to support community-based disaster planning at the village and local self-government levels in tropical cyclone and flood prone regions of India (Kuberan 2007). These local planning initiatives help to raise awareness of hazard risk reduction and response strategies, building local capacity to manage emergencies.

In most countries surveyed, civil defence, emergency response and other disaster related ministries offer training courses aimed at improving risk awareness, risk reduction and emergency response. These programs are often targeted at emergency response personnel and local civil protection jurisdictions rather than the general public. While these programs can effectively improve risk awareness and risk reduction education among professional and volunteer response personnel, they are beyond the scope of this report.

In several countries, civil defence agencies or fire departments offer *Community Emergency Response* courses lasting between 12 and 30 hours for community volunteers. These often begin with basic risk awareness and risk reduction education, teach life-saving non-medical triage, fire suppression, and organisation skills for response. Trainees become ancillary to professional responders. They build response capacity, and successfully convey the importance of communities developing resilience and helping themselves following a disaster, often leading to community-based risk reduction planning. There is a strong spirit of volunteerism in these programs, and collaboration with both civic and private sectors has proven indispensable. Trainees often become engaged in further community-based education and risk reduction planning. While costly, these programs can produce strong community advocates for risk awareness, risk reduction and response preparedness.

The education sector and cross-sectoral partnerships for school education

Educating children about natural hazards and risk reduction is of significant importance. Research conducted by *State Farm Insurance* found that people were very likely to take action when their children came home from school and told them they had to do it (Harvey 2007).

The task of infusing risk awareness and risk reduction education into curricula is a multi-decade effort. It begins with elaborating the scope and sequence and competencies expected at each age level and undertaking a full curriculum audit in all subjects to identify the appropriate insertion points. Textbook revisions, development of supplemental teacher training material, introduction of the subject matter through teacher-training colleges and in-service training plans are the subsequent steps for full integration. While advocacy for full infusion is underway in some countries, none have achieved this yet (for a more extensive survey of risk reduction education in schools, see BRI and GRIPS 2007; UNISDR 2007; Velicer et al. 2006; Wisner 2006). In the meantime, most countries have taken the approach of supplementing curriculum with regional and national co-curricular education developed by civil protection agencies or civic organisations, often in conjunction with wider public education campaigns.

Box 2.2. **School Education Programme Approaches**

Masters of Disasters, developed by the *American Red Cross*, and *Expect the Unexpected,* developed by the *Canadian Red Cross*, are financially sponsored by the insurance industry. These curriculum kits support risk awareness, reduction and preparedness for primary and middle school children and are aligned with education standards in math, science, language arts and social studies. For younger students, lessons in language arts may encourage students to brainstorm about risks and risk reduction strategies. Students in secondary school prepare news reports on disasters and the positive effects of risk reduction for imaginary towns experiencing natural hazard events. Lessons in math and science incorporate hurricane tracking and flood depth measurement calculations into lessons on reading maps and charts. Risk awareness and reduction education is not mandatory in either country's curriculum and, thus, use of this material varies widely.

In Japan, children are also encouraged to learn about disaster risk reduction. *The General Insurance Association of Japan*, in collaboration with civic organisations, gives grants to schools and communities for children to carry out neighbourhood safety inspections. *The Challenge Plan* also gives grants to 15 schools or organisations each year to support risk awareness and reduction education. *Kodomo Bousia Koushien*, a national contest, gives awards to children each year for learning about and engaging in disaster risk reduction. School response and evacuation drills are also mandatory.

New Zealand has a mandatory risk awareness and risk reduction education national curriculum. Developed by the *Ministry of Civil Defence and Emergency Management* with the support of teachers, the 2006 *What's the Plan Stan?* curriculum targets primary and intermediate school children. The curriculum teaches risk awareness and risk reduction by highlighting four "R"s of emergency management: reduction, readiness, response and recovery. Lessons feature activities, stories, and historical information using five children and a mascot dog who model what to do before, during, and after earthquakes, tsunamis, volcanic eruptions, storms, floods and other emergency events.

China, India, Mexico, New Zealand, and Turkey have co-curricular risk education in regional or national curriculum. Japan also has co-curricular risk education in some schools, though it has been removed from the national curriculum.

In China, nearly 500,000 textbooks on natural disasters and mitigation have been produced for elective high school geography courses. The textbook covers characteristics and impacts of natural hazards in China, hazard monitoring, mitigation, preparedness and disaster relief. India's Central Board of Secondary Education, one of the largest boards in the country, integrated risk awareness and preparedness into social and environmental science curricula in 2004; the upper level geography track also introduces disaster management principles. Some Indian states which have recently experienced severe disasters have also initiated their own state-level curriculum (BRI and GRIPS 2007; Kuberan 2007). In Mexico, environmental awareness, the interaction of humans and the environment, and disaster risk reduction and preparedness are taught in secondary school geography classes. As part of these studies, students participate in risk mitigation activities in their communities.

New Zealand currently has one of the most extensive national curricula for risk awareness and reduction. Civil defence and emergency service personnel are responsible for developing and delivering community safety programs in primary and intermediate schools. Curriculum and initiatives for these programs are produced by national level committees and are well supported by resource materials. The program increases its impact by encouraging students to talk with their parents about natural hazard risks and preparedness. In Turkey, teachers voluntarily participated in web-based training courses and select teachers became master-trainers in basic disaster awareness. Select trade and high schools have followed similar programs for more advance risk mitigation education

(Turkmen 2007). While Turkey's program has not become institutionalised through annualised outreach to new teachers, the program maximises impact by encouraging trained teachers to provide education seminars not only for students, but for staff, parents and the wider community (Petal et al. 2006).

Mandatory risk education was removed from the Japanese national curriculum in 1951 due to concerns over declining achievement in other subjects. However, most schools have hazard drills and teach disaster risk reduction in this context. In a recent study 80 percent of the high schools in 5 prefectures of Japan had participated in disaster education (Shaw 2005). A small percentage of schools in Japan have also been recognised as pioneer schools in disaster risk reduction, teaching risk awareness and reduction education integrated into their comprehensive studies time slots (Shiroshita 2006; Shiroshita and Kawata 2007). Extensive materials for disaster awareness and risk reduction have been produced by municipalities, prefectures, engineering and scientific institutions and the *General Insurance Association of Japan* (discussed below).

Some countries are currently considering adding risk awareness and risk reduction education into their educational mandates. In the United Kingdom, integration of hazard awareness and risk reduction is being discussed as part of a new citizenship curriculum. Segments of this citizenship curriculum may draw upon innovative risk awareness and reduction education in geography lessons developed by a secondary school teacher. These lessons ask students to learn about hazards in their neighbourhood, country of origin or holiday destination, create educational videos and help their families better prepare for natural hazard events.

In other countries such as Canada, Italy, the United Kingdom and the United States, teaching material for risk awareness and risk reduction education in the schools is implemented on a voluntary basis. In the United Kingdom, the *Meteorological Office* has developed multi-media resources that explain weather related hazards, including flooding and climate change. These materials are freely available to citizens, teachers and students and are compatible with primary and secondary school geography curriculum. This curriculum includes activities on reading flood risk maps, calculating the number of buildings damaged during various flood events and explaining the causes of flood disasters.

In the United States, the *American Red Cross* has developed interactive risk awareness and risk preparedness education modules for primary and secondary schools with funding from the *Allstate Foundation*. This curriculum is aligned with some state-level education standards for science, math, language arts and social studies. Schools can order material from local Red Cross societies and work with them to implement this material within schools. Approximately half of the 756 local Red Cross chapters have implemented this program in schools within their community, reaching 5.2 million children in six years.

The Canadian provincial government of British Columbia has also produced and distributed local grade-appropriate earthquake preparedness teaching aids, in addition to the national *Expect the Unexpected* school program developed by *Canadian Red Cross* with support from *State Farm Insurance* and the *Weather Network*. While providing excellent education curriculum content, the voluntary nature of these programs has meant that penetration varies greatly across school districts, regions and over time.

The *Italian Civil Protection Agency* is developing an interactive web-based program for primary school students, *La Protezione Civile per i Piccolo.* The *Civil Protection and*

Emergency Agency of Spain also has a website that contains a large amount of reference material on flood and seismic risk. In Portugal, educational material to support teachers when educating about natural hazards is currently being developed.

As evidenced through this stocktaking, a large quantity of education material on risk awareness has been produced during recent decades. Much of this innovative material continues to place significant emphasis on hazard identification, risk awareness, drills and emergency response. It often fails to adequately integrate this material with risk reduction education, a necessary component for encouraging wider adoption of risk reduction strategies and financial protection across society. Many programs miss opportunities to introduce students to land use planning, building codes, financial pooling of risk and risk-wise environmental stewardship as means of managing and reducing disaster risk.

Much of the education material for schools has been primarily developed by civic, private and public agencies with limited collaboration with regional or national education boards or ministries. Material that conforms to national education standards is easier for teachers to integrate into their teaching schedules. However, this approach typically relies on enterprising teachers, thus significantly limiting penetration. Many teachers are understandably unwilling or unable to integrate this material into already full teaching programs. They may not feel confident enough in the subject to teach it to their students, especially when student performance in other core subject material is heavily scrutinised. Support from teachers' unions, education ministries, and official mandates can help to fully integrate risk awareness and reduction education into school curricula, developing a culture of safety within the next generation.

At the university level, natural hazards awareness, risk reduction, risk mitigation and emergency management is taught through certificate programs in a wide variety of disciplines and in newly emerging disaster risk management programs. Many countries also have research centres connected to natural hazard risk reduction and emergency management. Despite the often high quality of these programs, risk awareness and planning are often not integrated into other university-level education tracks. Classes in risk awareness, risk reduction and emergency planning within business programs, international development programs, urban planning, and similar disciplines are rare, despite the important impact that natural hazard risk can play in these professional arenas.

Some examples of university-affiliated research centres that engage in extensive public education for natural hazard risk and reduction awareness are the *Kandilli Observatory and Earthquake Research Institute* in Turkey, the *National Information Center for Earthquake Engineering* at *IIT Kanpur* in India, and the *Southern California Earthquake Center* in the United States. At the international level, the *Global Open Learning Forum on Risk Reduction (GOLFRE)* offers an on-line certificate courses in disaster management for field practitioners of aid organisations.

The private sector and private sector sponsorships

Insurance sector

Several insurance companies and associations currently sponsor conferences, research and publications on issues related to provision of services and loss reduction. These programs help raise awareness among policy makers, researchers, and technical experts in the field of financial loss reduction and can be crucial for developing sound natural hazard risk insurance markets.

The *Benfield Hazard Research Centre* of London, funded by one of the largest reinsurance and risk intermediaries, transfers natural hazard and risk research, practice, and innovation from the academic environment to business, government and international agencies. They have a notable education program for insurers regarding natural hazards, including certified courses. Similarly, *Lloyd's*, a leading insurance provider, has developed *Climate Wise*, a framework to educate insurance companies internationally on how to incorporate climate change issues into their business operations. The *Institute for Catastrophic Loss* in Canada is a coordinated effort to reduce disaster loss involving member insurance companies, the University of Western Ontario and other partners. They promote research, as well as provide education of the public on natural hazards (Obonsawin 2007).

Programs sponsored by the insurance sector have also improved hazard resistant construction practices in some countries. Sponsored research and advocacy can help persuade local and national governments to adopt stricter risk reduction measures (Alesch et al. 2004). The *Insurance Bureau of Canada* funds research on building resistance to extreme weather (Obonsawin 2007). Similarly, the *Institute for Business and Home Safety (IBHS),* a non-profit organisation funded by major insurers in the United States, sponsors research on hurricane insurance claims, showing that improved building codes has reduced losses by 42 percent (IBHS 2004). *IBHS* has also lobbied for the inclusion of disaster-resistant features in model building codes and the adoption of such codes by local jurisdictions. Through a broad multi-sector *Fortified for Safer Living* program, they have created disaster-resistant construction standards and authorised inspectors to review construction built to these higher standards for each region of the United States. The research, advocacy and public education outreach provided by these international reinsurers and national insurance consortia have provided significant sectoral leadership in developing and promoting physical and financial protection tools for catastrophic risk.

Box 2.3. **Innovation in Private Sector Risk Awareness Campaigns**

The *General Insurance Association of Japan* identified radio broadcasters as crucial knowledge disseminators. Yearly, they host a risk awareness event for 100 radio presenters. The presenters first experience simulations of major disasters and emergencies, and then participate in lectures on topics such as disaster preparedness, tips to mitigate damage and earthquake insurance. The association asks the radio presenters to relate their experience and the knowledge they gain to their station listeners.

The *Institute for Home and Business Safety* in the United States has produced over a dozen videos for home and business owners that delineate steps to fortify buildings against common natural catastrophes. The Institute has developed voluntary improved construction standards and an inspector authorisation program that incorporate construction techniques to lower losses from earthquakes, flooding, severe weather and wildfires. These standards help to reduce greenhouse gas emissions, energy-efficiency and material recycling, thus also addressing growing concerns about climate change.

Aksigorta, an insurance provider in Turkey, has created a Fire and Earthquake Training Centre in their headquarters for school children to learn how to protect themselves from these hazards and to promote insurance awareness in the next generation.

Many insurance companies and insurance consortia in the countries assessed provide innovative and engaging insurance education programs for consumers and school children (OECD, 2008). Some of these insurance education programs include natural hazard risk awareness and reduction education components. Dissemination methods

include brochures, ad campaigns, workshops, websites, museums and school curriculum. For example, the *Insurance Bureau of Canada* provides free resources for the public and has a website to raise awareness of natural hazard risk and risk reduction measures (Obonsawin 2007). Mexico's *Comision Nacional de Seguros y Financieros* has organised *Safety Week* to promote awareness of natural hazard risk in primary schools and promote an "insurance culture" in Mexican society (OECD, 2008). The *National Association of Insurance Commissioners* in the United States includes some information on how natural hazards can affect insurance in their information for the general public. The *Association of British Insurers* provides general information on flooding and flood insurance on their website.

Following the 1995 Kobe earthquake, the *General Insurance Association of Japan (GIAJ)* realised there was a general lack of public knowledge regarding earthquake insurance and coverage mechanisms. They have promoted public understanding of hazard and insurance mechanisms through campaigns, elementary school programs, posters, flyers and advertisements. In part due to their efforts, there has been an increase in earthquake insurance penetration from 33.5 percent in 2002 to 40.3 percent in 2006. These efforts are an important component of public risk awareness. In countries where natural hazard risk is significant, insurance education programs have considerable scope for improving awareness of natural hazard risk and risk pooling through insurance, reinsurance, risk bonds and other means.

Natural hazard risk and insurance awareness programs are also found in nations that have mandatory or nationally sponsored catastrophic insurance. The *Turkish Compulsory Insurance Pool*, part of a new earthquake insurance scheme, has engaged in significant campaigns to raise public awareness of earthquake insurance, including celebrity advertisements and posters. While only modest penetration has been achieved, earthquake insurance in Istanbul has risen from 15 percent to nearly 30 percent in the seven years since the program's inception (OECD 2005a). In the United States, flood insurance, which is provided through a public insurance program, is heavily promoted through the *Flood Smart* website. The public can access information about flood insurance and checklists for hurricane preparedness. The *Consorcio de Compensacion de Seguros* of Spain is currently considering preventative campaigns to prevent and reduce losses due to natural hazards (OECD, 2008). Similarly, the *Associçäo Portugesa de Seguradores*, a Portuguese insurance association, is working with the government to develop an insurance system for earthquake risk. An awareness campaign targeting building owners is expected to follow the creation of such a system.

Insurance industry consortia have also been active in promoting broad awareness of natural hazard risk and risk reduction measures. *IBHS* directly targets the general public through campaigns, such as programs that raise awareness of the role of building code inspectors and permit processes in ensuring public safety. *The Earthquake Commission* in New Zealand provides the brochure 'Quake Safe Your Home, a guide that teaches how to reduce damage and injury from home contents during an earthquake. *The Insurance Bureau of Canada* has information aimed at the general public regarding earthquakes, hurricanes, severe storms, and tornadoes on their website.

Some individual insurance companies give information regarding disaster risk reduction on their websites and in brochures. While an important first step, often this information is buried in the website and consists of no more than a bulleted list of risk reduction techniques.

In some countries, insurance providers and consortia have also been active in partnering with the public, civic and education sectors to sponsor risk awareness and risk reduction education. *State Farm Insurance*, partnering with the *Canadian Red Cross* and the *Weather Network*, has developed the program *Expect the Unexpected,* which has reached over 750,000 children. The *Allstate Foundation,* a non-profit organisation established by a major North American insurer, helped sponsor the innovative *Masters of Disasters* curriculum developed through the *American Red Cross.* In the United States, *State Farm Insurance* gives grants to non-profit organisations who are educating home-buyers about catastrophe risk reduction, response preparedness, and disaster recovery.

Computer-based risk modelling and mapping has become a strategic tool for risk management within the insurance and public sector. This technology has the opportunity to reduce financial burdens that natural hazards have on insurance and reinsurance companies, governments, and the public. When disseminated in non-technical formats, risk management information also has the potential to increase public understanding of geographic risk variation and corresponding policy premiums. As was discussed above, public agencies are beginning to provide hazard and risk maps to the general public. Insurance consortiums have the capacity to follow suit. *The Earthquake Commission of New Zealand* provides public access to earthquake hazard maps on their website. Many other consortiums and risk research institutes are creating hazard and risk maps for use in the insurance industry. These maps could be adapted for use in public risk awareness and risk reduction education. However, for these efforts to be most efficient in encouraging the adoption of risk reduction strategies at the individual and collective level, they should be embedded within larger public education programs that both explain risk maps in non-technical language and promote available and effective physical and financial protection strategies.

The insurance sector is taking initiative, largely without public funding, to promote and educate policy makers and private citizens regarding natural hazard risk and financial protection. Some have used these education opportunities to explain and promote land use and construction standards that will help reduce exposure to and provide physical protection from natural hazards. Others have partnered with civic and public organisations to create some of the most innovative and engaging public risk awareness and reduction education. There remains significant scope for additional efforts to routinise catastrophic risk awareness in consumer education programs that currently cover non-catastrophic risks and improve the quality of risk awareness and risk reduction education material insurance agencies offer to the general public. This could include the wider dissemination of simplified hazard and risk maps.

The corporate sector

Forward thinking businesses and corporations are increasingly concerned about business continuity planning for natural hazard events. The *IBHS* offers *Open for Business: A Disaster Planning Toolkit for the Small and Mid-sized Business Owner*. The United States *Department of Homeland Security*'s *Ready Campaign* also includes information on disaster planning and risk reduction for smaller businesses. The *Emergency Preparedness for Industry and Commerce Council,* a cross-sectoral partnership started by British Columbian business leaders, provides similar education materials for businesses in Canada. The national government of New Zealand funds the research group *Resilient Organisations* to research lifeline infrastructure and business organisations. The research builds tools and techniques for organisational and business

continuity in the case of natural hazard events. The *Preparing for Emergencies Campaign,* developed by the United Kingdom Civil Contingencies Secretariat also provides information for businesses. The Central Disaster Management Council of Japan has published business continuity guidelines. Recent research estimates that the financial industry in Japan spends nearly one billion dollars on business resiliency per year. It should be noted that there are also many consulting firms that offer business disaster continuity guides, training and assessment.

A significant component of business disaster planning includes risk awareness and risk reduction education for managers and employees. In India, several chemical manufacturers such as *Siel Chemical* and *Tata Chemicals*, have hazard and preparedness seminars for workers, school children and local community members as part of their corporate good neighbour policies. Business efforts such as these often contribute to and build upon wider risk awareness and risk reduction education efforts.

In the wider community, the corporate sector is often involved in charitable giving following natural hazard events, but there is great potential for their further involvement in risk awareness and risk reduction education for the general public and their employees.

Some corporations are partnering with public and civic organisations to promote risk awareness and risk reduction education. *Home Depot, Inc.* and *Lowe's Companies, Inc.*, both large home improvement specialty retailers in North America, have funded in-store risk awareness seminars and promoted do-it-yourself products for home strengthening to reduce natural hazard risk. In the United States, *Home Depot, Inc.* has partnered with American Red Cross to give grants to local chapters of the Red Cross for disaster preparedness education and to support Red Cross disaster readiness efforts. This effort includes the ambitious goal of educating one million people in three years. On a smaller scale, *Praktiker Bau- und Heimwerkermaerkte AG*, has handed out risk awareness and risk reduction material in Turkish retail outlets. Also in Turkey, a two-sided Family Disaster Plan was distributed to millions of school children; hundreds of thousands of information cards also reached Istanbul residents through private sector sponsorship (Petal 2003; Turkmen 2007).

The engineering industry and some segments of the construction industries support many risk reduction initiatives, including strict and mandatory building codes, hazard-conscious land use planning and environmental stewardship as a means of encouraging risk-wise behaviour. The *Omaxe Foundation*, created by a leading real estate and construction company in India, has facilitated disaster resistant construction workshops and seminars throughout the country (Kuberan 2007). Likewise, members of the insurance industry often advocate risk-based insurance premiums to promote awareness of risks and incentives for risk mitigation and reduction. These strategies are often not well understood or supported by the public, given the potentially high insurance costs for individuals and businesses residing in high-risk hazard zones.

The civic sector and civic sector partnerships

The size of the civic sector, and its involvement in risk awareness and risk reduction education, varied greatly across the countries surveyed. Many civic sector programs are cross-sectoral partnerships, combining the community-level focus of the civic sector with school programs in the educational sector and public or private sector funding. Some civic sector programs engage the strengths of women or children in risk awareness and reduction education (Petal et al. 2003; Plan 2007). The resulting programs are eclectic

and often effectively tailored to local needs and risk perceptions. While dynamic local initiatives exist in a host of locations, this stocktaking focused on large national or regional programs engaged in risk awareness and risk reduction education.

Engineering and construction associations, such as the Earthquake Engineering Research Institute, the Japan Building Disaster Prevention Association, the Turkish Architects and Engineering Chamber and others are often active in educating their members about new research on hazards and infrastructure performance through training programs, conferences and industry publications. Few of these organisations actively and consistently attempt to educate a wider general public about risk and risk reduction measures. There is much untapped potential for sustained partnerships with local grass-roots organisations to effectively disseminate scientific knowledge in a non-technical manner for the public.

The *International Federation of the Red Cross/Red Crescent Societies (IFRC)* and its affiliated national societies actively promote risk awareness and reduction education in almost all countries. The level of activity, however, varies considerably based on the primary mandate of the national society. In some countries such as China, Italy, Iceland, Japan, Spain, Portugal, New Zealand and the United Kingdom, activities predominately focus on first aid, safety, disaster and emergency response training. These core programs are invaluable in reducing non-disaster related deaths and injuries and can strengthen community emergency response during disasters and catastrophes. However, they typically do not emphasise public awareness of natural hazard risk or risk reduction strategies as a means of reducing disaster related losses.

In 2007, the *IFRC* initiated the *Global Alliance for Disaster Risk Reduction* to place a major emphasis on disaster risk reduction in their national societies and local chapters. The *IFRC* plans to proactively incorporate disaster risk reduction into national society plans and strategies, train volunteers, and regularly track progress of these efforts. The *Global Alliance* will likely increase the level of risk awareness and risk reduction education programs in all countries assessed. Already, many national societies have recently moved to include these efforts in their national strategies. Notable in this regard is the newly developed *Vulnerability and Capacity Assessments* for household, school, community and business sectors established and heavily used in Mexico and the rest of Latin America.

In Canada, Mexico, Turkey and the United States, local Red Cross/Red Crescent Society activities currently include public risk awareness and risk reduction education. In these countries, local chapters often offer personal disaster preparedness courses. These national societies have also formed cross-sectoral partnerships aimed at implementing risk education in the schools. Examples include the *Turkish Ministry of Education, Safe Living* unit for schools, the Canadian *Expect the Unexpected* school education program (Obonsawin 2007) and the *Masters of Disasters* program in the United States. The *Mexican Red Cross Society* has also recently begun including risk awareness and risk reduction education. They promote hurricane preparedness through an extensive media outreach, have trained local chapters in vulnerability and capacity assessments, and have become a regional example. Training courses for community based disaster preparedness are also being currently developed by the *Indian Red Cross Society* (Kuberan 2007). Because the roots of the Red Cross movement are in humanitarian response, many of these programs continue to emphasise response preparedness; risk reduction is a conscious and new addition to their outreach.

In some countries, large, independent civic organisations and public-civic partnerships addressing natural hazard awareness and disaster risk reduction have also

emerged. The *IFRC*-hosted *ProVention Consortium* has developed and maintained the *Community Risk Assessment Network*, collecting and disseminating practical tools for vulnerability and capacity assessment. It has also supported several young researchers in developing countries in applied research projects in thematic areas that support public risk awareness, such as: identifying enabling factors and incentives from disaster risk reduction, improving educational materials and curricula, and promoting risk reduction in response and recovery activities.

Some civic organisations have emerged in the aftermath of major natural disasters. Following the Kobe earthquake, the *Asian Disaster Reduction Center* in Japan was formed to sponsor international co-operation, research and learning towards improved disaster management. One of their public education efforts has been the production of a children's book to teach tsunami risk awareness and response. Following the Northridge Earthquake, the *Earthquake Country Alliance of Southern California*, a coalition of government agencies, research institutes and the *American Red Cross,* has developed a multi-faceted preparedness campaign, sponsored risk perception research, and facilitated major regional simulation exercises. Several civic organisations grew out of the Marmara earthquakes in Turkey and now have extensive regional and national grass-roots based training programs for public natural hazard risk awareness, risk reduction, and community preparedness (Turkmen 2007). With significant funding and collaboration between public and private sectors, local civic sector initiatives such as these have been able to extend the scope and geographical reach to become major contributors to public risk awareness and risk reduction education (Petal 2003).

Box 2.4. **An Example of a Cross-Sectoral Partnership**

According to experts, cross-sectoral partnerships are one of the most effective strategies for raising public awareness and promoting risk reduction behaviour. In the United States, the Federal Emergency Management Agency's *Project Impact* funded pilot city initiatives for comprehensive disaster risk reduction. Unfortunately, these programs were cut short when they had just begun to prove themselves. Seattle's *Project Impact* is a surviving success story that achieved the goal of effective risk awareness and reduction education for home and school structural mitigation through extensive cross-sectoral collaboration between the public, private, civic and educational sectors.

In Seattle, program coordinators used national seed funding to create training seminars that started with clear, specific, and non-technical earthquake hazard information and ended with achievable risk reduction actions. The program ensured that materials needed for the strategies promoted were available on the local market and that financial institutions offered incentives for home risk mitigation. *Project Impact* trained local builders in home strengthening and worked with local building inspection departments to develop permitting and inspection procedures. They also worked with lending institutions to offer special loan packages and lower interest rates tied to the home strengthening mitigation program. Partnerships with local civic and business organisations ensured that their message reached home owners. With encouragement from *Project Impact* staff, local hardware stores provided short seminars and stocked materials for do-it-yourself home strengthening. The project included low-income and minority advocacy groups and worked with charitable organisations to offer free home mitigation for some low-income households. In the first 8 years, 500 local contractors were trained, more than 3,000 homeowners took part in the training program and more than 700 building permits were issues for home retrofits.

Because the program was supported by broad, cross-sectoral support and collaboration, when national seed funding ceased, *Project Impact-Seattle*'s home mitigation program was already institutionalised. It is currently administered by the local office of emergency management in collaboration with local universities, building centres, building departments and the public school system. Currently 190 regional building departments are considering extension of the program into their jurisdiction and the adoption of updated and consistent standards for home strengthening.

International and regional efforts and collaboration

International efforts to promote and support risk awareness and reduction education have centred on two major themes: disaster reduction through international development aid and efforts to raise risk awareness of national governments and policy makers.

Following major disasters, international aid and financial institutions have supported the development of improved disaster management strategies in China, India, Mexico, and Turkey. This assistance has often been aimed at capacity building and a movement from relief-centric disaster response to more holistic disaster management that includes disaster risk reduction and education at all levels of society. These public education campaigns and community-based disaster management programs develop support for a national shift in disaster management, build local capacity for disaster risk management and reduction, and build public acceptance for stricter regulations and insurance programs that may be instituted.

International efforts have also focused on improved risk mapping in order to raise awareness of national governments regarding the hazards affecting their countries. The *World Bank, United Nations, Inter-American Development Bank,* the *European Seismological Commission* and others have worked to synthesise risk maps for major natural hazards (Dilley et al. 2005; IADB 2005). Global risk maps created through these efforts have been useful for raising risk awareness among national governments and helping nations to compare risk levels. For countries with under-developed risk mapping capacity, these maps have also strengthened country level knowledge of natural hazards through cross-national information sharing.

At a smaller scale, international community development agencies and local non-governmental organisations in countries such as Mexico and India have also promoted public risk awareness through community risk and vulnerability mapping using techniques from participatory rural appraisal and newly developed hazard and vulnerability assessment tools. Some of these funds support risk reduction education efforts that are more innovative than typical programs found within the sponsoring countries.

The UNISDR, a system comprising UN agency partners, national platforms for disaster risk reduction, and thematic platforms, works through biennial Global Platform meetings to implement the *Hyogo Framework for Action 2005-2015*, adopted by 168 countries at the World Conference for Disaster Reduction in 2005. To help guide countries in the implementation of the five priority areas for actions, UNISDR, in consultation with organisations and individuals from dozens of countries, published *Words into Action: A Guide for Implementing the Hyogo Framework* (UNISDR, 2007). The *Guide* provides specific advice on how to improve risk information and early warning and build a culture of safety and resilience, two of the priority areas for action in the *Hyogo Framework* that touch upon risk awareness and risk reduction education. The *Guide* provides terminology, outlines recommended steps for implementation, identifies responsibilities for action and required resources, and provides illustrations of implementation and avenues for further reading.

As mentioned earlier, Priority Three of the *Hyogo Framework* is to "build a culture of safety and resilience at all levels through the use of knowledge, innovation and education." In order to pursue this priority, a global Thematic Platform on Knowledge and Education of committed partners collaborates on international and regional work plans, sharing information, strategies, good practices, and promoting innovation and

institutionalisation of disaster risk awareness and risk reduction education for children and for the public. The Disaster Risk Reduction Begins in Schools Campaign (2005-2007) highlighted these issues, reaching out to policy-makers and opinion-leaders with concerted efforts by UN and other international agencies, national government and civic sector partners.

The UNESCO-led *International Decade of Education for Sustainable Development* incorporates risk awareness and risk reduction education in its program and is expected to continue this focus. The Council of Europe's *European-Mediterranean Major Hazards Agreement* (EUR-OPA) also maintains risk awareness and risk reduction education as an ongoing focal area, bringing together 25 member states to build a culture of safety through information exchange, awareness, education and training (Europe 2005, 2006). Similarly, in Asia, the *Asian Disaster Preparedness Center* currently works with 26 countries participating in the Regional Consultative Committee on Disaster Management's Mainstreaming Disaster Risk Reduction into Development program. The program has been drafting guidelines for "Integrating Disaster Risk Reduction into School Curriculum" (ADPC 2007). In the Americas, the Organization of American States promotes strategic planning for public awareness through its *Eduplan Hemisferico* initiative, and in Mexico is collaborating on a pilot school safety campaign with Earthquakes and Megacities.

Chapter 3

Conclusion and Next Steps: The Role of Risk Awareness and Risk Reduction Education in Building a Culture of Safety

3.1. Conclusions

Human decisions about where and how to live can lay the foundation for a society resilient to catastrophes. Public awareness of natural hazard risk and risk reduction measures forms the foundation and pre-requisite for effective natural catastrophic risk management and disaster risk reduction. In this vein, the Advisory Board of the *International Network on the Financial Management of Large-Scale Catastrophes*, set up by the OECD, has notably agreed that risk awareness initiatives constitute one of the key components of appropriate and sustainable financial management of large-scale catastrophes. This current stocktaking effort, in combination with OECD studies on financial education, builds upon national and international efforts to increase risk awareness and risk reduction education as a tool for catastrophic loss reduction.

Current research on risk awareness and risk reduction education, as well as the stocktaking of 11 OECD countries, China and India, suggest innovative strategies for using public education as a tool for catastrophic loss reduction. This work shows that risk awareness and risk reduction education messages should provide specific details on how to reduce risk and financial exposure, inform people about where to seek further information, be presented through a variety of media and trusted sources, and be frequent and consistent (McClure 2006; Mileti et al. 2004). Most successful are the efforts that create broad, cross-sectoral partnerships. These partnerships provide public information and educate policy makers in parallel with wider efforts to provide trusted, affordable and effective risk reduction tools for voluntary adoption and policy changes that incentivise or mandate behaviour change. These efforts, moreover, are most successful in countries where there has been a sustained and a long-term strategy for raising risk awareness and promoting risk reduction.

Box 3.1. **Towards a Culture of Safety**

Support for disaster risk reduction policy implementation may become widespread in areas where risk awareness and risk reduction education have been consistent, even when individual preparedness may remain low.

Research conducted in California shows that while residents reported low levels of personal preparedness, over 70 percent of residents supported policies for strict building codes, restrictions on home construction, and government funding to preserve and restore wetlands for flood protection. Support for building codes did drop from nearly 90 percent to 65 percent when respondents were informed of a 6 percent construction cost increase, but remained remarkable high (Miller 2006). This type of public support for mandatory risk reduction policies is the result of extensive regional awareness and education campaigns and is crucial for effectively implementing risk reduction policies.

Long-term strategies for risk awareness and risk reduction education that work within and across the public, education, private and civic sector can **encourage voluntary risk reduction activities** and build understanding of and compliance with mandatory measures. Risk awareness and risk reduction education in compulsory education curricula should form a key component of this effort. Also important are large-scale campaigns that use consistent and engaging messages which include local risk identification and promote specific and practical risk reduction and preparedness strategies. Like other successful national and global campaigns, risk awareness and risk reduction education campaigns will need to be part of a long-term strategy for disaster risk reduction, a strategy that seeks to raise public awareness of the most important local hazards through as many communication channels as possible.

Despite the importance risk awareness and risk reduction education programs can play in encouraging voluntary adoption of risk reduction strategies, these programs may be insufficient by themselves. Without financial incentives and some compulsory policies for risk reduction, some individuals and communities will continue to put off adoption of these measures or decide that risk reduction is not a high priority. As such, risk education is often a **complementary part of larger national risk reduction strategies** that mandate and enforce risk reduction through land use planning, construction standards, evacuation planning, catastrophe insurance and emergency response. Education can ensure that local policy makers and the general public understand the role of such measures and build majority acceptance for any restrictions these policies bring to daily life.

Governments, in partnership with the private, civic and education sectors, have a fiscal and social responsibility to current and future generations to raise awareness of current and emerging catastrophic risk and educate the public on risk mitigation and reduction strategies. Through a sustained and long-term effort, they will encourage voluntary and compulsory strategies that reduce physical and financial exposure to natural hazards. Such education efforts are a key component to promoting a culture of safety within a nation's borders and beyond. Risk awareness and risk reduction education is a foundation and pre-requisite for effective catastrophic risk management and disaster risk reduction.

3.2. Possible next steps for the OECD

This stocktaking of risk awareness and risk reduction education programs and policies in 11 OECD countries, China and India, serves as an initial step towards developing effective policies for risk education as a key component of national risk reduction strategies. To extend this initial assessment, the following projects may serve as useful actions:

- **In-depth country-level assessments.** This would involve taking stock of previous and existing country efforts and good practices in risk awareness and risk reduction education. A more thorough in-country assessment is warranted to identify the overall strengths and opportunities for improvement within each country.
- **Broader assessment of innovation in non-OECD countries.** Many low and middle-income countries outside the scope of this assessment are engaging in innovative and effective risk awareness, risk reduction education and community-

based risk assessment and management. Lessons learned in Iran (Izadkhah 2005), Nepal (BRI and GRIPS 2007; Shiwaku et al. 2006), and other countries have significant implications for improving risk awareness and risk reduction education within OECD countries. While school-based risk education programs have been thoroughly covered as a result of UNISDR's recent efforts (UNISDR 2007; Wisner 2006), public, civic and private sector initiatives are less well documented.

- **Assessment of the effectiveness of risk awareness and risk reduction education campaigns.** The effectiveness of risk awareness and risk reduction education programs within OECD countries could benefit from a more thorough evaluation. An important first step may be the development of a common framework for evaluating the effectiveness and penetration of risk reduction education programs and campaigns. This work could gain from synergies with likely future OECD work on the evaluation of financial education programmes.
- **Cross-country survey of risk perception and insurance penetration**. Insurance offers a crucial financial loss reduction tool, yet penetration is often low even in countries with compulsory insurance schemes. Further research and comparison is necessary to understand how risk awareness and penetration rates vary and how both policy and risk awareness programs can improve insurance penetration.

Chapter 4

Policy Recommendations for Enhancing Natural Hazard Risk Awareness and Risk Reduction Education

The international consensus around the *Hyogo Framework for Action*, global efforts such as the new International Decade for Education for Sustainable Development, risk reduction research, the OECD project on enhanced risk awareness and the OECD International Network on the Financial Management of Large-Scale Catastrophes all point to the imperative need for enhancing natural hazard risk awareness and risk reduction education in the general population.

Box 4.1. **Innovation and Creativity**

Recent promotion of disaster risk reduction has resulted in the development of several new and engaging risk awareness and risk reduction awareness games.

- Hurricane Strike! developed through the United States National Weather Service, is an interactive computer game that teaches youth about hurricanes and hurricane evacuation steps. Players must advise "Aunt Betsy" of the best order in which to carry evacuation tasks. Monologues help guide students and give concrete explanations of reason for each step. This game has been used in classrooms and on news channel sites in areas of high risk.
- The virtual Earthquake Museum in China includes interactive games on earthquake response and information on a range of topics, including basic hazard awareness, Chinese seismographic history and earthquake risk management. Information is engaging and accessible for children and adults with access to the internet.
- A Non-Structural Mitigation Table-top Model developed in Turkey has been used for hands-on demonstration of how to fasten furniture to prevent falling, sliding and colliding in an earthquake. The model has been enthusiastically replicated in Kazakhstan, Uzbekistan, and Tajikistan, and localised for application in India.

Long-term, sustained risk awareness and risk reduction education programs can encourage wide-spread voluntary adoption of simple risk reduction strategies, and limited adoption of more costly measures. It can also build public and political support for complementary risk reduction strategies that mandate and enforce risk reduction through land use planning, construction standards, catastrophe insurance and institutional emergency response. **As part of a broad national risk reduction strategy, risk awareness and risk reduction education can strengthen public support for, and engagement in risk reduction at the national, regional, and local level.**

4.1. The role of key stakeholders in promoting risk awareness and risk reduction education

National governments are in a position to provide the needed policy-level guidance and leadership in risk awareness and risk reduction education. As part of an extended and sustained effort, the following steps may help to raise public risk awareness and reduce natural catastrophic losses:

Promotion of cross-sectoral collaboration

Disaster risk awareness and risk reduction education has been especially effective when representatives from the public, private, education and civic sectors collaborate together. In order to involve these many stakeholders, cross-sectoral platforms such as disaster risk reduction task forces can promote a collaborative process for the creation, implementation and dissemination of risk awareness and risk reduction education programs and strategies. At all levels, cross-sectoral collaboration can help develop processes for achieving broad consensus and ownership of disaster risk reduction mechanisms, a key component when educating the public and policy makers about disaster risk reduction.

Integration of risk awareness and reduction measures in compulsory education

Incorporating risk awareness and reduction strategies into school curricula is the strongest method for institutionalising the reach of these messages to the largest percentage of the population in perpetuity (BRI and GRIPS 2007; Davis, Hosseini, and Izadkhah 2003; Izadkhah 2005). What is learned in childhood becomes incorporated into collective knowledge and carried into future decision-making.

While innovative and in-depth school education materials have been developed in many countries, several of these have only been piloted, rather than thoroughly integrated into national or regional curriculum standards (Izadkhah and Davis 2006). Formal curricula approaches have included infusion into existing courses at all grade levels, insertion of modules into existing courses, and supplemental stand-alone courses. Informal and co-curricular approaches have included special assemblies, drills, projects, competitions, festivals, exhibitions and performances. Development of leadership in teacher training, targeting both education faculty as well as a program for in-service training of existing teachers will support any effort at national risk awareness and reduction curricula. School risk awareness and reduction education cannot simply be tacked onto overloaded curriculum. Nor can over-taxed teachers be expected to research and develop new materials in a field which they have little prior knowledge. Successful programs have included both curriculum and teacher support materials and have formally incorporated these materials into national curricular guidelines. Moreover, some argue that the development of leadership in teacher training by targeting teacher-training colleges as well as in-service training of existing teachers can increase success.

The content of risk reduction and placement in school curricula is important. Historically, hazard awareness content has been placed in science and geography courses (Fredricks 2001; Lidstone 2005), but educators have noted important opportunities for integration in social studies, civics, life-safety, health or life skills courses, language and literature, and mathematics. More broadly, risk awareness curricula can support students

and communities in learning skills to identify and reduce hazard exposure and vulnerability, even as these evolve. Impact can be maximised by including practical guidelines for risk-wise actions, problem-solving skills for risk reduction, and education on financial tools for risk sharing and protection.

Box 4.2. **Integration into School-based Curricula**

In 2004, the National Text-book Authorisation Committee for Primary and Middle Schools of China approved a text-book for senior middle schools on natural hazards. The book offers a thorough introduction to natural hazards in the world, with a more detailed focus on China, and includes a final chapter on preparedness and disaster risk reduction. The book also features a list of Chinese web sites that students and teachers can consult, including an excellent site maintained by the Chinese Science Museum. By 2006, there was a copy on every senior middle school student's desk (Wisner 2006).

Iran's national earthquake safety education program is mandatory in schools, supported by a range of text-books and extended through posters and public awareness campaigns. Lessons are reinforced through a national earthquake drill day, an event widely publicised by the media.

Successful school programs have integrated student learning with community risk preparedness programs through learning extensions at home and the encouragement of child-parent and teacher-parent communication. This has been achieved through community risk mapping projects, community-based fairs and exhibits, publicised drills, and other community based projects.

Public risk awareness and risk reduction education can develop consciousness about the need for school and community-based disaster management planning. These education activities may also create citizens eager to participate in local and regional risk mitigation and planning.

National-level guidelines on public service message content

While multiple organisations and sectors can be encouraged to develop and disseminate risk awareness and reduction education materials, guidelines on important content will help limit confusion, conflicting messages and disinformation (Alexander 2007). Development of standardised material from which organisations can take and modify for their particular target audiences has proven successful in the United States. There, a Coalition of Organizations for Disaster Education that includes the American Red Cross, government and research centres, has developed standardised language, advice for readiness, and reduction strategies (ARC 2007). The Ministry of Home Affairs in India has also compiled and prepared an extensive set of resource materials developed by various organisations and distributed them to the state governments for local language translation and dissemination (Kuberan 2007).

When trusted institutions collaborate in developing broadly accessible and high quality risk awareness material, widespread repetition of the same basic message throughout national awareness and educational material can be achieved. In developing national guidelines for risk awareness and risk reduction messages, care should be taken to include the perspectives of children, minority language groups, people with disabilities, the elderly, and those who have experienced disasters. This can help avoid the dissemination of incorrect, inappropriate, or simply ineffective guidelines to target audiences.

National risk awareness and risk reduction guidelines can also be used to counter common myths or develop new public messages. Yet care must be taken to ensure that new information disseminated is appropriate, accurate and will not need to be re-developed soon after dissemination. Following flooding in the United Kingdom, reviewers noted that the public relied heavily on older, less effective strategies such as sandbagging (Pitt 2007). In recent studies of United States preparedness guidelines, for example, two fifths of survey respondents indicated they would not or could not shelter in place in the way currently promoted but did have ideas for improving their own and their community's ability to protect themselves in a crisis (Lasker 2004). These examples clearly demonstrate the importance of testing the quality and accuracy of risk and risk reduction messages prior to their widespread dissemination.

Support outreach programs to opinion-leaders and knowledge disseminators

Increasing awareness of natural hazards and risk reduction is a daunting task made easier by prioritising the education of key knowledge disseminators and policy makers. It has been especially important to target opinion-leaders trusted by the public and well-known "champions" of safety issues who can promote awareness and education on a sustained basis.

Box 4.3. **Targeting Disseminators, Opinion Leaders and Policy Makers**

Several regional, national and international initiatives target knowledge disseminators, opinion leaders and policy-makers for efficient and effective dissemination. This strategy may reduce the need for more costly campaigns targeting the general public by assuming that disseminators will educate large audiences independently.

- The United States *National Weather Service* funds the *COMET* program as a means of providing education and training resources for the weather forecasters. Through strong email lists, ties with professional bodies, and an information rich web-site, *COMET* instructional materials are promoted to over 10,000 forecasters and concerned individuals. The instructional material is designed so that professionals can quickly access and incorporate risk information into local weather forecasts, news shows, and emergency briefs. Underlying this risk awareness program is the realisation that the public most often seeks explanations of meteorological hazards and guidance regarding appropriate risk reduction behaviour from professional forecasters.
- Italian initiatives have helped raise awareness of natural hazard risk and risk reduction planning for government representatives and policy makers. The Metropolitan Municipality of Rome developed a network of capital city governments and facilitated multiple meetings to discuss capital city emergency management. A similar program was later adapted for 14 national metropolitan areas. Emergency management courses were also held for public administrators in Lombardy and nearly a third of the city mayors attended. Plans to institutionalise mandatory attendance are underway. These programs may help develop public sector leadership for risk awareness and reduction education within the jurisdiction.
- In South Asia, Duryog Nivaran South Asian Network for Disaster Risk Reduction, has developed *Disaster Communication: A Resource Kit for Media*. The kit includes information about natural hazard events and community vulnerability. It also promotes a more progressive approach to gathering and presenting news with the aim of stimulating risk reduction actions by policy makers and the public.

People often seek out or receive risk related information from a small number of trusted sources. Studies in the United States indicated that the many would not trust public announcements about health hazards, but would instead call their doctors to receive information and advice about eminent hazards (Lasker 2004). Studies following the 1999 earthquakes in Turkey suggested that the public trusted search and rescue

organisations over government officials and even scientists (Fişek, Müderrisoğlu, and Özkarar 2001). Religious leaders, neighbourhood leaders, business managers, school principals, media personnel and others may be effective and trusted disseminators of risk and risk reduction information. It is important that these and other knowledge disseminators have heightened awareness of risks and reduction strategies and have easy access to further information.

Box 4.4. **Examples of Community Participation in Risk Awareness and Reduction**

Direct community participation in the development of hazard and risk reduction education material will lead to a higher quality of targeted products. The creation of very local materials (e.g. children's posters for their own community) can promote deeper questioning of, and engagement in, the material. It can also create a more thorough understanding, longer retention and implementation. School-based materials should explicitly involve parents.

Following the 2000 Gujarat earthquake in India, SEEDS, a local NGO, worked to increase rural community awareness of disaster resistant construction through a participatory approach to community education. Local builders helped construct two scale models of local buildings, one incorporating seismic resistant components and the other not. Community members helped label these components. Following construction, during a multi-village festival, the buildings were repeatedly rammed by local tractors. Villagers watched as the building with seismic resistant features withstood shaking and the other model collapsed.

Environmental awareness education in Mexico's secondary education geography classes seeks to educate students about hazards, identifying vulnerable sub-populations, and the importance of raising awareness about disasters. An important component of this education is allowing students to propose and participate in mitigation measures for risk reduction that are identified in their homes, schools, and communities.

In 2007 in La Paz, Philippines, geoscientists identified landslide risks to an elementary and a high school and several homes. Following community debates on what to do, the headmaster put the decision about whether to relocate to a vote. Broadly, the adults, concerned about requiring the children to travel to school, voted against relocation. The children, however, made an effort to educate the community and ultimately prevailed 2:1 in having their school relocated to a safer place (Plan 2007).

In Japan, subsidies are provided to community groups (Jishubo) for the purchase of emergency food and rescue tools. Jishubo members who accept this subsidy take part in government-sponsored disaster preparedness workshops (Bajek, Matsuda, and Okada 2007).

In New Zealand, remote communities have been invited to be part of the hazard mitigation process. Community member priorities and beliefs have become part of a technical report that became the foundation for mitigation. This approach enhanced awareness and community preparedness while also increasing alliances between professionals and the community (Gough 2000).

Following an evacuation drill, ranchers and farmers on the east side of the Iceland's Myrdalsjokul icecap stated that they will not follow the flood evacuation plan in an emergency. They are worried about leaving their livestock and are concerned about driving across the flood plan to reach the designated evacuation shelter. The Icelandic Civil Defence is working with the community to develop an evacuation plan that takes into account both governmental and local concerns.

Child-oriented non-governmental organisations such as *Plan International, Action Aid, Save the Children* and others routinely involve children in consultation and decision-making relative to risk reduction and sustainable development.

Funding the development of education material and training specifically for respected disseminators has been a high priority for some national governments and other stakeholders. These programs have paid special attention to tailoring the material to the culture and the role the knowledge disseminators play in society and to ensuring that the material is amenable to the ways in which knowledge disseminators engage the public.

Community participation

Broad community engagement is vital not only in the civic sector where it is currently most prevalent, but also in private, public, and educational sector efforts (Twigg 2004; Zugman Do Coutto 2004). When communities have been invited to participate throughout the process of program development and message dissemination, it has helped to avoid wasting valuable time and resources on inappropriate or ineffective efforts.

Extensive experience indicates that communities should be full participants in risk awareness and risk reduction initiatives. Least successful are efforts that interpret "participation" as the need for community approval of plans already developed (Izadkhah and Davis 2006). This token approach to community participation can create suspicion or hostility as people recognise co-optation. Care must be taken so that efforts to include communities do not become marred in political alliance-building or become seen as a means of extracting favours (Wisner 2006). Funding stipulations that require extensive community engagement are one method to promote more effective and sustainable risk awareness and risk reduction.

Past experience has shown that it is especially important to involve community members in risk education efforts when these efforts have been initiated by technical experts. Technical experts often need assistance communicating risk messages in ways that take into account factors that are important to targeted individuals and communities. Moreover, technical experts may not be well equipped to know what information is most sought after and which information will most likely lead to increased risk reduction behaviour (Gough 2000).

Grassroots initiatives

Many excellent risk awareness, risk reduction and advocacy programs have begun with grassroots efforts rather than national initiatives (Alesch et al. 2004; Twigg 2004). These programs are often more grounded in the local physical, cultural, economic and political context of a community than nationally developed programs. Often these programs are developed by or for vulnerable or marginalised members of a community. These are important not only for the content of the materials they have created, but the social networks on which they rely for dissemination. Much can be learned from these efforts (Victoria 2005).

Box 4.5. **Grassroots Partnerships for Disaster Risk Awareness and Reduction**

National education ministries and civil defence agencies are often in a strategic position to enhance the dissemination and institutionalisation of grassroots developed risk awareness material.

- In India the Gujarat State Disaster Management Authority partnered with SEEDS, a small non-profit organisation with expertise in community-based disaster risk management. Over the course of 3 years, they piloted a variety of strategies and tested materials before scaling up to a state-wide program for teacher-training and curriculum support that will reach all school children, and provide a model for other states.
- In Indonesia the Coalition for Disaster Education is a public/civic partnership pioneering in developing materials and programs for adults and children with strong prospects for scaling up as their experience grows.

Grassroots initiatives, while creative, dynamic and flexible, often lack the financial and human capital to sustain and expand their efforts (Gupta 2002). Endeavours to capitalise on the strengths of grassroots risk awareness and risk reduction through scaling-up of local programs are most successful when grassroots organisations partner with governmental agencies, larger civic organisations or businesses. Partnerships such as these can be supported and enhanced as part of a holistic, top-down and bottom-up integration strategy.

Accountability and effectiveness through scientific evaluation

Very few of the risk awareness and risk reduction education efforts so far undertaken have been studied beyond consumer satisfaction. Both monitoring and evaluation of initiatives and efforts are essential to assure accountability and transparency, and will increase both public confidence and a broad-based stake in the outcomes. Monitoring and evaluation of current strategy for risk awareness and education can serve as a first step towards developing effective strategies and materials and as an assurance of the effectiveness of ongoing programs.

Understanding the actual causes of deaths, injuries and economic losses from disasters in a particular location is an important aspect of risk education. Post-disaster investigations can be coordinated as part of national risk reduction strategies in order to determine whether losses result from infrastructure collapses, inappropriate evacuation procedures, breakdown of early warning systems, a lack of resources or skills, or inaccurate perception of risks. These investigations will support the development of better risk reduction tools and inform current risk awareness and risk reduction education efforts. Many institutions for higher learning and centres for risk management have the expertise to engage in post-disaster investigations and carry out studies of risk perception and risk reduction actions.

Scaling-up and sharing

Fundamentally, developing a "culture of safety" is about building local, regional and national momentum for disaster risk reduction. Many pilot programs have been successful and can be expanded through policies, guidelines, curricula, training programs and mass material distribution that is scaled to reach the entire risk-exposed population. In larger countries and those with federally-organised governments, scaling-up may entail a colourful, but complementary patchwork of efforts.

Multi-level participation in strategic planning, educational and scientific workshops and conferences, broad publication of case studies and sharing existing material for adaptation contribute to bringing successful efforts at one scale to the attention of those working at other scales.

4.2 Effective tools to enhance risk awareness and risk reduction education

Past efforts to educate the public regarding natural hazard risk and risk mitigation have had mixed success. Those that have been most successful have followed a few key strategies:

- **Clear, consistent message.** Despite inherent uncertainties that exist in the understanding and prediction of hazards, people need clear, consistent and

persistent messages to internalise information and move towards action. Inconsistent and conflicting messages from the scientific, governmental, or civic communities and the media can lead to confusion, wasted energy or apathy (Evans, Frick, and Schwing 1990; Whittaker 1986). A consensus message, from a broad array of trusted sources, can be crucial to effective risk education.

- **Non-technical language.** Complex information is most easily understood when described using every-day terms and concepts (Gupta 2002; Mileti and Darlington 1995). The public often needs new terms fully explained, easily recognisable landmarks, features, and boundaries on maps and logical and consistent symbols (e.g. indicating 'right' and 'wrong', danger levels, etc.). Research suggests that the use of probabilistic language should be used with caution (Stone, Yates, and Parker 1994).
- **Promotion of both awareness and action.** Past research has shown that increased hazard awareness does not directly lead to adoption of risk reduction measures and financial loss pooling. Risk awareness and risk reduction understanding are more effective when paired. Educational material that stresses the effectiveness and feasibility of risk reduction actions also better supports the growth of a culture of safety (Lindell and Perry 2000; McClure 2006; Mulilis and Duval 1995).
- **Engaging format.** Without direct experience of a hazard event, many people do not independently seek out hazard and risk reduction information. Educational material that is engaging, attractive and interactive can catch and keep the public's attention. Innovative strategies such as games, toys, models, videos, experiential demonstrations, mass media ads, mascots and catchy slogans have heightened engagement for many audiences (Fredricks 2001; McClure 2006; Suarez et al. 2005).
- **Positive, empowering and accurate examples**. Negative images of disaster destruction can be overwhelming (Lopes 1992). Positive, empowering and accurate visuals can reinforce proactive behaviour (Lehman and Taylor 1988; Mulilis and Duval 1995).
- **Use of role models.** Community leaders and carefully-selected celebrity spokespeople can be especially effective role models for risk reduction action. Teachers, as key role models for young people, can also be change agents when promoting risk awareness, risk reduction and use of financial tools to protect against loss (Shiwaku et al. 2006).
- **Targeting of multiple audiences.** Vulnerability to hazards can vary across populations (Cutter 1994; Fothergill 1996; Wisner et al. 2004). Education efforts that have found effective dissemination avenues for vulnerable sub-populations, have been able to reach the greatest number of at-risk individuals (Bhatti and Ariyabandu 2022). These efforts have varied to take into account the specific needs, languages, cultures, as well as vulnerabilities and capacities of each audience. They have also included positive and empowering illustrations of women, children, and members of minority groups, allowing the receiver to identify positively with the examples.
- **Multiple dissemination strategies.** With diverse populations exposed to natural hazards, successful risk awareness programs have found ways to repeat their

messages to each audience for maximum impact. The use of multiple dissemination strategies has supported the process of behaviour change from contemplation, to action, and finally habit development (Ajzen 1991; Velicer et al. 2006).

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Annex I.A1

Selected Examples of Risk Awareness and Reduction Education Programmes

(Annotations in parenthesis indicate scale of reach and sector)

Canada

Canadian Natural Hazards Assessment Project *(National: Cross Sectoral)*

The Canadian Natural Hazards Assessment Project is collaborative effort of the Meteorological Service of Canada, the Institute of Catastrophic Loss Reduction and the Office of Critical Infrastructure Protection and Emergency Preparedness. A set of background technical papers regarding the risk to Canadians from natural hazards, how those risks might be mitigated, and an inventory of gaps in knowledge have been developed as well as a synthesis document suitable for the general public.

www.msc-smc.ec.gc.ca/projects/hazards_assessment

Canadian Red Cross *(National: Civic Sector)*

The Canadian Red Cross provides information on how to be prepared for emergencies. They also teach *Quakesafe,* a personal preparedness course and first aid classes, as well as selling first aid and emergency kits.

www.redcross.ca

Emergency Preparedness for Industry and Commerce Council (*Regional: Cross-Sectoral Partnership)*

EPICC is a non-profit government endorsed society supported by and for the benefit of business and institutions throughout British Columbia, Canada, to influence and help businesses prepare for emergencies and disasters. They organise conferences and provide information kits for businesses concerned about natural hazard risk reduction.

www.epicc.org

Expect the Unexpected *(National: Civic-Private Partnership)*

Expect the Unexpected is a program of the Canadian Red Cross, State Farm Insurance and the Weather Network to prepare children for natural hazards, and emergency preparedness. The program has three components: It can happen, be ready (7-8 years); Facing the unexpected, be prepared (10-11 years); and Be ready, be safe (12-13 years). The program has reached more than 750,000 children.

www.redcross.ca/article.asp?id=009874&tid=028

FireSmart *(National: Public Sector)*

Natural Resources Canada in collaboration with federal, provincial and municipal governments and organisations developed the FireSmart Program which provides information and guidelines for protecting communities from wildfire. Over 15,000 copies of the manual have been distributed across Canada and internationally. They also provide Community Grant Program for projects to reduce the risk of wildfire in a community.

www.srd.gov.ab.ca/wildfires/firesmart

Get Prepared *(National: Public Sector)*

The national *Get Prepared* campaign educates the general public about the risks in their area and encourages them to make a plan and an emergency kit. There are also publications regarding specific hazards and a general guide for business continuity. Each May, Public Safety of Canada in collaboration with provincial and territorial governments has an emergency preparedness week to increase awareness and reinforce the idea that preparedness can reduce risks and lessen disasters.

http://getprepared.ca/

Institute for Catastrophic Loss Reduction *(National: Cross Sectoral)*

The Institute for Catastrophic Loss Reduction (ICLR) is a co-ordinated effort to reduce disaster losses involving member insurance companies, The University of Western Ontario and other partners. They have risk awareness and preparedness information for the general public on earthquakes, flood/droughts, hurricanes, lightening/hail, tornadoes, wildfires, and winter storms.

www.iclr.org

Insurance Bureau of Canada *(National: Private Sector)*

The Insurance Bureau of Canada provides free resources to educate the public on how to protect their families and homes before, during and after natural disasters, such as earthquakes, hurricanes, lightning, hail, tornados and winter storms.

www.ibc.ca/en/natural_disasters

Ministry of Public Safety *(Regional: Public Sector)*

The British Columbia Ministry of Public Safety provides information for the general public regarding community emergency planning, response and recovery. There are similar programs in each province.

www.pep.bc.ca

Ontario Storm Prediction Centre *(Regional: Public Sector)*

The Ontario Storm Prediction Centre and Environment Canada advise the public by providing special winter weather alerts and information regarding preparedness for weather hazards.

www.on.ec.gc.ca/weather/SVRWX/SVRWX_Awareness-e.html
www.on.ec.gc.ca/pubs_e.html

Pegasus Emergency Management Consortium *(National: Private Sector)*

The Pegasus Emergency Management Consortium distributes two booklets: *Quick Guide to Family Emergency Preparedness* and *Generic Emergency Plan for Schools.* They also have the *Kids Can, Emergency Plan* colouring and activity book.

www.pegasusemc.com

School Earthquake Safety Guidebook *(Regional: Public Sector)*

British Columbia's Provincial Emergency Preparedness Program has developed the *School Earthquake Safety Guidebook*, which is distributed to schools.

www.pep.bc.ca/schools/schools.html

Seismic Hazard Mitigation Program *(Regional: Public Sector)*

The Seismic Hazard Mitigation Program for High-Risk Buildings in Vancouver, British Columbia is developing a long term strategy to prepare for and reduce the impact of a major earthquake on seismically vulnerable buildings. Some of the goals of the project are to educate building owners about the seismic vulnerability of their buildings in the hope that they will upgrade them voluntarily and to provide incentives to encourage building owners to upgrade their buildings within a certain time period.

vancouver.ca/commsvcs/cbofficial/sesmicupgrade.htm

China

Academy of Disaster Reduction and Emergency Management *(National: Public Sector)*

The Academy of Disaster Reduction and Emergency Management Education in the Ministry of Civil Affairs and Ministry of Education have created materials to educate students in middle school and at the undergraduate, master and doctorate levels in risk mitigation and preparation. The websites are in the process of being constructed.

http://adrem.org.cn
http://iRisknet.cn

Beijing Earthquake Administrations *(National: Public Sector)*

The Beijing Municipality Earthquake Administration provides public information via its website on earthquake risk awareness, risk reduction measures and what to do during an earthquake.

www.bjdzj.gov.cn

China Ministry of Civil Affairs *(National: Public Sector)*

China Ministry of Civil Affairs is the main emergency management governing body in China. The Ministry of Civil Affairs & Ministry of Education, the People's Republic of China, along with the Academy of Disaster Reduction and Emergency Management has established the Risk Mitigation Education Program.

www.mca.gov.cn

Chinese Museum of Earthquakes *(National: Public Sector)*

The Chinese Museum of Earthquakes is a virtual museum created by the Chinese Academy of Sciences. It is dedicated to educating the public about earthquakes in China. It works to teach all ages about earthquake risk awareness, preparedness and planning.

www.kepu.net.cn/english/quake

Red Cross Society of China *(National: Civic Sector)*

The Red Cross Society of China has held disaster relief training workshops and first aid training.

www.chineseredcross.org.cn

Iceland

Civil Protection Department *(National: Public Sector)*

The Civil Protection Department of Iceland's website has lists of what to do before and during disasters. There is also general information regarding how to be prepared for an emergency. They have also created maps and brochures regarding volcano and flash flood evacuation. The information is available in several languages.

www.almannavarnir.is

Icelandic Emergency Insurance Organisation *(National: Public Sector)*

The Icelandic Emergency Insurance Organisation manages the coverage of damages from volcanic eruptions, earthquakes, earth slides, avalanches, and floods. All insurance companies that insure property against fire are required to collect a tariff to fund this mandatory catastrophe insurance along with their premiums.

www.fme.is

Icelandic Meteorological Office *(National: Public Sector)*

The Icelandic Meteorological Office website gives locations of earthquakes in Iceland in the last 48 hours. The image is refreshed every 2 minutes. It also provides hazard zoning for slides and gives reports and other information about hazard zoning in communities where there is a danger of avalanches and landslides.

http://andvari.vedur.is/english/

Icelandic Red Cross *(National: Civic Sector)*

The Icelandic Red Cross has training for course leaders in emergency response.

http://redcross.is

India

Amity Institute of Disaster Management *(National: Private Sector)*

The Amity Institute of Disaster Management has created a three month course to address the urgent need to raise awareness levels of the general public. The courses are aimed at officers of the defence forces and other professionals.

www.amity.edu/aidm

Central Board of Secondary Education *(National: Public)*

The Central Board of Secondary Education has integrated a short course on Disaster Management in the 8th, 9th and 10th standard school curriculum and provided teacher training programs across the country. Disaster management is ten percent of the total social science syllabus. The curriculum contains information on the nature and types of hazards, natural and manmade disasters and need for their management, efforts made in different regions towards disaster preparedness and mitigation, the role of the community and schools, partnerships with the government and non-governmental agencies, the use of technology to combat disasters, and survival skills. The board also intends to introduce Disaster Management as a part of Geography, Sociology, and Environmental Education in the 11th and 12th standard.

www.cbse.nic.in

Global Open Learning Forum on Risk Education *(National: Civic-Private Partnership)*

The Global Open Learning Forum on Risk Education (GOLFRE) is a group of internationally based universities and non-profit organisations that have created a three month certificate course on disaster awareness, preparedness, and response for school teachers and field practitioners. Material is either distributed by electronic media or by post. This program is implemented in India by the Sustainable Environment and Ecological Development Society (SEEDS).

www.seedsindia.org

Gujarat State Disaster Management Authority *(Regional: Public-Civic Partnership)*

The Gujarat State Disaster Management Authority and the Sustainable Environment and Ecological Development Society (SEEDS) implemented a two year pilot project entitled the *Gujarat School Safety Initiative (GSSI)* that made disaster risk reduction an integrated part of school based learning. The first phase of the project focused covered three cities: Ahmadabad, Jamnagar and Vadodara. The second phase covered all 25 districts in the state. The third phase of the School Safety Initiative is being planned to upscale the program in selected districts and talukas of the State.

www.gsdma.org

Indian Red Cross Society *(National: Civic Sector)*

A Diploma Course in Disaster Preparedness and Rehabilitation was started by the Indian Red Cross Society. The course is aimed at increasing the capacity of the managers in Government and Private Sector for effective disaster response and rehabilitation. They are also finalising a Community Based Disaster Preparedness (CBDP) model for the Training of Trainers.

www.indianredcross.org

Duryog Nivaran -South Asia Network for Disaster Risk Reduction *(International: Civic Sector)*

Duryog Nivaran, a multi-national south Asian network of civic sector organisations working on disaster risk reduction, aims to reduce the vulnerability of communities to disasters and conflicts by promoting the integration of alternative perspectives on disaster and vulnerability in development and disaster mitigation programmes. In India, the organisation engages in community disaster preparedness projects and has recently published a guide for journalists, encouraging them to cover both disasters and underlying causes.

www.duryognivaran.org

National Disaster Management Authority of the Ministry of Home Affairs *(National: Public Sector)*

The National Disaster Management Section of the Ministry of Home Affairs 2007 Guidelines on Management of Earthquakes has made awareness and preparedness a key focal area. Information for the public on disaster preparedness, response and mitigation has been and continues to be developed. This information includes the *Children's Colour Activity Book for Disaster Preparedness* and information on the *School Awareness Safety Programme*. The Ministry of Home Affairs has also compiled a set of disaster resource materials to be translated, adapted and disseminated by state governments and DMAs based on local vulnerabilities. One of the four sections included is education and training.

www.ndmindia.nic.in

National Steering Committee for Media Campaign and Publicity Relating to Disaster Management *(National: Public Sector)*

A steering committee has been organised to devise a nation wide awareness campaign as part of the governments overall disaster risk management strategy. The committee plans on using print and electronic media, postings in places with high public visibility, and messages on government stationary (postal letters, railway tickets, and airline boarding cards) to promote their message.

www.ndmindia.nic.in/Mitigation/mitigationhome.html

National Cyclone Mitigation Project *(National: Public Sector)*

The Government of India has decided to implement the World Bank assisted *National Cyclone Mitigation Project* in nine states and four Union Territories that are vulnerable to the risks of cyclones. The plan includes the creation of shelters, warning systems and public education.

http://mdmu.maharashtra.gov.in/pages/nationalcyclone/nationalcycloneShow.php

National Information Centre of Earthquake Engineering *(National: Education Sector)*

The National Information Centre of Earthquake Engineering located at The Indian Institute of Technology Kanpur provides seismic risk reduction information for professionals and the general public. They have an informative website, printed material and offer courses aimed at teaching seismic resistant construction techniques to engineers, construction workers and self builders.

www.nicee.org

National Institute of Disaster Management *(National: Public Sector)*

The National Institute of Disaster Management (NIDM) is part of the Ministry of Home Affairs. It provides policy advice and facilitates capacity building services including strategic learning, research, training, system development, and expertise promotion for effective disaster preparedness and mitigation.

www.nidm.net

Omaxe Foundation Earthquake Resistant Structures Education *(National: Private-Public Partnership)*

The Omaxe Foundation, a leading real estate and construction company, facilitates disaster resistant construction workshops and seminars throughout India, including the *All India Workshop on Earthquake Resistant Structures in Partnership* that was organised in cooperation with the UNDP in 2007.

www.omaxefoundation.co.in

Orissa State Disaster Mitigation Authority *(Regional: Public Sector)*

The Orissa State Disaster Mitigation Authority (OSDMA) publishes a quarterly newsletter in English and Oriya languages and disaster reduction education materials. They also organise workshops and training programs for officials, Panchayati Raj Institutions and non-profit groups involved in disaster management. Community based disaster preparedness, preparation of community based disaster management plans, and earthquake preparedness training programs are also being offered.

www.osdma.org

Sanghamitra Service Society *(Regional: Civic Sector)*

The Sanghamitra Service Society (SSS) under its Community Initiatives in Disaster Risk Reduction works actively in 10 districts of Andhra Pradesh State, covering almost 100 villages. They focus on community capacity building by providing school training, mangrove development, preparedness classes, response information, a community disaster relief fund, and awareness camps.

www.disasterwatch.net

Save the Children *(Regional: Civic Sector)*

Save the Children is working with 40 villages in Rajasthan to establish village level committees comprised of local leaders, Panchayat members, teachers and children. These committees meet once a month to work on issues pertaining to drought in their villages.

http://savethechildren.in/india/

SEEDS Mason Association *(National: Public-Civic Partnership)*

The SEEDS Mason Association has a mason certification program that was introduced by the Gujarat State Disaster Management Authority (GSDMA) and the Gujarat State Vocational Training Institute (GSVT). Over 450 masons have been trained in disaster resistant skills to date.

www.seedsindia.org/SMA/en.pdf

Siel Chemical *(Local: Private Sector)*

Siel Chemical conducts preparedness programs for employees, school children and nearby villages.

www.sielchemical .com

Sustainable Environment and Ecological Development Society *(Regional: Civic Sector)*

The Sustainable Environment and Ecological Development Society (SEEDS) has several sustainable community initiatives, including disaster reduction awareness, cyclone preparedness drills, and safe construction practices.

www.seeds.india.org

Tata Chemicals *(Local: Private Sector)*

Tata Chemicals conducts safety and risk management programs to educate their employees and the communities surrounding their plant about disaster risk.

www.tatachemicals.com

United Nations Development Programme in India *(National: Public Sector)*

The United Nations Development Program is supporting the government of India to set up an institutional framework for disaster preparedness, response, prevention and mitigation. The project has been implemented in 169 districts spread across 17 states. Two of the main objectives of this program are to strengthen education and awareness programs.

www.undp.org.in

Voluntary Health Association of India *(Regional: Civic Sector)*

The Voluntary Health Association of India through the Aparajita Orissa Project and Aparajita Andamans Project aims at empowering the local community and build their capacity to recover from devastation and prepare for future natural disasters.

www.vhai.org

Italy

Civil Protection Agency *(National: Public Sector)*

The Italian Civil Protection Agency has information for the general public regarding fires, hydrological risk, volcanoes, earthquakes, and health risks.

www.protezionecivile.it

Civil Protection Club *(National: Public Sector)*

The Italian Civil Protection Agency has created a civil protection club for 4th and 5th graders in elementary school in Italy. They use a login name and password in order to enter the site and learn disaster risk awareness, reduction and preparedness.

www.protezionecivile.it/club

Civil Protection for Children *(National: Public Sector)*

La Protezione Civile per i Piccolo has awareness and preparedness information geared at children in an interactive format. It has information regarding industrial risk, seismological risk, fire risk, hydrological risk, volcanic risk, and health risk.

www.protezionecivile.it/sitobambini/home.html

The European University Centre for Cultural Heritage *(National: Education Sector)*

The European University Centre for Cultural Heritage has courses on seismic risk and mitigation for builders and school teachers.

www.univeur.org

International Institute to Stop Disasters *(International: Civic Sector)*

The International Institute to Stop Disasters, located in Italy, has created many different educational campaigns focused on disaster risk preparedness and sustainable development. They have also coordinated the Medsafe Network, which facilitates interaction and communication between individuals and organisations focused on disaster prevention and sustainable development in the Mediterranean region. They also support CIDAS, a centre which contains hundreds of documents in several languages on city emergency, the prevention of risk and sustainable development. Students, teachers, university researchers, professionals and others consult CIDAS to gain information.

www.stopdisasters.org

Italian Red Cross *(National: Civic Sector)*

The Italian Red Cross provides first aid training for their staff and volunteers.

www.cri.it

CESPRO at the University of Florence *(National: Education Sector)*

CESPRO uses an interdisciplinary approach to promote work connected with natural and technological risks in liaison with civil protection, security and environmental authorities and organisations.

www.cespro.unifi.it

Japan

Annual Radio Presenters Disaster Preparedness Event *(National: Private Sector)*

The General Insurance Association of Japan and the National Association of Commercial Broadcasters organise an edification event annually that invites more than 100 radio presenters from all over the nation. Presenters experience affects of a large earthquake and then listen to lectures on the importance of disaster preparedness. The presenters are then asked to speak about their experience with their listening audience.

www.sonpo.or.jp

Council for Promotion of Building Disaster Prevention *(National: Civic Sector)*

The Japan Building Disaster Prevention Association is part of the Council for Promotion of Building Disaster Prevention. The Association contributes to promoting building disaster prevention and to disseminating appropriate building maintenance and use. It also distributes pamphlets and posters to raise the public awareness on building disaster prevention during Disaster Prevention Week.

www.kenchiku-bosai.or.jp/english/file/epanf.PDF

Disaster Prevention Research Institute *(National: Education Sector)*

The Disaster Prevention Research Institute (DPRI) at Kyoto University has an online disaster information database that is searchable and open to the public.

www.dpri.kyoto-u.ac.jp

Exploration for Disaster Prevention Forum *(National: Cross Sectoral)*

The General Insurance Association of Japan has created a hands-on educational program for elementary school children to help them discover the importance of disaster risk reduction. They also held the *Exploration for Disaster Prevention Forum* under the co-auspices of UNESCO, the Asahi Shimbun Co., and Nippon Volunteer Network Active in Disaster (NPO) as part of the *Tokyo Disaster Prevention Fair 2007.*

www.sonpo.or.jp

Fire and Disaster Management Agency *(National: Public Sector)*

The Fire and Disaster Management Agency (FDMA) is housed within the Ministry of Internal Affairs and Communication. They teach fire and earthquake safety to the general

public and have 'quake simulation machines that visit schools and communities to allow people to experience the feeling of a large earthquake.

www.fdma.go.jp/en

General Insurance Association of Japan Disaster Preparedness Campaign *(National: Cross Sectoral)*

The General Insurance Association of Japan has created an earthquake experience forum, educational information posting on their website, educational videos, TV and newspaper advertisements and posters and flyers to help promote earthquake insurance and disaster preparedness in Japan. They often invite experts and academics in the field to give lectures and work in cooperation with local municipalities and fire departments.

www.sonpo.or.jp

Japanese Red Cross Society *(National: Civic Sector)*

The Japanese Red Cross Society provides nationwide courses on first aid, water safety, snow safety, home nursing and child safety with the purpose of promoting health and safety.

http://www.jrc.or.jp

National Preparedness Day *(National: Cross Sectoral)*

The Japanese government leads a broad scale public participation exercise on National Preparedness Day. This event involves the private, public, civic, and education sectors and in 2007 involved more than half a million people.

http://search.japantimes.co.jp/cgi-bin/nn20070902a2.html

Shizuoka Prefecture Earthquake Preparedness Education Center *(National: Public Sector)*

Visitors to this centre learn about earthquakes and secondary risks like tsunami and fire that may follow a seismic event. Visitors can learn about risks, risk reduction strategies and emergency response through a series of interactive rooms that are both educational and entertaining. The centre website shows videos of centre educational displays and interactive activities, provides further information in an engaging format and allows web visitors to take online quizzes to test their knowledge of risk, risk reduction and emergency response.

www.e-quakes.pref.shizuoka.jp

Mexico

Civil Protection Agency *(National: Public Sector)*

The Civil Protection Agency (Sistema Nacional de Protección Civil) website provides basic and technical reports on several natural and human induced disasters. It also has an

up-to-date information bulletin to disseminate information on developing hazards and weather/volcanic watches.

www.proteccioncivil.gob.mx

Fondo Nacional de Desastres Naturales *(National: Public Sector)*

The Fondo Nacional de Desastres Naturales (FONDEN) is one of the primary mechanisms that the Mexican Civil Protection Agency uses to meet its responsibilities in the event of a disaster. The Natural Disaster Fund has two goals: 1) Prevention of events as part of a development strategy and 2) Insuring that reconstruction contributes to a reduction in vulnerability. It should be noted that the National Disaster Fund is considered complimentary support and not as the sole instrument for disaster prevention.

www.gobernacion.gob.mx

Mexican Red Cross *(National: Public Sector)*

The Mexican Red Cross has developed a 20 second spot for television and radio promoting hurricane preparedness. They have also recently begun to include risk awareness and risk reduction education in their public training programs. Some local chapters of the organisation have been trained in vulnerability and capacity assessment, a process that can heighten public awareness and promote risk reduction activities.

www.cruzrojamexicana.org

National Disaster Prevention Centre *(National: Cross Sectoral)*

The National Disaster Prevention Centre (Centro Nacional de Prevención de Desastres) provides information on natural and anthropogenic risk developments for the government and the public, as well as actions that can be taken to mitigate the negative consequences of a disaster. The centre also has written training material for civil protection agents.

www.cenapred.unam.mx

Regional Center for Information on Disasters *(International: Public-Civic Partnership)*

The Regional Center for Information on Disasters (Centro Regional de Información sobre Desastres) has disaster education resources for Latin America and the Caribbean, including a virtual library.

www.crid.or.cr

Safety Week *(National: Public Sector)*

The Comision Nacional de Seguros y Financieros (CNSF) in Mexico seeks to enhance catastrophic risk-exposure awareness through *Safety Week* organised by an association of insurance agents in primary schools.

www.cnsf.gob.mx

Secretary of Public Education for Mexico *(National: Public Sector)*

Risk education is taught as part of the Geography of Mexico and World Geography curriculum in the first year of Secondary School in Mexico. Mexican students are taught the processes that transform geography of a region from a sustainable development perspective, population dynamics, economic interdependence, cultural diversity, political organisation and the prevention of natural disaster at the national and international level.

www.reformasecundaria.sep.gob.mx/geografia/sitios.html

New Zealand

Ministry of Civil Defence and Emergency Management *(National: Public Sector)*

The *Get Ready, Get Thru* campaign is a new program implemented by New Zealand's Ministry of Civil Defence and Emergency Management. The website has an assortment of material available to regional emergency management offices and other community organisations for the purpose of increasing emergency preparedness. Included in this material are information brochures, preparedness checklists, television commercials, and radio commercials that organisations can access and disseminate in their specific region. The website also has information that the general public can access for general risk awareness, preparedness, and what to do in an event.

www.getthru.govt.nz.

National Institute of Water and Atmospheric Research (*National: Public Sector)*

National Institute of Water and Atmospheric Research includes pages on climate change, its affects on weather in New Zealand and steps the public can take to reduce greenhouse gas emissions.

www.niwa.cri.nz

Red Cross New Zealand *(National: Civic Sector)*

Red Cross New Zealand provides first aid training for the general public. They also sell first aid kits and manuals.

www.redcross.org.nz

Resilience Organisations (*National: Public Sector)*

The national government of New Zealand funds the research group Resilient Organisations to research lifeline infrastructure and business organisations. The research builds tools and techniques for organisational and business continuity in the case of natural hazard events.

www.resorgs.org.nz

Te Papa Museum *(National: Public Sector)*

The Te Papa Museum of New Zealand has created an interactive website entitled *Awesome Forces*. It has information, games, stories and quizzes that help educate children about disaster preparedness.

www.tepapa.govt.nz/TePapa/English/Learning/OnlineResources/AwesomeForces

What's the Plan Stan? *(National: Public Sector)*

What's the Plan Stan? is a program developed to inform school age children about New Zealand's potential hazards and disaster preparedness. Besides general risk awareness and prevention education, the website also contains teacher resources for teaching students about disaster preparedness.

www.whatstheplanstan.govt.nz

Portugal

National Authority for Civil Protection *(National: Public Sector)*

The National Authority for Civil Protection website is mostly focused on forest fire awareness, preparedness and prevention targeted at the public. It has a colour key showing the alert level for forest fires and a link to the *Portugal without Fires* campaign that includes four videos.

www.proteccaocivil.pt

Portuguese National Service of Civil Protection *(National: Public Sector)*

The Portuguese National Service of Civil Protection was established in order to safeguard the integrity of life and the environment from damage or from the danger of damage resulting from technological or natural disasters, catastrophes and other calamitous events. The website contains information about safety procedures, general news, natural disasters, and emergency plans. It also has information about the single European emergency call number: 112.

www.snpc.cv

Portuguese Red Cross *(National: Civic Sector)*

The Portuguese Red Cross website provides information regarding hurricane season. They also provide training for their volunteers. They have had several public awareness campaigns including, flu pandemic, summer safety, poverty and environmental stewardship. One notable campaign was the *Green Days* campaign in 2006 that educated the public on the effects of pollution and the importance of regional planning.

www.cruzvermelha.pt

The Portuguese Ministry of Education *(National: Public Sector)*

The Portuguese Ministry of Education states that all members of the educational community must work towards a 'culture of safety' in their schools. Towards this aim they have listed preventative measures and evacuation procedures in documents that are distributed to school personnel. They are currently creating teacher materials on disaster risk reduction.

www.min-edu.pt

Association of Portuguese Insurers *(National: Private-Public Partnership)*

The Association of Portuguese Insurers is working with the government to develop an insurance system for earthquake risk. An awareness campaign targeting building owners is expected to follow the creation of such a system.

www.apseguradores.pt

Spain

Consorcio de Compensacion de Seguros *(National: Public Sector)*

The Consorcio de Compensacion de Seguros (CCS) in Spain is committed to providing compensation for losses incurred as a result of extraordinary risk. The consortium is currently considering preventative campaigns and measures aimed at better preventing and reducing losses.

www.consorseguros.es

Spanish Civil Protection *(National: Public Sector)*

The website contains useful information for disaster related professionals on natural and technological risks (listed separately) and access to national documentation of disasters (which provides an extensive list of documents on disaster information, agreements, special plans, etc).

www.proteccioncivil.org

Spanish Red Cross *(National: Civic Sector)*

The Spanish Red Cross and Ericsson market unit, Iberia have collaborated on a project in disaster response and awareness. The Spanish Red Cross also works extensively in disaster response with other partners and on its own.

www.cruzroja.es

Turkey

Disaster Preparedness Education Unit *(National: Public-Education Partnership)*

The Disaster Preparedness Education Program at Boğaziçi University, Kandilli Observatory and Earthquake Research Institute (AHEP / AHEB) has developed 4

instructor-training programs and public education materials covering: Basic Disaster Awareness (BDA), Non-Structural Risk Mitigation, Structural Awareness for Seismic Safety, and Community Disaster Response. Programs have been implemented with public and civic society partner organisations. The BDA program has been implemented by the ministry of education (MEB) in 50 provinces. Master trainers have trained 20,000+ Primary school teachers who have reached more than 5 million children with the curriculum.

www.ahep.org/ev

Primary School National Disaster Education Week (*National: Public Sector)*

Disaster Education Week is part of the national primary school curriculum. Students take part in activities arranged in their local schools. There are also school drills and take home information regarding disaster preparedness. There are government sponsored contests and school visits by Civic Defence Officers.

http://cerkezkoy.meb.gov.tr/belirligunhafta.asp?belirliID=53

Earthquake Park *(Local: Education-Civic Partnership)*

The Disaster Preparedness Education Unit at Bogaziçi University operates an earthquake simulation centre provided by Rotary International, for school-children. Basic disaster awareness and earthquake insurance information is provided.

www.koeri.boun.edu.tr/aheb

Earthquake Awareness *(Local: Cross Sectoral)*

The Earthquake Awareness program is a local program based in Istanbul that is promoting earthquake risk awareness and preparedness. The program is geared towards the general population including children.

www.depremeduyarliyiz.org

Istanbul Seismic Risk Reduction and Earthquake Preparedness Project *(Local: Public Sector)*

The Istanbul Seismic Risk Reduction and Earthquake Preparedness Project is a program being developed by the Istanbul Governorship and funded by the World Bank. They are creating and implementing disaster risk reduction training curricula and campaign materials. The materials are expected to be ready by April 2008.

www.ipkb.gov.tr

Learning Safe Living with Kızılay *(National: Civic-Public Partnership)*

Learning Safe Living with Kızılay is a supplementary textbook that aims to teach children of 11-13 years and above how to deal with and reduce or prevent disasters. It is sponsored by the American Red Cross and Turkish Red Crescent Society. A teacher's edition of the textbook and a disaster calendar for the classroom are also available.

www.guvenliyasam.org.tr

Neighbourhood Disaster Volunteers *(Regional: Civic-Public Partnership)*

The Neighbourhood Disaster Volunteer (MAG) program trains citizens at the neighbourhood level to be first responders after a disaster. MAG operates in the provinces of the Marmara Region.

www.mag.org.tr
www.magvakfi.org.tr

Safe Living *(Local: Civic-Public Partnership)*

The *Safe Living* project is a pilot project being implemented in Istanbul in coordination with the Ministry of Education and Red Cross/Red Crescent.

www.ahder.org

Turkish Catastrophe Insurance Pool *(National: Cross Sectoral)*

Turkish Catastrophe Insurance Pool (TCIP or DASK) is a non-profit public entity affiliated with the Ministry of State, to whom the Under-secretariat of Treasury reports. It was formed to provide household earthquake insurance at affordable premiums when earthquake insurance was made mandatory for all registered residential buildings within the municipality boundaries.

www.dask.gov.tr

Turkish Red Crescent *(National: Civic Sector)*

The Turkish Red Crescent Society trains volunteers in first aid and disaster response. They have also partnered with other civic sector organisations and the Ministry of Education to develop and disseminate natural hazard risk awareness and household risk reduction education for the general public and school children.

www.kizilay.org.tr

Investing in the Future *(Local: Private Sector)*

Ak Sigorta insurance operates an educational fire and earthquake simulation centre, *Investing in the Future* for school groups ages 7-14 in Istanbul, which teaches disaster risk reduction and creates insurance awareness.

www.bilimmerkezi.org.tr/yenideneybirimleri.html

United Kingdom

Association of British Insurers *(National: Private Sector)*

The Association of British Insurers (ABI) in the United Kingdom provides general information on flooding on their website. The association also works in collaboration with the Environment Agency to support the availability of flood insurance through local insurers.

www.abi.org.uk

Benfield Hazard Research Centre, London *(National: Education-Private Partnership)*

The Benfield Hazard Research Centre, affiliated with University College, London transfers natural hazard and risk research, practice, and innovation from the academic environment to business, government and international agencies. They also have an education program for insurers regarding natural hazards.

www.benfieldhrc.org

British Red Cross *(National: Civic Sector)*

The British Red Cross teaches first aid courses and sells first aid kits on their website.

www.redcross.org.uk

Environmental Agency *(National: Public Sector)*

The Environmental Agency of the United Kingdom has responsibility for developing and disseminated flood risk and zonation maps. Their website has a postal code search feature where individuals can view flood maps for any local area.

http://environment-agency.gov.uk

Geo-World *(Local: Public Sector)*

Geo-World.org is part of the Beal High School Website in the United Kingdom. It showcases the innovative classes that are being taught by in geography and provides information about natural hazards and preparedness. It also includes a link to the *How Prepared Are You* website.

www.geo-world.org

How Prepared Are You? *(National: Civic Sector)*

This interactive website was created by a secondary school teacher in the United Kingdom. It teaches about different hazards that students may encounter when leaving the United Kingdom to go on vacation and what to do before, during and after a disaster occurs.

www.edu4hazards.org

Know Before You Go *(National: Public Sector)*

The *Know Before You Go* campaign encourages British nationals to be better prepared for their overseas trips by learning about the hazards in their destination country. The website and toll-free phone number have travel advice for over 200 countries, including information about natural disasters.

www.fco.gov.uk/travel

Lessons Learned Review of 2007 Summer Flooding *(National: Public Sector)*

A flood review website has been created by Sir Michael Pitt, the independent chair overseeing the government's Lessons Learned review regarding the 2007 summer flooding. Citizens are asked to log on and share their experiences. Sir Michael Pitt will

also be 'visiting affected communities, talking to residents, local businesses and members of front-line services to get their first-hand experiences.'

www.cabinetoffice.gov.uk/floodingreview

London Climate Change Partnership *(Local: Public sector)*

The London Climate Change Partnership (Greater London Authority) has created leaflet to raise public awareness and change policy in the London regarding climate change.

www.london.gov.uk/climatechangepartnership

Met Office *(National: Public Sector)*

The Met Office has a range of activities and material based around the requirements of the national curriculum to help teachers and students understand weather and climate. The website is updated regularly for severe weather forecasts and gives up to date information about weather in all areas of the globe. It has information for the general public about what to do when severe weather is forecast, before, during and after the storm.

www.metoffice.gov.uk

Preparing for Emergencies Campaign *(National: Public Sector)*

The Preparing for Emergencies website is run by the Civil Contingencies Secretariat. It is based on the pamphlet that was created in 2004 by the same name. The pamphlet and website advise citizens on what they can do to reduce the risk of emergencies and how to cope with emergencies when they do occur. The pamphlet is available on the website and is produced in 18 languages, English large print, audio tape, and Braille.

www.preparingforemergencies.gov.uk

Scottish Environmental Protection Agency *(Regional: Public Sector)*

The Scottish Environmental Protection Agency (SEPA) has information regarding their 24 hour flooding information line, live flood warning information, and tips on how the general public can prepare for flooding.

www.sepa.org.uk/flooding

United Kingdom Environment Agency *(National: Public Sector)*

The United Kingdom Environment Agency has information regarding their flood line, current flood warnings in place, actions that the general public can take to prepare for flooding, and a flood guide for older people.

www.environment-agency.gov.uk/subjects/flood

United States

3 Days, 3 Ways *(Regional: Public-Civic Partnership)*

3 days, 3 ways is a local campaign in the western United States that includes an interactive video with general preparedness information and quizzes after each section. The campaign has also been advertised in the media and pamphlets have been distributed.

www.govlink.org/3days3ways

72hours.org *(Local: Public Sector)*

A City of San Francisco program, 72hours.org addresses all hazards and provides public information urging people to make a plan, build a kit and get involved. Online information is provided in English, Spanish and Chinese. A 24/7 text-based emergency information service is broadcast to wireless devices.

www.72hours.org

The American Red Cross (National: Civic Sector)

The American Red Cross' main message is to get make a plan, prepare a kit, and be informed. There is specific information regarding different types of disasters, as well as disaster preparedness kits for sale.

www.redcross.org

Disaster Management e-gov *(National: Public Sector)*

The information on the Disaster Management e-gov website is intended to reach five overlapping audiences: (1) Local / State / Tribal Governments, (2) individual Citizens, (3) private sector businesses, (4) non-Government organisations, and (5) Federal agencies. The intergovernmental audience is the primary focus at present, and that audience is seen as composed of: political and civil service leadership, emergency managers, homeland security advisors, and first responders (including fire and law enforcement, emergency medical services, etc.). There is also a community section that gives the general public a list of all the emergencies in the nation at any given moment, the level of national security, recent news feeds and links to local resources.

www.disasterhelp.gov

Earthquake Country Alliance *(Regional: Cross Sectoral)*

The Earthquake Country Alliance in Southern California has launched a multi-year public education campaign entitled *Dare to Prepare*. The first year of the campaign, *Shift Happens: Secure your Space,* is focused on non-structural risk reduction directed at home and business owners. A free guide has been distributed through local newspaper promoting Seven Steps to Earthquake Safety. *The Great California Shakeout*, a mass-participation simulation exercise is planned for 2008.

www.earthquakecountry.info

Federal Alliance for Safe Homes *(National: Cross Sectoral)*

The Federal Alliance for Safe Homes has information for homeowners and their children regarding risk awareness and reduction. They have specific instructions for how to incorporate disaster resistant features in an existing home.

www.flash.org

Federal Emergency Management Agency *(National: Public Sector)*

The Federal Emergency Management Agency (FEMA) has general and specific disaster information, risk maps, and preparedness information for a wide range of hazards.

www.fema.gov/hazard

FEMA for Kids *(National: Public Sector)*

This section of the FEMA website is dedicated to educating children about disaster preparedness. It has interactive games they can play, printable pages and informational sheets to fill out with their families.

www.fema.gov/kids

Firewise Communities Program *(National: Public Sector)*

The Firewise Communities Program, formed out of a multi-agency collaboration, aims to promote community responsibility in reducing wildfire risk through environmental stewardship, urban planning, building code restrictions, and individual preparedness. It provides educational resources for local governments, communities and individuals. The program offers conferences, workshops, and printed material. On their website, an online library, forum blog and chat room can be found in addition to their education materials.

www.firewise.org

Flood Smart *(National: Public Sector)*

Flood Smart is a national site dedicated to teach citizens about flooding and flood insurance. It has information about flood insurance and checklists for hurricane preparedness.

www.FloodSmart.gov

Guided By History *(National: Private Sector)*

Wells Fargo Bank has a blog site that was launched for the 100th anniversary of the great California Earthquake. It discusses famous historical events and how they relate to our lives today, including famous historical disasters. There are also links to disaster preparedness information on the site.

http://blog.wellsfargo.com/GuidedByHistory

Home Safety Council *(National: Civic Sector)*

The Home Safety Council is a national non-profit organisation dedicated to preventing home related injuries. The website has information for homeowners and

children regarding all aspects of home safety, including disaster preparedness. *The Get Ready with Freddy* campaign teaches children how to prepare for disasters using a singing flashlight that is "lighting the way to safety."

www.homesafetycouncil.org

Hurricane Strike *(National: Public Sector)*

FEMA, National Weather Service, American Red Cross and Weather Channel have developed "Hurricane Strike!" a multimedia learning package on hurricanes for middle school students. The package integrates hurricane safety and preparedness with science instruction which provides an engaging interactive learning environment.

http://meted.ucar.edu/hurrican/ strike/

Institute for Business and Home Safety *(National: Private-Civic Partnership)*

The Institute for Business & Home Safety works on behalf of member insurance companies to ensure that model building codes and industry standards incorporate the latest disaster-resistant features. They have information on their site for homeowners and builders regarding home preparation for natural disasters.

www.ibhs.org

Map Modernization *(National: Public Sector)*

Map Modernization (Map Mod) is a five-year initiative by FEMA to remap floodplains in the United States and provide digital maps accessible to the public via the internet. A significant component to Map Mod is public awareness and education. When the mapping is complete, citizens should be able to view their flood risk anywhere in the country.

https://hazards.fema.gov

Masters of Disaster *(National: Civic Sector)*

The *Masters of Disaster* Curriculum Kit created by the American Red Cross contains ready-to-go lesson plans, activities, and demonstrations on disaster-related topics that teachers can incorporate within core subject areas. It also has a home version that families can use with their children at home.

www.redcross.org/disaster/masters

National Association of Insurance Commissioners *(National: Private Sector)*

The National Association of Insurance Commissioners (NAIC) in the United States provides insurance information for the general population, including some information regarding how natural hazards can affect insurance.

www.naic.org

National Disaster Education Coalition *(National: Cross Sectoral)*

The National Disaster Education Coalition is composed of national agencies and organisations that have developed, *Talking About Disasters: Guide for Standard*

Messages, which provides standardised safety messages for about 13 hazards and general disaster preparedness topics.

www.redcross.org/disaster/disasterguide

National Oceanic and Atmospheric Administration *(National: Public Sector)*

The National Oceanic and Atmospheric Administration (NOAA) has information for the public regarding weather related natural disasters on their website. The agency is also developing Hazard Education and Awareness Tool (HEAT), an interactive web mapping tools that allows some areas to view tsunami risk maps of their neighbourhoods.

www.nssl.noaa.gov

Project Impact, Seattle (Local: Cross Sectoral)

Project Impact Seattle was a pilot program that was carried out by the Seattle Office of Emergency Management and funded by the United States government. The goal was to make an impact on disaster reduction in Seattle, Washington. The focus of the pilot project was home mitigation.

www.seattle.gov/emergency/programs/projectimpact/retrofit.htm

Ready Campaign *(National: Public Sector)*

The Ready campaign is a national preparedness campaign that was launched by the United States Department of Homeland Security in 2003. The campaign stresses being prepared for all emergencies by getting a kit, making a plan, and being informed. There is specific information about many different types of disasters and a links for pet owners, the elderly, businesses, children and minority language speakers. The campaign has included a national advertising campaign and sports sponsorship.

www.ready.gov

State Farm Insurance *(National: Private-Civic Partnership)*

As a major insurance agency within the United States, State Farm Insurance promote risk awareness and risk reduction education by giving grants to non-profit organisations educating home-buyers and home-owners about natural hazard and other risks and risk reduction strategies. Their granting program also covers public education on disaster response preparedness and recovery.

www.statefarm.com

Team Safe-T *(Local: Public-Civic Partnership)*

Publicly-funded, this group provides school-based education materials to teachers of grades K-12, and links for families in the state of California.

www.teamsafe-t.org

United States Department of State *(National: Public Sector)*

Travel information for United States citizens travelling abroad. This information includes natural hazards in destination countries and safety tips for Americans travelling abroad.

http://travel.state.gov/travel/cis_pa_tw/cis/cis_1765.html

United States Geological Survey *(National: Public Sector)*

The United States Geological Survey produces maps, imagery, and publications on all hazards. They also have educational materials for teachers and students, including science fair ideas, online games, photos, information on earthquake science and scientists, and interactive educational resources.

www.usgs.gov/hazards

Weather Ready *(National: Public Sector)*

The Weather Channel has created *Weather Ready,* a website where you can log in and create a family preparedness plan, learn about dangerous weather in your area, and watch videos about severe weather safety.

www.weather.com/ready

International

Asian Disaster Risk Reduction Network (*International/Regional: Civic Sector)*

A coalition of more than 25 non-governmental agencies in Asia, involved in disaster risk reduction work, and public awareness. ADDRN worked with Asian Disaster Reduction Center on the translation and localisation of the Tsunami education story, "Inamura-no-hi" into 8 Asian languages, for use in school and community-based education. Members took materials further, innovating with cultural arts and lesson plans. ADRRN plans to similarly support future educational materials localisation efforts.

www.adrrn.net/index.asp

Climate Wise *(International: Private Sector)*

Lloyd's is the world's leading insurance market providing specialist insurance services to businesses in over 200 countries and territories. The Climate Wise principles provide a framework for insurance companies worldwide to set out how they will build climate change into their business operations. The principles have been developed following consultation between The Prince of Wales's Business & the Environment Programme, Lloyd's, the ABI, and other insurance market participants.

www.lloyds.com

Disaster Risk Management and Learning Program *(International: Public Sector)*

The World Bank Institute Disaster Risk Management Learning Program provides online courses and printed materials to promote proactive disaster risk management practices by raising awareness among key stakeholders and by advancing the analytical skills and professional knowledge of development practitioners in specific areas of disaster risk management.

http://web.worldbank.org

Eduplan Hemisferico *(International: Public Sector)*

This initiative of the Organization of American States (OAS) promotes the adoption of policies for safe schools, disaster risk reduction education, and schools as hubs for community education. This policy advocacy and awareness effort has spurred several important initiatives in Latin American.

www.oas.org/nhp/nhpcatalog/Webpages/PPNAccionesHemsf13.htm

The European and Mediterranean Major Hazards Agreement (EUR-OPA) *(International: Public Sector)*

Twenty-five members states are party to the Council of Europe' Major Hazards Open Partial Agreement which reinforces cooperation between member sates to ensure better prevention, protection and organisation of relief. Ministerial Sessions raise awareness among policy-makers, adopting resolutions and making recommendations regarding knowledge transmission, education on disaster reduction, school curricula and teacher training (Council of Europe, 2005, 2006).

www.coe.int/T/DG4/MajorHazrds/Default_en.asp

The European Commission's Humanitarian Aid Department *(International: Public Sector)*

The European Commission's Humanitarian Aid Department (DG ECHO) launched the DIPECHO programme in 2006 to invest finances in disaster preparedness. This programme now covers 6 disaster-prone regions and has invested more than EUR 120 million since its inception. The projects funded by the programme include simple and inexpensive preparatory measures, often implemented by the communities themselves.

http://ec.europa.eu/echo/field/dipecho/index_en.htm

Global Facility for Disaster Reduction and Recovery *(International: Public Sector)*

The World Bank Global Facility for Disaster Reduction and Recovery (GFDRR) is developing various instruments to support its client governments to integrate risk reduction strategies in development processes, building capacities at the local and national levels to "disaster proof" the Millennium Development Goals and supporting ongoing UNISDR processes.

www.worldbank.org/hazards/gfdrr

International Federation of Red Cross and Red Crescent Societies *(International: Civic Sector)*

Part of the IFRC's global agenda for 2006-2010 is to scale up their actions with vulnerable communities in disaster risk reduction. Among collaborative, regional public education efforts by RC societies, a set of community educational workbooks on disaster risk reduction has been produced in the Americas related to Prevention of Disasters to Rural Aqueducts, Community Dialogue on Water and Climate, Floods, Community Maintenance of Schools and Early Warning.

www.ifrc.org

Mainstreaming Disaster Risk Reduction into School Curriculum *(International: Civic-Public Sector Partnership)*

The Asian Disaster Preparedness Center's Regional Consultative Committee on Disaster Management is currently developing RCC Guideline 6.1 “Mainstreaming Disaster Risk Reduction into School Curriculum”. These guidelines for Ministries of Education in Asia are intended to guide the introduction and infusion of disaster risk reduction into school curricula. Priority Implementation Projects are designed to kick-start these efforts in selected countries.

www.adpc.net

Organisation for Economic Cooperation and Development *(International: Public Sector)*

The Organisation for Economic Cooperation and Development (OECD) has developed several publications on managing disasters, including: *Large-Scale Disasters: Lessons Learned, Catastrophic Risks and Insurance, Terrorism Risk Insurance in OECD Countries* and *Keeping Schools Safe in Earthquakes*. Their projects include: *Futures Project on Risk Management* (which has produced studies of floods, earthquakes and a variety of hazards in France, Japan, U.S. Denmark, Italy, Norway and Sweden) and *The OECD Directorate for Education, Programme on Educational Buildings* (which has led several meetings on school safety issues and published *Educational Facilities and Risk Management: Natural Disasters).*Their recommendations on Safe Schools have been adopted by 30 countries.

www.oecd.org

United Nations Centre for Regional Development *(International: Public-Civic Partnership)*

The UNCRD, based in Hyogo, Japan is conducting a multi-year School Earthquake Safety Initiative "Reducing Vulnerability of School Children to Earthquake" in Fiji, India, Indonesia and Uzbekistan. This project includes public-awareness raising efforts for school safety. Other projects promote community-based disaster risk reduction.

www.hyogo.uncrd.or.jp

United Nations Decade of Education for Sustainable Development 2005-2014 (DESD) - *(International: Public-Civic Partnership)*

The UNESCO-led education effort is to encourage changes in behaviour that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society. Specific initiatives within this framework, particularly in Asia, address stocktaking and policy advocacy for disaster risk reduction education.

http://portal.unesco.org/education/

United Nations International Strategy for Disaster Reduction *(International: Public-Civic Partnership)*

The UN/ISDR aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters. The World Conference on Disaster Reduction which adopted The Hyogo Framework for Action, and the biennial Global Platform meetings and campaigns focus the attention of national decision-makers on disaster reduction. The Disaster Reduction Begins in Schools Campaign (2005-2007) in particular highlighted the importance of awareness and risk reduction education. Follow-on activities of the Knowledge and Education Platform and Regional Task Forces are expected to continue this work. Prevention Web provides a common information platform for the disaster risk reduction community. It plans to launch the Global Online Library for Disaster Risk Reduction developed in association with UNESCO. This online library will share and permit evaluation of public education and children's education materials and strategies.

www.unisdr.org
www.preventionweb.net

Part II

Catastrophe-Linked Securities and Capital Markets

Catastrophe-linked ("CAT-linked") securities provide a mechanism for the transfer of catastrophe risks to capital markets, and may provide an additional layer of protection to traditional insurance and reinsurance arrangements or serve to reduce reliance on these arrangements by permitting direct access to capital markets.

This report examines the nature and costs of CAT risks and the ability of insurance and reinsurance to absorb and transfer these risks and investigates the role that capital markets might play in the direct transfer of CAT risks. It also provides an overview of the evolving market for CAT-linked securities and derivatives, identifies the key drivers of, and impediments to, further growth in the market, and recommends action for policymakers seeking to encourage the growth of this market.

Summary

Catastrophe-linked ("CAT-linked") securities provide a mechanism for the transfer of catastrophe risks to capital markets, and may provide an additional layer of protection to traditional insurance and reinsurance arrangements or serve to reduce reliance on these arrangements by permitting direct access to capital markets for the coverage of catastrophe risks. CAT-linked securities may also create opportunities for the transfer of catastrophe risks that are currently not covered by insurance markets, thus potentially broadening the overall financial coverage of such risks.

This report provides an overview of CAT-linked securities and a framework for understanding their growth and recommends actions for policymakers. The report examines the nature and costs of CAT risks and the ability of insurance and reinsurance to absorb and transfer these risks, and investigates the role that capital markets might play in the direct transfer of CAT risks. The report reviews the growth of securitisation and identifies key drivers of securitisation that can be used as a framework for explaining the growth of CAT-linked securities. The report provides an overview of the evolving market for CAT-linked securities and derivatives, and the role of pricing and credit ratings in the use of CAT-linked securities, and examines the key drivers of, and impediments to, further growth in the market.

Six key recommendations are advanced for policymakers seeking to encourage the growth of this market, namely: (i) promote the collection and dissemination of high-quality data on CAT risks and losses according to harmonised criteria; (ii) promote transparency in the CAT-linked securities market; (iii) consider the opportunity to use CAT-linked securities to transfer a portion of the CAT risk currently borne by governments; (iv) examine the accounting, solvency and prudential rules governing the CAT-linked securities market to remove any unnecessary impediments; (v) encourage research on areas worthy of further investigation; and (vi) encourage further education on CAT-linked securities.

Chapter 5

Introduction*

Catastrophe-linked ("CAT-linked") securities provide a mechanism for the transfer of catastrophe risks to capital markets, and may provide an additional layer of protection to traditional insurance and reinsurance arrangements or serve to reduce reliance on these arrangements. CAT-linked securities may also create opportunities for the transfer of catastrophe risks that are currently not covered by insurance markets, thus potentially broadening the overall financial coverage of such risks.

As capital markets have a potentially huge capacity to absorb catastrophe risks, CAT-linked securities may enhance the ability of the financial system, and economic actors more broadly, including governments, to manage the costs of natural and man-made catastrophes. In the recent years, the transfer of the higher layers of disaster risks, often referred to as "peak risks", to capital markets has been considered by public and private sector participants in the context of integrated catastrophe risk management strategies.

CAT-linked securities appeared in the aftermath of Hurricane Andrew in 1992 in the belief that the capacity offered by the traditional reinsurance market and the retrocession market would shrink. The Chicago Board of Trade ("CBOT") launched futures and options contracts with payouts linked to the U.S. industry catastrophe losses. Securitisation of catastrophe risk[1] in the form of catastrophe ("CAT") bonds appeared soon thereafter with the first experimental offering of CAT bonds in 1994.

During the past decade the CAT bond market followed a steady growth path and reached its peak at the end of 2007, when the total amount of CAT bond risk capital outstanding[2] was US$17.3 billion, up from US$10.1 billion in 2006, and more than double the US$6.4 billion outstanding at the end of 2005.[3] The total value of new issuance in 2007 amounted to US$8.5 billion, a notable increase compared with US$5.7 billion in 2006, US$2.5 billion in 2005, and US$1.1 billion in 2004.

After this record-setting year, in 2008, the value of CAT bond issuance (new and renewal capacity) fell dramatically to US$3.0 billion. Towards the end of the year, planned CAT bond transactions were postponed partly because of the impact of the global financial crisis on secondary market spreads, and partly because of concerns over the effectiveness of the collateral protection mechanics embedded in CAT bond structures.[4] The enhanced capacity and favourable rates in the traditional reinsurance market also contributed to this downward trend.

* This paper was prepared, in large part, by Prof. Richard MacMinn and Prof. Sylvie Bouriaux of Illinois State University. Members of the High-level Advisory Board, the OECD Secretariat (Timothy Bishop) and Prof. Alberto Monti of Bocconi University contributed to its drafting. Swiss Re, ISO, and PCS made invaluable contributions to this report by providing data and other assistance. This paper was approved for publication by the OECD's Insurance and Private Pensions Committee in 2009.

New CAT bonds featuring improved structures and tighter collateral requirements were issued in 2009: while previous CAT bond transactions used a total return swap ("TRS")[5] counterparty – usually an investment bank – to guarantee the collateral pool backing the bonds, most recent deals impose strict prudential rules on how the collateral is invested, feature daily mark-to-market accounting on the collateral accounts and "top up" requirements in the event that asset values fall below par. These new structures also feature improved transparency and easier access to information on the underlying assets, as well as contractual mechanics to facilitate the replacement of the swap counterparty or to unwind the transaction in case of default, with a view to better protecting the interests of investor and sponsor. Notwithstanding significantly increased prices,[6] after a six-month halt the CAT bond market seemed to have resurged in 2009: the total risk capital outstanding as of 14 October 2009 reached US$14.2 billion.[7]

In the time immediately preceding the current financial crisis, CAT-linked derivatives instruments had re-emerged, after a period of quiet in derivatives market following the CBOT's failed attempt in generating insurer and investor interest in exchange-traded derivatives. Three futures exchanges – the New York Mercantile Exchange ("NYMEX"), the Chicago Mercantile Exchange ("CME"), and the Insurance Futures Exchange Services ("IFEX") – re-introduced exchange-traded CAT-linked futures and options contracts. Each exchange sought to capitalise on a perceived larger appetite for CAT-linked products by investors and an expected increasing need for risk transfer by insurers and reinsurers. In the first half of 2009, demand for disaster derivatives – such as Industry Loss Warranties ("ILWs") and CAT futures – surged as insurers sought alternatives to scarce reinsurance and expensive CAT bonds, especially in anticipation of the North Atlantic hurricane season.[8]

The High-level Advisory Board ("Advisory Board") to the OECD International Network on the Financial Management of Large-Scale Catastrophes, with the support of the Insurance and Private Pensions Committee and the Committee on Financial Markets, has followed these developments and identified the role of capital markets in the financing of large-scale natural catastrophes as meriting policy attention among OECD and non-OECD countries. The Advisory Board considers that CAT-linked securities may provide a useful tool in the financial management of large-scale catastrophes by offering an alternative risk transfer instrument for insurers, reinsurers, governments and corporations seeking to transfer CAT risks, and thus enhancing the capacity of these entities to bear such risks. This is especially important in light of the increasing costs of catastrophes due to several factors, including the impact of climate change on extreme weather events. The Board expressed particular interest in identifying possible impediments to the growth of CAT-linked capital market instruments and considering possible solutions, if any.

The topic of convergence of insurance and capital markets was addressed in a comprehensive report published in 2008 by the World Economic Forum ("WEF Report").[9] The WEF Report, focusing on insurance-linked securities ("ILS") and building on previous research work conducted, *inter alia*, by the International Association of Insurance Supervisors ("IAIS"),[10] starts from the observation that while the potential capacity offered by global investors is vast, insurance risks still lack a liquid, transparent and tradable market. With a view to identifying key issues[11] and possible solutions to stimulate growth of a global ILS market – which is implicitly considered as a desirable goal – the WEF Report makes an important point in that it recognises that there are notable distinctions between the securitisation of *assets* and the securitisation of *liabilities*. While most life insurance securitisations – backed by the embedded value of

future profit streams – are structurally similar to asset-backed securities ("ABS"),[12] the case of non-life (e.g., property and casualty) securitisation is very different. Since the typical property and casualty portfolio consists of a wide spectrum of uncorrelated risks, creating diversification benefits, non-life insurers have limited incentives to transfer these risks to the market. Moreover, from a legal perspective, insurers cannot be removed from the risk equation since they retain obligations toward their policyholders. Insurers, therefore, are in a position to use ILS to transfer risk and obtain additional financial capacity,[13] but not to adopt an aggressive "originate and transfer" model similar to the one that characterised the sub-prime lending practice and related mortgage-backed securities ("MBS") market in the United States.[14]

The issues and questions surrounding the potential future development of CAT-linked securities acquire special interest if addressed from a public policy angle and in the context of disaster risk management strategies developed at the national or regional level. Confronted with the growing impact of natural hazards, governments in OECD countries have in recent years adopted policies aimed to enhance disaster risk awareness, preparedness, prevention, mitigation and response and, consequently, to reduce vulnerability and exposure to natural hazards. The adoption of such policies, however, can only diminish the direct and indirect costs of extreme natural events, but cannot completely eliminate such costs.

The economic coverage of disaster losses, therefore, constitutes a key policy issue for governments and it concerns: (i) the cost of emergency rescue, response and relief measures aimed at saving lives and providing temporary assistance to the population hit by a disaster event; (ii) damages to public assets and critical infrastructure; and (iii) property damages, including reconstruction costs, and economic losses suffered by businesses and individuals affected by a disaster.[15]

Since the availability of financial compensation and risk transfer tools ex ante may enhance economic efficiency and performance, CAT-linked securities attract the attention of policymakers not only because they may be able to significantly expand the capacity of the private insurance and reinsurance sector to cover disaster losses in the context of an integrated CAT risk management strategy, but also because they may constitute innovative risk transfer tools for governments themselves.[16]

Against this background, this report intends to assess the potential role of capital markets in financing reconstruction and recovery from large-scale natural catastrophes, develop a better understanding of CAT-linked instruments – including the drivers and impediments to their further growth – and identify technical and policy issues relating to the future growth of CAT-linked securities markets. While it is predicted that in the long term these markets will continue to grow, the recent financial crisis suggests the need for caution in the development of CAT-linked instruments and markets in light of possible transparency issues and investor protection concerns.

The report is divided into five chapters (5-9). Chapter six identifies the problem by describing the nature and costs of CAT risks and the ability of insurance and reinsurance to absorb and transfer these risks. This chapter investigates the role that capital markets might play in the direct transfer of CAT risks, whether as a substitute for, or complement of, insurance and reinsurance. The chapter also provides a framework for analysis by reviewing the growth of securitisation and identifying key drivers accounting for its growth. Chapter seven provides an overview and analysis of CAT-linked securities and derivatives. The evolving structure of CAT-linked instruments, and the role of pricing and credit ratings, are considered in this chapter. Chapter eight notes the key drivers of,

impediments to, and issues in the development of, CAT-linked securities, using the framework for analysis developed in chapter six. The final chapter advances recommendations for policymakers.

Notes

1. The term "securitisation" is used in a very broad sense in this paper to mean the conversion of (credit, interest-rate, catastrophe, etc) risks into marketable securities (e.g., bonds, derivative instruments). According to the International Association of Insurance Supervisors (IAIS), the term "securitisation" involves a simple financial concept: "the future cash flows that can be expected from a particular source (e.g., receivables or loan repayments) serve to back up a financial instrument for sale to an investor. When a business entity (originator) engages a securitisation, it first transforms the cash flows into a tradable instrument and then transfers the attendant risk from the entity to capital market investors who, in turn, expect a return commensurate with the risks." (IAIS (2003), Issues paper on non-life insurance securitisation).
2. Total risk capital outstanding is the total bond principal at risk in the market, irrespective of issuance year. See GC Securities (2008), The Catastrophe Bond Market at Year-End 2007: The Market Goes Mainstream, p.6.
3. Based on data provided by Swiss Re Capital Markets.
4. During the last quarter of 2008, in fact, a number of CAT bonds were directly affected by the global credit crisis, due to the loss of their total return swap ("TRS") counterparty as a result of the failure of Lehman Brothers.
5. A TRS converts the interest earned on the collateral investments to a LIBOR or EURIBOR basis, and the swap counterparty assumes the credit risk and the liquidation/spread risk of the underlying assets. In other words, the swap counterparty guarantees both the LIBOR or EURIBOR based interest rate and the full return of principal. Thus, principal default would occur only if both the counterparty and the collateral defaulted. See IAIS (2003), Issues paper on non-life insurance securitisation, p. 13.
6. Price sensitivity manifested itself in the CAT bond market in 2009: some transactions were postponed because of cost, while others were replaced with capital from other sources such as Industry Loss Warranties (ILWs). See GC Securities (2009), Cat Bond Update: First Quarter 2009.
7. Based on data from Swiss Re Capital Markets. Recent data from Guy Carpenter indicate that CAT bond issuance in terms of risk capital and number of transactions rebounded in 2009 (though still below 2007 peaks), with pricing declining by 20 to 40 percent in the third and fourth quarters of 2009; see GC Securities (February 2010), Catastrophe Bond Market Continues to Improve.
8. See Insurance Journal (May 19, 2009), "Catastrophe Derivatives Demand Surges as Storm Season Nears", available at www.insurancejournal.com.

9. See World Economic Forum (2008), Convergence of Insurance and Capital Markets, World Economic Forum, Davos, available at: http://www.weforum.org/pdf/ip/fs/ConvergenceReport.pdf

10. See: IAIS, Issues paper on non-life insurance securitisation, October 2003; IAIS, Issues paper on life insurance securitisation, October 2003. Most recently: IAIS, Developments in (re)insurance securitisation, August 2009. See also: Swiss Re sigma, Securitization – New Opportunities for Insurers and Investors, n.7/2006; Swiss Re sigma, The role of indices in transferring insurance risks to the capital markets, n.4/2009.

11. According to the WEF Report, in order to develop a market for ILS the following issues must be addressed in a multi-year time horizon: lack of standardisation; insufficient cost/benefit analysis; poor data quality; basis risk; limited secondary market; complexity of risk valuation and uncertainties concerning the probability of catastrophic loss.

12. "While there are risk transfer securitisations in life business that protect against catastrophic mortality risk, the majority of life securitisations to date have been designed to generate present cash flow against the amortisation of statutory and technical provisions. These have been termed "embedded value securitisations" (IAIS, Issues paper on non-life insurance securitisation, October 2003, p. 4). See also IAIS, Issues paper on life insurance securitisation, October 2003; Swiss Re Sigma, Securitization – New Opportunities for Insurers and Investors, n.7/2006.

13. As acknowledged by the IAIS (Issues paper on non-life insurance securitisation, 2003), securitisations can provide non-traditional sources of capital market financing, thus complementing and supplementing traditional debt and equity financing available to a business. For the insurance and reinsurance businesses, in particular, the securitisation concept has proven to provide an attractive alternative source of capacity, since CAT bond investors for the most part do not also provide traditional (re)insurance protection. See also: Swiss Re sigma, Securitization – New Opportunities for Insurers and Investors, op cit., p. 3 ff.

14. In other words, while in the context of a MBS, the originator of a mortgage loan can completely remove itself from the risk equation, an insurance/reinsurance company issuing ILS remains directly liable vis-à-vis the policyholder/primary insurer. This may inhibit the growth of the market for ILS, but it may also avoid distorted incentives of the type that contributed to the sub-prime lending crisis in the United States.

15. The public sector is directly concerned with the economic coverage of disaster losses for several reasons: the financial impact of a disaster on individuals and businesses may be significant, which could lead to large welfare losses and have broad macroeconomic consequences; public assets, including buildings and infrastructures, are exposed to risk and whose destruction or impairment may have economic impacts; finally, in the aftermath of a catastrophe, the public authority will likely be under strong political pressure – or sometimes even under a legal duty – to provide compensation to victims. See Monti A. (2008), "Policy Approaches to the Financial Management of Large-Scale Disasters", in 'Financial Management of Large-Scale Catastrophes', Policy Issues in Insurance n.12, OECD, Paris.

16. With some notable exceptions, such as the parametric catastrophe bonds issued by the Mexican government in 2006 and 2009 to cover certain financial consequences of

catastrophic earthquake and hurricane risks and the recently established Caribbean Catastrophe Risk Insurance Facility, sovereign-sponsored transactions are still relatively uncommon. CAT bonds were nevertheless used in the past by the Taiwan Residential Earthquake Insurance Fund, a governmental entity. In a number of emerging countries, moreover, capital market solutions, including multi-country multi-peril catastrophe bonds, are currently being considered to cover the cost of emergency relief measures and damages to public infrastructures and lifelines due to a disaster. To this end, in October 2009, the World Bank launched the "MultiCat Program", a CAT-bond issuance platform aimed at allowing governments and other public entities to access international capital markets. The 2009 multi-peril Mexican CAT-bond was the first sovereign issuance under this platform. For more details, see below, Chapter 8.1. d).

Chapter 6

Catastrophe Risks and the Role of Capital Markets – A Framework for Analysis

6.1. Nature of natural catastrophe risks, their economic costs, and losses absorbed

Insurance markets provide the means for individuals and organisations to transfer the risks of loss to insurers who pool the pure risks and, via the law of large numbers, make the unit loss more certain and the distribution less risky. The law of large numbers relies, however, on the independence of risks in the pool. Some perils (e.g., earthquake, flooding) in some countries abrogate that independence because the spatial correlation of risks diminishes the effectiveness of domestic insurers' geographic diversification. While reinsurance does allow direct insurers to transfer risk to entities with a more geographically diversified pool of risks, reinsurance capacity is finite and any onward retrocession[1] simply chases a diminishing capital capacity.

a) Existing system for the transfer of CAT risk

The property-liability insurance industry faces risks that may be characterised as high frequency, low severity and as low frequency, high severity. The high frequency, low severity risks in its books of business (e.g., automobile collision losses) may represent serious financial risks to the insured but are small risks to the insurer and industry. These risks can be characterised as independent, so that the law of large numbers applies; given a large number of independent risks, the law of large numbers shows that the average risk becomes fairly predictable. By pooling such risks in its books of business, insurers can charge premiums that reflect the average loss plus expenses plus a risk-bearing premium. The industry's equity capital may be expected to cover any adverse deviation in losses.

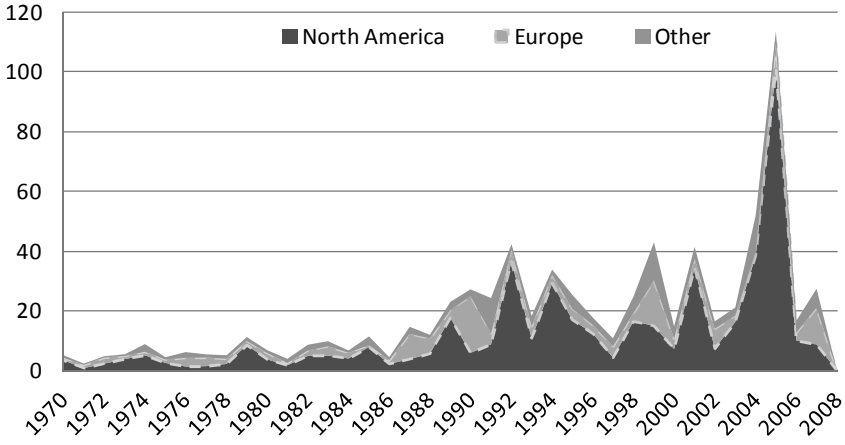
By contrast, the low frequency, high severity risks in its books of business (e.g., home owner's property loss due to a hurricane), while representing the same serious financial risks to the insured, also create large risks to the insurer and the industry. Such catastrophic risks are more difficult to manage. The low frequency makes predictability problematic and, given the occurrence of a CAT event, the risks in a book of business may be highly correlated. Hence, the law of large numbers, which makes pooling an effective management tool in the high frequency, low severity case, becomes ineffective and less appropriate in the low frequency, high severity case. The equity capital of the insurer and the industry may not be able to cover a large CAT risk.

To gain an historical perspective, Figure 6.1 shows the dollar costs of the worldwide catastrophic risks both natural and man-made from 1970-2008. The North American losses are quite large; it is instructive to compare those insured losses with the capital capacity of the insurers.

Figure 6.2 shows the historical development of U.S. policyholder surplus (PHS), which is a measure of the property-liability insurance industry's capacity to meet unexpected, adverse events – including catastrophe losses[2] -- and write new business. It reached a local minimum in 2002 but rose to reach a half trillion US$ in 2007. The U.S. property-liability industry's policyholder surplus fell back to US$456.1 billion in 2008.

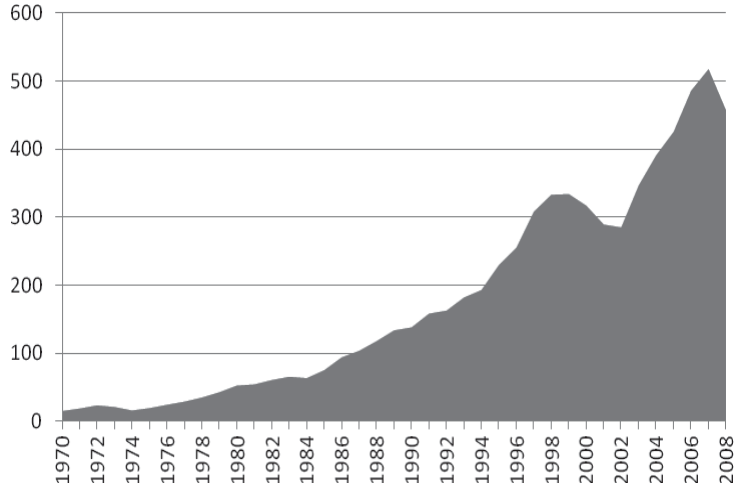
While the surplus is instructive, viewing CAT losses as a proportion of the surplus allows us to roughly gauge the ability of the U.S. insurance industry to absorb losses resulting from these large events in the absence of reinsurance arrangements or direct transfers to capital markets. Figure 6.3 shows that the proportion of CAT losses has risen to 14 percent or above only twice in the last forty years; the last time it did so was due to Hurricanes Katrina, Rita and Wilma in 2005.

Figure 6.1. **Natural and Man-Made Catastrophes (nominal US$ billion)[3]**



Source: Swiss Re

Figure 6.2. **U.S. Insurer Policyholder Surplus (in nominal US$ billion)[4]**



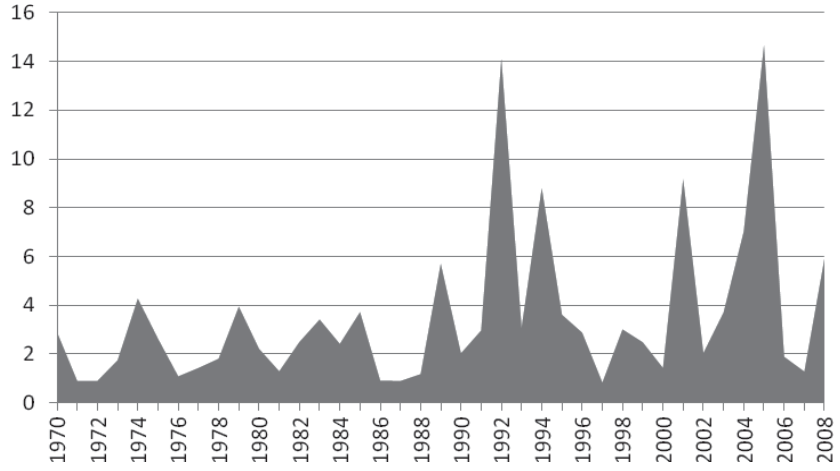
Source: ISO®

While the last spike reached almost 15 percent of aggregate industry policyholder surplus, a substantial portion was reinsured or covered by capital market instruments; at the time, in 2005, the year of Hurricane Katrina, it was estimated that 44 – 53 percent of losses was absorbed by reinsurers and 1 - 3 percent by capital markets.[5]

b) Pricing and capacity dynamics

The reinsurance market is subject to cycles and reinsurance premia for property catastrophe coverage were rising before Hurricane Andrew in 1992. World reinsurance prices for catastrophe coverage increased further after Andrew, but then, from 1994, fell for the rest of the decade before starting to climb again in 2000 and increasing substantially in 2001 as a result of the tightened reinsurance markets following the losses of September 11.[6] World reinsurance rates for have fluctuated in recent years, but with no dramatic increases as seen in the early 1990's. The typical cycles of hard followed by soft reinsurance markets are well known but have not been adequately explained by insurance or financial market theory.[7]

Figure 6.3. **U.S. CAT Losses as a Proportion of U.S. Insurer PHS[8]**



Source: PCS®, ISO®

c) Possible limitations of insurance markets: insurability of natural catastrophe risks and capacity of the insurance and reinsurance industry

Insurance and reinsurance markets are well suited to independent risks that can be pooled. Natural catastrophes generate highly correlated risks and therefore challenge the typical notion of an insurable risk. This has become increasingly important as the size of the CAT losses has risen so dramatically this century. The capital capacity of the insurance industry has increased as evidenced by Figure 6.2, but that increased capacity does not necessarily represent an efficient use of financial resources.

Transferring CAT risks to the capital market, however, does allow these risks to be divided and borne by investors at a price that should be appropriate for the risk bearing involved. In fact, financial market theory does quite clearly show that hedging risks in

capital markets can reduce volatility and create value. Although the amount of CAT risk that has been transferred to capital markets is still quite small, it may have helped to dampen the pricing cycle in reinsurance markets. CAT-linked securities decrease the volatility of insurer or reinsurer earnings by providing capital when it is needed, i.e., when a catastrophe triggers a payout; the vast majority of these securities also provide multi-year coverage at a known premium and this may help to dampen the rise in reinsurance premia in a hard market.

6.2. Stages of evolution of risk securitisation in capital markets: framework for analysis

Some lessons can be drawn from past experiences of securitisation of risk in capital markets – including the recent financial crisis – in order to assess the possible roles of capital market instruments in the transfer of catastrophe risks. Specifically, by reflecting on the conditions that contributed to the growth and liquidity of markets like the MBS and ABS markets, the credit derivatives market, and, to a lesser extent, the weather derivatives market, and understanding the reasons for the breakdown of securitised markets in 2007 and 2008, we can identify key drivers and impediments to the future development of the CAT-linked securities market. The following examination of past experience with securitisation (mostly pre-dating the financial crisis) provides a framework for analysis that will serve to facilitate our understanding of the growth and evolution of CAT-linked securities.

Securitisation dates back to the early 1970's when the Government National Mortgage Association (Ginnie Mae), a U.S. government sponsored agency, pooled mortgage loans and sold single-class MBS collateralised by that pool of loans. Other federal agencies, namely the Federal Home Loan Mortgage Corporation (Freddie Mac) and Federal National Mortgage Association (Fannie Mae), followed suit in the early eighties, but instead issued multiple classes of securities against the pooled mortgages in order to access investors with various risk tolerances more efficiently. Financial institutions started issuing their own collateralised securities soon thereafter. Non-agency (private) MBS issuance surpassed agency MBS issuance for the first time in 2005.[9]

Securitisation soon expanded to ABS and collateralised debt obligations ("CDO"). ABS typically refer to the securitisation of pools of homogeneous assets like account receivables. CDO, which appeared in the late eighties, are more complex instruments. They became – until the current financial crisis – a crucial component of securitisation in the mortgage and credit markets.[10] Issues related to the opacity of CDO structures emerged in the course of the financial crisis.

Finally, securitisation of weather risk began in 1996 with an over-the-counter derivative contract between Aquila Energy and Consolidated Edison. The appearance of weather derivatives contracts just preceded the issue of CAT-linked securities such as CAT bonds. Weather derivatives were somewhat unique in securitisation markets in that they were usually not based on portfolios of pooled individual risk, but on indices of more independent measures of weather risk like indices of temperatures or snowfalls for a specific location.

a) Key drivers to initial market development

Historically, some common factors contributed to the initial development of securitised capital market instruments:

Need for additional market capacity and need for transferring risk: Securitisation in the MBS market allowed banks to move loans off their balance sheets by selling them to outside investors. This technique enabled them to grant more loans and, in the process, transfer mortgage-related risks (interest risk, default risk, and pre-payment risk) to risk-takers. The same motivation accounted for the securitisation of credit risk via credit derivatives and weather-related risks via weather derivatives and for CAT risks via insurance-linked securities. As mentioned, however, there are notable distinctions between the securitisation of *assets* and the securitisation of *liabilities*. Since the typical property and casualty insurer's portfolio consists of a wide spectrum of uncorrelated risks, creating diversification benefits, non-life insurers have limited incentives to transfer these risks to the market. Moreover, from a legal perspective, insurers cannot be removed from the risk equation since they retain obligations toward their policyholders. Insurers, therefore, would be able to use ILS to obtain additional financial capacity,[11] but not to adopt an aggressive "originate and transfer" model similar to the one that characterised the sub-prime lending practice and related MBS market in the United States.

Investor appetite for diversified risk: Hedge fund managers, money managers, and other institutional investors provide services to their clients in the form of portfolios of securities. These services require the selection of assets and construction of portfolios. Institutional investors view assets from the perspective of what they contribute to the portfolio; if an asset has an expected return as least as great as the existing portfolio and a return uncorrelated with the portfolio then received financial theory shows that such an asset should be included in the portfolio (Samuelson 1967). Uncorrelated assets allow institutional investors to diversify their asset portfolios. Hence, institutional investors seeking uncorrelated assets provided the demand for securitised risks.

Securitisation helps in the pooling of individually illiquid assets into portfolios and in the subdividing of these assets into classes of securities. This process allowed investors to participate in previously illiquid markets and helped them further diversify their asset portfolios.

Development of methodologies for risk assessment: U.S. rating agencies like Standard & Poor, Moody's and Fitch Ratings played an important role in the development of asset securitisation by developing methodologies to evaluate the risk embedded in securitised instruments. Securitisation is a complex procedure, so that investors rely heavily on risk ratings for the selection of securities in their portfolios. While U.S. ratings agencies have been under fire lately, allegedly for flawed ratings of mortgage CDO structures, their role remains crucial in securitisation. As discussed below, the role of credit rating agencies and catastrophe modelling firms in assessing the impact of a natural disaster on an insurer's book of business has been invaluable to the CAT-linked security market.

Government initiatives aimed at facilitating market growth: The MBS market, in particular, may not have expanded as quickly as it did if the U.S federal government and federal agencies had not contributed to its development at the outset. The role of Ginnie Mae, Freddie Mac, and Fannie Mae in mortgage-backed securities issuance, and in providing liquidity in the secondary market, was critical for the development of securitisation and remains crucial.

Legislative and/or regulatory factors: Elul (2005) argues that legal factors and government regulation were also important drivers of securitisation. For instance:

Securitisation helped in lowering banks' regulatory capital requirements. For instance, the demand for credit derivatives by banks was spurred largely by the 1988 Basel Accord, which mandated that large commercial banks maintain a minimum amount of surplus, based on the amount of (credit, operating and interest) risks in their balance sheet. The banks realised that they could transfer the credit risk of borrowers to entities not subject to bank capital requirements, while retaining at the same time the ownership and revenue from such loans.

Pension fund, mutual fund, and hedge fund regulations (or lack thereof) may explain the credit enhancement and tranching techniques embedded in some securitised products, which broadened their appeal. In the U.S., pension and mutual funds can be heavily regulated in their holdings of low-rated asset-backed securities, while hedge funds are lightly regulated in their investments. Security tranching into high-rated senior tranches and low-rated junior tranches helped in circumventing the regulatory framework applicable to pension funds and mutual funds. Hence, tranching expanded the breadth of the market by enabling the participation of additional institutional investors.

While the above mentioned factors certainly contribute to explaining the success of securitisation in the recent past, regulatory arbitrage should not be encouraged and, to the contrary, it may lead to undesired outcomes, as witnessed by recent events in the CDS market.[12]

b) Market evolution

While the securitisation of mortgage, credit, and weather risk is currently experiencing difficulties in light of the financial crisis, the evolution of this market in recent years and its features are worth noting as a point of reference:

Increased complexity in design of capital structures: Increased complexity could be observed in the design of capital structures. For instance, the securitised mortgage market evolved from simple pass-through securities to CMO to CDO. In the credit markets, cash and synthetic CDO issuance surpassed the size of the CDS market. This complexity largely stemmed from the introduction of new types of collateral in the underlying pools of assets. This led to less homogeneity in the underlying collateral and possibly made the pricing of these securities more difficult.

Refinement of risk-return profiles: The tranching of securities into highly rated senior debt and low-rated junior debt helped to refine the risk-return profiles of CDO and attract a larger base of investors. Banks, pension funds, and insurance companies were likely to invest in AAA-rated securities in the senior securitised tranches, while hedge funds and other specialised funds could focus more on the equity portion of a CDO and on lower-rated tranches.

Further advances in technology and modelling: Advances in technology and modelling - cash flow modelling, data processing, and data availability - contributed to public acceptance of securitised products and will continue to play and integral role in innovation in markets for securitisation. Market participants can now model more accurately the timing and amount of irregular cash flows (such as late payments, defaults, recoveries, prepayments) from an underlying asset pool in a securitisation deal. Data

vendors like Bloomberg or Reuters even post their proprietary pricing models on their terminals for use by investors.

Growth of index-based securitised instruments: The proliferation of index-based securitised instruments likely contributed to increased liquidity and trading of securitised instruments prior to the crisis. This development was notable in credit markets; CDS on indices surpassed CDS on single names as the dominant product type.[13] Research has shown that the issuance and trading of index-based products grew rapidly due to the increased acceptance of indexes such as, for instance, the Dow Jones iTraxx credit indexes (Mengle 2007). These indexes are subject to transparent rules and helped to standardise CDS structures. Moreover, since 2004, dealers in credit markets have promoted liquidity in the trading of index-based CDS. Such measures included the development of master confirmation agreements[14] and commitments to make markets with tight bid-offer spreads.

c) Conditions for market growth and liquidity in securitised markets

Based on this description of securitisation, the conditions for market growth and liquidity in securitised markets can be identified (beyond the basic driving factors of demand for securitised risks on the part of investors and hedgers, and the desire on the part of originators and other parties to transfer these risks):

i. Organised regulatory framework, government support, and conducive regulatory and tax environment

Securitised markets function better and gain public acceptance if they operate under an organised regulatory framework, provided either by government supervision or by self-regulation, that is aimed at protecting market participants and fostering efficiency. For instance, in the credit derivatives markets, the ISDA, the self-regulatory arm of swap dealers, routinely helps to settle trade disputes and counterparty default issues. Exchange-traded derivative instruments, like the CME weather derivatives or the credit index event contracts, benefit from the management of default and recovery by the exchanges' clearing corporations.

In addition, government participation in, and backing of, securitised markets provide a major stimulus. For instance, the U.S. federal government greatly facilitated the development of the mortgage securitised market by backing issuance of Ginnie Mae mortgage-backed securities. And, while Fannie Mae and Freddie Mac securities were not explicitly backed by the full credit and faith of the U.S. government, U.S. regulators ultimately would not let these institutions fail in the event of financial problems, as demonstrated in the context of the recent financial crisis where the U.S. Treasury publicly indicated the need to sustain the solvency of these mortgage institutions and injected capital to support these institutions.

A conductive legal and tax environment also favours securitisation, as demonstrated by the U.S. experience. For instance, in the mortgage market, CMO issues first faced complex tax, accounting and regulatory obstacles. The U.S. tax reform act of 1986 included the Real Estate Mortgage Investment Conduit tax vehicle that solved most of these legal issues.

ii. Organised market frameworks and infrastructures

Securitised markets also function better and gain public acceptance if they operate under an organised market framework and well-functioning market infrastructures. For instance, the credit derivative markets benefited from such collective actions. The rapid growth of CDS outpaced the development of infrastructure necessary to clear and settle these transactions. Post-trade processes were largely manual and by early 2005, credit derivatives dealers had huge backlogs of unconfirmed trades. Dealers and asset managers moved to adopt an electronic confirmation service; as a result, the number of CDS confirmations outstanding thirty days or more declined significantly.[15] In light of the crisis, governmental authorities have proposed the establishment of a comprehensive institutional framework for over-the-counter ("OTC") derivatives (including CDS), including requiring standardised contracts to trade through regulated central counterparty clearing houses,[16] in order to minimise systemic risks.

iii. Standardisation

Standardisation enhances market liquidity and helps investors manage their portfolios more efficiently. Credit derivatives, for instance, are characterised by a higher degree of standardisation than other types of OTC derivatives. Market participants have widely used the relatively standardised ISDA Credit Swap Master Agreement as a blueprint for credit derivatives transactions. The standardisation of such agreements decreases the costs of initiating and trading credit default swaps. As noted above, transactions in index-based CDS attracted considerable interest. Their 'popularity' stemmed from the fact that they provided, by means of indices, investors with new tools for taking on, hedging, and managing credit risk in their portfolios, thus contributing to greater market liquidity. Finally, the growth of the weather derivatives market in recent years can be attributed almost exclusively due to increased trading volume in OTC index-based derivatives and in index-based futures and options contracts at the CMEX.

iv. Market transparency

Market transparency also enhances market liquidity. Transparency in some securitised markets (MBS and CDS) improved in the course of their development, and particularly in recent years, while some other markets (e.g., CDO) remained opaque, as witnessed by the current financial crisis. In the U.S., the mortgage-backed security market benefited from a regulatory change that took effect in 2002 and which enhanced transparency. Security dealers had to start reporting almost all corporate bond trades to the National Association of Securities dealers (NASD) within 15 minutes, for subsequent immediate reporting by the NASD to the market via data vendors like Bloomberg or Reuters. The prices of many credit derivatives, including single-names or index-based CDS and credit index tranches, are also widely reported to services like Bloomberg and Reuters. On the other hand, more complex credit derivatives like CDO tranches remain largely illiquid and opaque.

v. Diversification of market participants

Diversification of market participants is a key driver to market growth. This point is well supported in the credit derivatives market. A British Bankers Association report (2006) on credit derivatives shed some light on the diversity of participation in this market. In 2000, banks and securities firms were dominant in 2000 and represented over

80 percent of credit protection buyers and 60 percent of credit protection sellers. By 2006, their participation had declined to about 60 percent of buyers and 44 percent of sellers. Recent new participants in the market included insurance companies, which tend to be active sellers of credit protection, and hedge funds, which tend to function as both buyers and sellers of credit protection. In 2000, hedge funds represented 3 percent of buyers and 5 percent of sellers, but in 2006, they had grown to 28 percent of buyers and 32 percent of sellers. Pension fund and mutual fund participation in credit derivatives remained at 1-2 percent as buyers and 2-4 percent as sellers.

It is important to note that, for the most part, the complexity of securitised structures in all markets made them suitable investments only for investors with knowledge of complex financial transactions, notably institutional investors who actively manage credit or mortgage portfolios. These investors typically have access to sophisticated analytical tools unavailable to individual investors. This explains why only qualified institutional investors are active (and are permitted by regulation to be active) in most securitised markets.

d) Impediments

Asymmetry of information among participants in securitised markets, combined with heterogeneity of pooled risks, may be an impediment to market growth, as demonstrated by the recent crisis in particular. Securitisation of risk becomes more successful when the capital structure provides an equal playing field in terms of information between risk transferors and risk takers. However, asymmetry of information combined with heterogeneous pools of risks may prevent risk takers from confidently assessing and pricing the underlying risk in various securitised structures, and may either deter some of them from participating in these markets or cause them to take flight at the first hint of trouble in a securitised structure, as demonstrated by the financial crisis.

Asymmetry of information often leads to adverse selection and moral hazard. In the context of securitisation, adverse selection refers to the fact that, without a full ability to monitor a risk transferor's portfolio of risks, the risk transferor may securitise the most unattractive part of its portfolio. Moral hazard arises when the entity that transfers individual risks or a portfolio of risks no longer has the incentive to reduce risk.

Some index-based capital market structures may alleviate asymmetry of information problems as long as the components of the index are not subject to possible manipulation. A good example of a non-manipulable index can be found in the weather derivative market. Most weather derivatives are based on an index of heating degree days (HDD) or cooling degree days (CDD), which are provided by an independent entity, the U.S. National Weather Service. In the credit market, Dow Jones is an independent firm that calculates and monitors both the CDX index (consisting of the risk of 125 North American investment grade firms) and the iTraxx index (consisting of the risk of 125 Euro-based investment grade firms).

In MBS and ABS markets, deal structures tend to bundle homogeneous pools of assets such as mortgages or receivables with similar characteristics and generally idiosyncratic risk[17] is well diversified within the pool. Consequently, diversified and homogeneous pools of assets can be valued based on default probabilities that draw on the historical performance of similar asset pools.[18]

In contrast, in credit markets, some complex CDO structures could be collateralised by a relatively heterogeneous pool of risks, such as different types of bank loans,

corporate debt, different types of derivative instruments, or even other CDO. Both systematic[19] and idiosyncratic risks remain important in the pool performance and valuing these pools on the basis of historical default probabilities may be inadequate because of the idiosyncratic risks remaining in the pool.

The CDO market moved toward more sophisticated valuation models, but these models were accessible only to "extremely sophisticated" institutional investors. The recent losses borne by large investment banks in complex CDOs backed by pools of sub-prime mortgage and credit risks show that even sophisticated investors are not immune from this problem.

6.3. Possible roles of capital markets and capital market instruments in the transfer of CAT risks

CAT risks can be large relative to the capital capacity of insurers, with the result that they have historically transferred a significant proportion of their property risk to reinsurers, including their CAT risk. Bob Hartwig,[20] President of the Insurance Information Institute, noted that global reinsurers absorbed 20 percent of the four 2004 hurricane losses and 45 percent of the 2005 hurricane losses – which were themselves more than twice the cost of the 2004 storms. Yet, as coverage in high-risk areas increases, the capital capacity of reinsurers themselves becomes stretched and generates the need for either higher limits on instruments such as excess of loss reinsurance or additional capital capacity at the right price. CAT-linked securities provide a means of managing this risk by transforming pure risks into speculative risks and then transferring these speculative risks to capital markets, which have a potentially huge capacity to absorb catastrophe risks.

a) Complement or substitute to reinsurance

Excess of loss reinsurance (or excess of loss retrocession) is often written in layers. The lower layers are associated with greater historical frequencies and thus are more predictable than the higher layers. This system allows insurers and reinsurers to select coverage and separate the higher frequency lower severity from the lower frequency higher severity; equivalently, the excess of loss coverage allows insurers and reinsurers to separate extreme CAT risks from other risks. The lower layers consist of those risks that can be expected to be effectively and efficiently pooled, and rely both on the law of large numbers and better diversification. The higher layers constitute the CAT risks where predictability is more of a problem.

In the higher layers, there is some reason to view reinsurance or retrocession and CAT-linked securities as *substitutes* if the capital capacity of the insurer or reinsurer is sufficient to eliminate its credit risk. The pricing of each type of instrument should determine whether reinsurance or CAT-linked securities dominate the market, even if cost comparison is not straightforward.[21] As the credit risk of reinsurers is strained by additional coverage of the higher layers, however, there is more reason to view the instruments as *complements*. Additional reinsurance requires more capacity and one way to achieve that capacity is via CAT-linked securities. There are, of course, other ways to create additional capacity, such as through IPOs and sidecars. New reinsurers entered the market and new sidecars were developed in the aftermath of Katrina.

In any case, the ability to tap both reinsurance and capital markets is crucial to ensure access to capacity in distressed times.

b) Potential size of demand

Until the recent financial crisis, the demand for CAT-linked securities had been growing with the size of the CAT losses. Evidence has already been provided in this report on the dramatic increases in the worldwide CAT losses as well as the U.S. CAT losses in the past decade. The CAT bond market also gained speed, especially in 2007; as mentioned, however, the market slowed down in 2008, partly because of the credit crisis. New CAT bonds featuring improved structures and tighter collateral requirements were issued in 2009.

Both insurers and reinsurers and other actors such as governments may, for a number of reasons outlined below, wish to make use of CAT-linked securities – such as CAT bonds and CAT-linked derivatives – for risk transfer purposes. For investors, there may a significant, longer-term demand for CAT-linked securities such as CAT bonds given their potential benefits for portfolio diversification.

Notes

1. Retrocession is the reinsurer's reinsurance; the retrocession transfers part of the reinsurer's risks to other reinsurers or insurers.
2. In the absence (or insufficiency) of technical provisions or reserves that might be set aside for catastrophe losses.
3. Other losses include losses from Africa, Antarctic, Australia and Oceania, South America, and sea, space, and other worldwide losses.
4. The U.S. property/casualty industry is considered, for the purpose of Figure 2.2, to include all private property/casualty insurers domiciled in the United States, including excess and surplus insurers and domestic insurers owned by foreign parents. See Insurer Financial Results at ISO website at www.iso.com.
5. See Towers Perrin (2005), Hurricane Katrina: Analysis of the Impact on the Insurance Industry, available at www.towersperrin.com,
6. Reinsurance prices as measured by the Guy Carpenter World Property Catastrophe Rate Online (ROL) index. ROL is defined as the premium divided by the indemnity. For the most recent snapshot of the World Property Catastrophe ROL, see GC Securities (January 2010), "Rates Retreat as Capital Rebounds: Global Reinsurance Renewals at January 1, 2010", available at www.gccapitalideas.com.
7. There have been notable explanations of cycles but none that are fully acceptable, e.g., see Cummins, J. D. and J. F. Outreville (1987), "An International Analysis of Underwriting Cycles in Property-Liability Insurance", Journal of Risk and Insurance

54(2), pp. 246-62; Winter, R. A. (1994), "The Dynamics of Competitive Insurance Markets", Journal of Financial Intermediation 3(4), pp. 379-415; Cummins, J. D. and P. M. Danzon (1997), "Price Shocks and Capital flows in Liability Insurance", Journal of Financial Intermediation 6, pp. 3-38; Lai, G. C., R. C. Witt, et al. (2000), "Great (and not so Great) Expectations: An Endogenous Economic Explication of Insurance Cycles and Liability Crises", Journal of Risk and Insurance 67(4), pp. 617-652.

8. This figure should be interpreted with caution. First, U.S. catastrophe losses have been obtained from Property Claims Service (PCS) and represent losses incurred by all direct insurers domiciled in the U.S., including residual insurers (e.g., Florida's Citizens Property Insurance Corporation); by contrast, policyholder surplus data obtained from ISO exclude residual insurers. Second, direct losses may not have actually been fully absorbed by policyholder surplus given likely reinsurance arrangements and possible use of capital market risk transfer arrangements such as CAT bonds. Third, direct losses would be absorbed only by those insurers that had written affected policies, not by all insurers. The purpose of the figure is to demonstrate the potential impact of natural catastrophe losses on industry policyholder surplus absent reinsurance and capital market arrangements, and thus the general magnitude of catastrophe losses relative to industry policyholder surplus.

9. FDIC (2006), FDIC Outlook.

10. Broadly speaking, CDO can be defined as a pool of debt contracts housed within a special purpose entity (SPE) whose capital structure is sliced and resold to investors. "Cash flow" CDO are collateralised by a portfolio of outstanding debt issued by a range of companies, while "synthetic" CDO are not collateralised by actual bonds but by more complex credit arrangements like swaps. Examples of cash flows CDO are MBS or credit-linked notes. Examples of synthetic CDO are CDO collateralised with credit default swaps ("CDS") or other types of credit derivatives.

11. As discussed by the IAIS (Issues paper on non-life insurance securitisation, October 2003), securitisations can provide non-traditional sources of capital market financing, thus complementing and supplementing traditional debt and equity financing available to a business. For the insurance and reinsurance businesses, in particular, the securitisation concept has proven to provide an attractive alternative source of capacity, since CAT bond investors for the most part do not also provide traditional (re)insurance protection. See also: Swiss Re Sigma, Securitization – New Opportunities for Insurers and Investors, op. cit., pp. 3 ff.

12. As opposed to regulated financial guaranty and credit insurance undertakings, protection sellers under a CDS are generally not required to set aside technical reserves commensurate to the risks undertaken. Moreover, CDS protection sellers can offer certain contract terms that, in several jurisdictions, cannot be legally included in policies issued directly by a financial guaranty insurer (e.g., broader definitions of "credit event", acceleration of payments provisions). See State Of New York, Insurance Department, Circular Letter No. 19 (2008), September 22 , 2008, available at http://www.ins.state.ny.us/circltr/2008/cl08_19.htm

13. British Bankers Association (2006), BBA Credit Derivatives Report, BBA Enterprises Ltd.

14. A master confirmation agreement is "…a contract in which all the terms that have to be agreed to only once by the parties are established for a single product group (such

as European/North American single credit default swaps). That allows only the terms that change with every trade, called the transaction supplement or "short form," to be automated and confirmed" (see http://www.dtcc.com/news/newsletters/dtcc/2006/jan/master.php).

15. Kroszner (2007).

16. See, for instance, U.S. Treasury press release of 13 May 2009 outlining U.S. proposals in this area ("Regulatory Reform Over-The-Counter (OTC) Derivatives"). See www.treasury.gov.

17. Idiosyncratic or non-systematic risk is that risk which is inherent in a company or industry; it is also often called diversifiable risk.

18. FDIC (2006).

19. Systematic risk is that risk which is inherent in the market; it is also often called market or non-diversifiable risk. The literature on CDOs points to the increased sensitivity to systematic risks resulting from CDO structures; see, e.g., Hamerle, A., Liebig, T., and Schropp, H-J, "Systematic Risk of CDOs and CDO Arbitrage", Deutsche Bundesbank Discussion Paper Series 2: Banking and Financial Studies, 13/2009.

20. See presentation by Robert Hartwig to the Institute for Building and Home Safety in Orlando, Florida on November 17, 2006, on file with the primary authors of this report.

21. See below, chapter 8.3 a).

Chapter 7

Overview and Analysis of CAT-linked Securities

7.1. Overview of CAT-linked securities

The following provides a brief description of some of the CAT-linked securities that have been issued or traded in capital markets:

a) CAT bonds

A CAT bond is a high-yield bond that contains a provision that may cause the principal or interest payments to be delayed or lost to investors in the event of a specified loss such as a hurricane or earthquake. The CAT bond provides the insurer with fully collateralised multi-year cover for well-defined risks on an excess of loss basis.

As an illustrative example, the sponsor (i.e., the risk bearing entity that wishes to transfer CAT risks to capital markets), creates a special purpose vehicle (SPV). The purpose of the SPV is to provide loss protection to the CAT bond investors and sponsors.[1] The sponsor pays a premium to the SPV that issues bonds to qualified institutional investors and uses the proceeds of the sale plus the premium to purchase highly rated short-term investments such as Treasury notes. The SPV also enters into an interest rate swap to convert the periodic investment income from the short term investments to LIBOR, makes the periodic coupon payments to investors, and ultimately repays the principal upon maturity unless a loss occurs before maturity that triggers loss payments to the sponsor.[2] As mentioned, the collateralisation provisions of CAT bond structures have been tightened in 2009: most recent deals impose strict prudential rules on how the collateral is invested, feature daily mark-to-market accounting on the collateral accounts and "top up" requirements in the event that asset values fall below par. These new structures also feature improved transparency and easier access to information on the underlying assets, as well as contractual mechanics to facilitate the replacement of the swap counterparty or to unwind the transaction in case of default, with a view to better protecting the interests of investor and sponsor.

b) Catastrophe collateralised risk obligations (CROs)

In a CRO, an SPV managed by a risk manager assembles a portfolio of risks consisting of traditional reinsurance and CAT-linked securities. The SPV then issues multiple tranches of notes and a tranche of equity that successively attach upon exhaustion of the previous layer. CRO offerings, like CAT bonds, are fully collateralised.[3] Investors in a CRO immediately benefit from portfolio diversification in insurance risk.

c) CAT-linked derivatives

While the first attempt to launch exchange-traded CAT-linked futures and options failed due to lack of attention and low liquidity, there have recently been attempts to revive a derivatives market. Over-the-counter instruments such as the Deutsche bank-sponsored event loss swaps or the NYMEX, the CME, and the IFEX exchange-traded futures and/or options contracts are examples of more recent innovations in CAT-linked derivatives. Below is a brief description of these products.

i. Event loss swaps

Although there is little publicly available information on OTC CAT-linked derivatives, Deutsche Bank has sought to make two-way markets in what it calls event loss swaps. The Deutsche Bank event loss swaps, in their current form, work like credit default swaps. The buyer of event loss protection pays an upfront premium to the seller of the protection who must then pay the full notional value of the swap contract if industry-wide insurance losses breach a pre-agreed upon trigger. Features of the Deutsche Bank swap transactions are as follows:

- The swap contracts cover a one-year risk period and are sold in notional US$5 million amounts, with the buyer upfront premium being expressed as a percent of the notional amount.
- The swaps contracts cover windstorm and earthquake risks in the U.S. with thresholds levels set at US$20 billion, US$30 billion, and US$50 billion for hurricanes and tornadoes, and at US$10 billion and US$15 billion for earthquakes.

ii. NYMEX CAT risk index futures and options

The NYMEX contracts are standardised futures and options contracts co-developed by NYMEX and Gallagher Re (now Aon Re). The contracts settle against indices of industry losses estimated by the Property Claims Services ("PCS"). The indices are computed and maintained by Gallagher Re. NYMEX offers the futures contracts in the open-outcry and the options contracts on the GLOBEX electronic venue. The NYMEX clearing corporation also offers clearing services for index-based options traded off-exchange.

Standard features of the NYMEX contracts are as follows:

- The futures and options contract prices are based on market (preliminary and subsequent) estimates of cumulative industry losses for catastrophes that occur during a calendar year. The contracts settle in cash at the end of March of the following calendar year.
- The Re-Ex index contains estimated losses from all perils identified by PCS except earthquake and terrorism.
- The Re-Ex index value is computed as the sum of cumulative industry loss estimates divided by US$10 million. For instance, cumulative loss estimates of $25 billion translate into a 2,500 point index. One index point is worth US$10.
- NYMEX currently offers futures and options contracts on three regions: National, Florida, Maine to Texas (excluding Florida).

iii. CME hurricane futures and options

In many ways, the NYMEX contract design mirrors that of the CBOT now-defunct instruments. The CME, on the other hand, adopted a radically different approach in the design of its hurricane futures and options. First, the CME products are one-peril instruments. Second, they settle against the Carvill Hurricane Index ("CHI"), which is based on the parametric features of a hurricane, such as maximum wind velocity and size (radius). Third, the CME futures and options expire as soon as an official hurricane makes landfall. The contracts settle in cash against the value of the CHI, which is immediately released after the hurricane landfall.

Other features are as follows:

- The CHI is expressed in points. One index point is worth US$1,000.
- CME currently offers futures and options contracts on five regions: Gulf Coast, Florida, Southern Atlantic, Northern Atlantic, and Eastern.
- The CME recently expanded its range of contracts to include seasonal aggregated futures contracts and options with a binary payout, i.e., either no payout or a full face value payout.

iv. IFEX event-linked futures

IFEX, a London-based insurance derivatives exchange, is a subsidiary of the Climate Exchange plc. Group and operates via the Chicago Climate Futures Exchange's trading platform. The IFEX launched event-linked futures (ELF) contracts linked to U.S. tropical wind in September 2007 and has offered ELF contracts on other specific U.S. seasonal hurricane risks. The futures contracts are designed to mimic industry loss warranties with a payout linked to "first event" of the year, "second event" of the year, and so on. The futures contracts settle against an industry wind loss as estimated by PCS and offer a binary payout of US$10,000 (when the industry loss amount reported by PCS equals or exceeds one of the applicable loss trigger levels) or zero. The applicable loss triggers levels for each listed event are currently US$10 billion to US$50 billion, in increments of US$10 billion.

d) Other instruments

i. Industry loss warrants

An industry loss warrant ("ILW") is an index-based instrument that can be structured either as an indemnity-based reinsurance contract or as a derivative contract. An ILW may be considered a reinsurance contract when: *(a)* the contract buyer suffers a loss; and *(b)* the industry suffers a loss over a specified threshold. However, it is generally viewed as a derivative contract when it is triggered only by an industry loss. A.M. Best[4] has recently drawn analogies between the basis risk associated with non-indemnity triggered CAT bonds with that of ILWs.

ii. Sidecars

A sidecar is a reinsurance company that is created and funded by investors, such as hedge funds, to provide capacity to a single insurer or reinsurer (commonly called the

sponsor) for its catastrophic losses. While CAT bonds allow insurers to transfer their property risk to the capital markets, sidecars are best described as tools that help insurers in financing any risk on their books, including property risks.

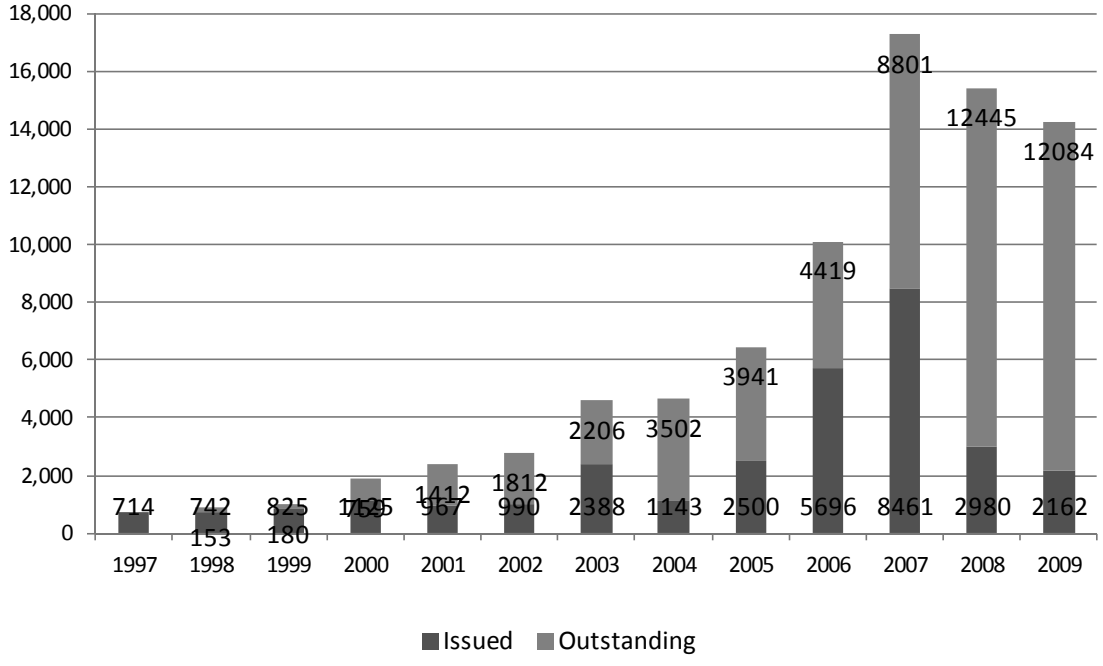
The structure of the sidecar is a reinsurance company created to provide quota share reinsurance protection to the sponsor via a quota share reinsurance agreement. The sidecar assumes a percentage of the sponsor's catastrophe risk in return for a percentage of the premium. The sidecar pays a ceding commission to the sponsor; the size of that commission increases in proportion to expected profitability. The sidecar accepts premiums and pays claims as a normal reinsurer. It also distributes interest and dividends to its shareholders. The sidecar usually has a lifespan of one or two years.[5]

7.2. Market trends and analysis of the main features of CAT-linked securities

a) Size and growth of the market

One of the most important measures of market size is the total risk capital outstanding; that measure showed record growth in 2007, with new issuance exceeding US$8 billion (see Figure 7.1). At year-end 2007, there was more than US$17 billion in outstanding principal. The number of transactions also set records in that year.

Figure 7.1. **Risk Capital (for CAT bonds issued and outstanding, in US$ million)**



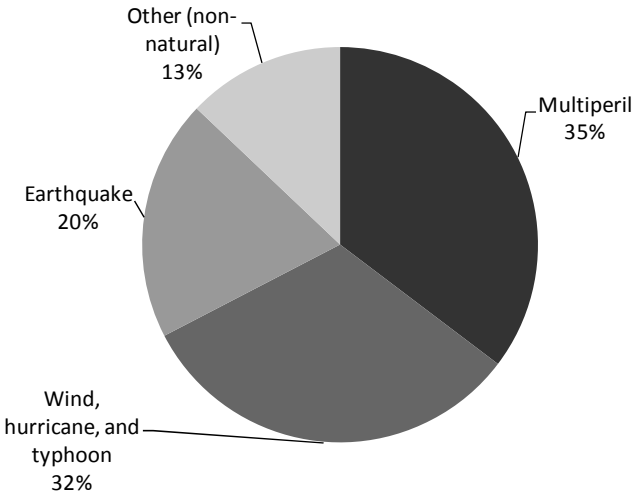
Source: Swiss Re Capital Markets, as of October 14, 2009

After this record-setting year, in 2008, new CAT bond issuance fell to US$2.9 billion (new and renewal capacity). Towards the end of the year, planned CAT bond transactions were postponed partly because of the impact of the global financial crisis on secondary

market spreads, and partly because of concerns over the effectiveness of the collateral protection mechanics embedded in CAT bond structures. The enhanced capacity and favourable rates in the traditional reinsurance market also contributed to this trend.[6] CAT bond issuance as of third quarter 2009 suggested that 2008 levels would be achieved.[7]

Figure 7.2 describes the non-life risks, by peril, that have been securitised through CAT bonds, including natural and non-natural risks. Natural hazards have, since 1997, largely been the risks securitised through CAT bonds. The multi-peril bond issues include combinations of the perils such as U.S. hurricane, California earthquake and European wind or U.S. earthquake, U.S. hurricane and Japanese earthquake and, in rare cases, property, launch, aviation and marine. Wind, hurricane, and typhoon, and earthquake, are the perils most often covered by CAT-linked instruments, whether individually or in multi-peril instruments. Indeed, the multi-peril CAT bonds have the most stable issuance history. These are perils for which more data exist, at least in North America, Europe and Japan; these are also perils that quite clearly violate the law of large numbers, making insurance coverage more difficult.

Figure 7.2. **Risks Securitised Since 1997**[8]



Source: Swiss Re Capital Markets, as of October 14, 2009

b) Triggers

The trigger on CAT-linked securities determines the conditions under which payments are made to the sponsor. The generic trigger types are as follows:

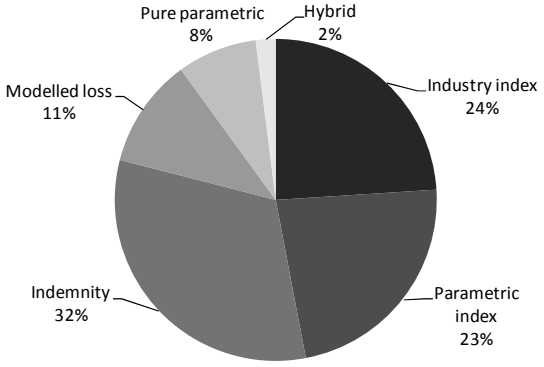
- **Indemnity**: The payouts depend on the sponsor's actual losses.
  - Advantage - This trigger eliminates basis risk.[9]
  - Disadvantages - This trigger requires costly disclosure by the sponsor, requires more detailed risk analysis by the modelling firm, and has a long recovery period for investors (of up to 18 months, due to the need for the sponsor to calculate loss claims), thus offering less liquidity for investors; this trigger may also introduce a moral hazard problem (see below), to the detriment of investors.

- **Industry index**: The payouts are triggered by the industry loss estimated by an agency that collates such information for CAT events.
  - Advantages - This trigger yields a more transparent process, protects insurer privacy, and eliminates the moral hazard problem.
  - Disadvantages - This trigger yields basis risk and a possible mark-to-market problem if the CAT-linked instrument is treated as a financial derivative as opposed to a reinsurance contract, as volatility may be introduced into the balance sheet and earnings.
- **Parametric**: The payouts are determined by well-defined parameters of a CAT event. Parametric structures have themselves evolved through two generations. First-generation parametric triggers ("pure parametric") were based on the broad parameters of the event – such as the magnitude and location of an earthquake (located within a defined area) or the intensity of a hurricane at landfall. Second-generation triggers ("parametric index") achieve a much better match with the actual loss by employing multiple windspeed recorders or earthquake strong motion recorders and weighting the values at each recording site into an index tuned to match the distribution of actual losses.
  - Advantages - This trigger also yields a more transparent process and a possibly more rapid verification process as well, allowing a transaction to be settled quickly (in weeks) after an event.
  - Disadvantages – Basis risk and mark-to-market risk, although these are significantly reduced in second-generation (parametric index) triggers.
- **Modelled loss**: The payouts are triggered by a model industry loss that is determined by running the parameters of the actual event through a modelling firm's database of industry exposures.
  - Advantages - This trigger may yield a rapid verification process. It also protects the privacy of the insurer.
  - Disadvantages - This process may be quite opaque, and yields basis risk and mark-to-market risk.
- **Hybrid**: The payouts are determined by a combination of two or more existing trigger types.
  - Advantages - This approach allows different triggers for different perils, or combinations of triggers, in order to reduce basis risk.
  - Disadvantages - The use of more triggers makes the process less transparent and more costly. Basis risk may remain as well as the mark-to-market risk.

The indemnity trigger has been the dominant form for CAT bonds because the payouts replicate reinsurance protection. The indemnity trigger requires the disclosure of details about the covered portfolio that make it more costly both to the insurer that would prefer to not to reveal the information and the investor who must digest the information. This trigger also generates a possible conflict of interest since the insurer may settle catastrophic claims in a way that is disadvantageous to investors; this is the well-known moral hazard problem.

The index, parametric, model, and hybrid triggers remove the moral hazard problem from consideration but may leave a basis risk problem. The imperfect correlation between the CAT-linked security payout and the insurer's loss represents the basis risk, e.g., for an index trigger, it is the difference between the estimated industry loss and the insurer's loss. See Figure 7.3 for an historical sketch of trigger use. The figure shows that indemnity triggers have been used the most frequently, followed by industry index triggers (e.g., PCS industry losses) and parametric index triggers. [10]

Figure 7.3. **Catastrophe Bond Trigger Breakdown (1997-2009)**



Source: Swiss Re Capital Markets, as of October 14, 2009 (percentages based on notional amounts)

c) Development of catastrophe loss models

Probabilistic catastrophe loss models have been crucial to the development of the CAT-linked securities market. The development of the CAT bond market was assisted by the general development and acceptance of second-generation catastrophe models that were first developed in the early 1990's and which became more generally accepted across the insurance and reinsurance industry by 1997 and in particular had become accepted by rating agencies for the assessment of capital adequacy requirements.

There were three principal catastrophe modelling companies working in this area in the mid-1990's: Risk Management Solutions (RMS), Applied Insurance Research (AIR), and EQECAT, a situation that remains unchanged today. The first CAT models were developed for U.S. earthquake and hurricane and the expansion of the countries and perils securitised reflects the expansion and maturity of the models themselves to other territories and the acceptance of these models as being sufficiently mature as to be used for risk transfer. Inevitably, acceptance of the models for structuring and pricing reinsurance risk transfer, as a standard procedure within the insurance industry, has preceded the use of the same models for transferring risk to the capital markets.

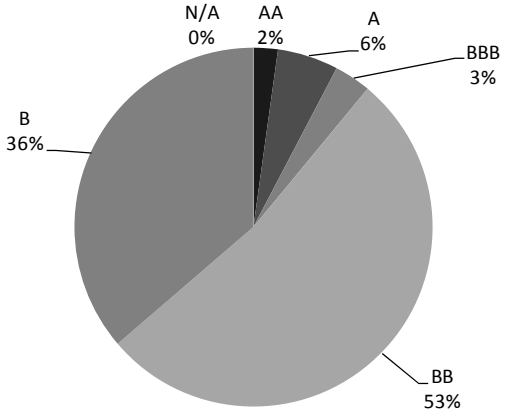
d) Credit ratings of CAT-linked bonds

U.S. credit rating agencies have also had an important role in the development of the CAT-linked securities market. Credit rating agencies rely on stochastic modelling undertaken by the CAT risk modelling companies to derive estimated loss statistics. Their rating methodology of CAT-linked securities typically focuses on the following factors:

- **Analysis of the issuer's insurance risk**: Credit ratings agencies rely on the input provided by catastrophe modelling firms in the form of a loss exceedance curve[11] that plots the bond issuer's loss against the probability of loss.[12] The credit rating agency may then ask that the model be stress-tested with different scenarios and assumptions. The trigger (or attachment point), once validated by the rating agency, is then applied to the exceedance curve to determine the probability of loss at the trigger point.
- **Evaluation of default risk**: Credit rating agencies compare the probability of catastrophic losses with the probability of default of corporate bonds estimated from historical data on corporate bond defaults, typically taking the probability of default from the loss exceedance curve and placing it in the relevant band. Figure 7.4 shows the distribution of ratings of outstanding CAT bonds (by number issued) at time of issuance. The figure shows that CAT bonds have been predominantly rated B and BB at issuance.
- **Terms and structure of the CAT bond transaction**: This includes the credit quality of the collateral placed in the SPV trust and the credit rating quality of the counterparty to the swap engineered by the SPV.[13]
- **Risk of the CAT-linked security sponsor**: This includes the sponsor's financial strength, length of time in business, history of sponsoring CAT-linked securities, management quality and other considerations.

Some CAT bond issues have been BBB-rated or higher; however, the dominance of BB and B issues underlines the prominent role played by the non-investment grade in the market.[14]

Figure 7.4. **Quality of Outstanding CAT Bonds**[15]



Source: Swiss Re Capital Markets, as of 14 October 2009

e) Pricing of CAT-linked securities

i. Theoretical considerations

The pricing of CAT bonds and other CAT-linked securities is perhaps the most investigated area of academic research in this field. Some research uses an actuarial

approach to model the yield paid on CAT-linked securities. The equilibrium models imply that disaster risk should yield an unbiased estimate of expected loss. This pricing approach, however, relies on the recognition that equilibrium models do not explain why yields on CAT bonds consistently exceed actuarially fair levels. Academics differ on the determinants of CAT-linked securities risk premium spreads. For CAT-linked instruments, the premium is most commonly determined as a fixed constant times the volatility of loss (other higher loss distribution moments, such that skewness, may also partly determine the premium spread). Others attribute high yields paid on CAT-linked securities structures to the uncertainty associated with actuarial probabilities.

Other research uses a financial approach to model CAT bonds and other insurance-linked securities structures. Vaugirard (2003) uses an arbitrage approach to value insurance-linked securities, which accounts for catastrophic events and interest rate randomness, notwithstanding the fact that markets are incomplete. Cox and Pedersen (2000) recognise that the pricing of CAT bonds requires an incomplete market setting and develop a pricing method based on a model of the term structure of interest rates and a probability structure for the catastrophe risk.

ii. Practical considerations

CAT bonds have, for some sustained periods over the course of their existence, traded with a wider spread than similarly traded corporate securities.[16] Market participants routinely attributed the wider spread to the following factors:

- Doubts by investors about the models used to predict loss probabilities, i.e. the estimated probability that a trigger will be reached.[17]
- The perception that the risk associated with CAT bonds may be more binary than that of corporate bonds (i.e., the perception that the loss is all or nothing).

Using a different benchmark, however, the cost of financing through CAT bonds – as measured by the coupon yield relative to the expected loss on the CAT bonds – appears to be in secular decline given growing capital market interest and expertise and increasing CAT-bond volume, with some suggesting that the critique of excessive spreads may no longer apply to the CAT bond market (Cummins, 2008).

Notes

1. The collateralisation of the risk capital underlying a CAT bond transaction provides investors and sponsors with protection: investors are protected against the default of the sponsor, so that interest income and the principal (at maturity) can collected, while sponsors with reinsurance arrangements with the SPV are assured of payment should the loss event(s) occur. As discussed on p. 5 and p. 19, collateral requirements have been recently tightened.
2. See GC Securities (2007), The Catastrophe Bond Market at Year-End 2006, p. 25.
3. An example of a CRO is Gamut Re that had a US$310 million bond offering in May 2007. Goldman Sachs was the lead underwriter of the offering. Nephila, a private

equity CAT fund assembled the portfolio of risks that includes traditional reinsurance, ILW, and CAT bonds.

4. See A.M. Best Press Release (April 8, 2008), "A.M. Best formally harmonises the basis risk evaluation of CAT bonds and ILWs".

5. As sidecars are not, strictly speaking, capital market securities, they will not, for the purposes of this report, be explored further.

6. See GC Securities (2009), Cat Bonds Persevere in Tumultuous Market .

7. More recent data from Guy Carpenter indicate that issuance of CAT bonds in 2009 in terms of risk capital and number of transactions exceeded 2008 levels. See GC Securities (February 2010), Catastrophe Bond Market Continues to Improve.

8. Other (non-natural) securitised risks include extreme mortality, automobile, industrial accident, credit reinsurance, and event cancellation.

9. Basis risk is the risk that the payoff on the catastrophe linked security will not match the sponsor's actual loss; such a difference can occur if, for example, the payoff on the CAT-linked security is determined as the average loss in the industry rather than the actual loss of the sponsor.

10. For a review of the role of indices in transferring insurance risks, see Swiss Re sigma (2009), The Role of Indices in Transferring Insurance Risks to the Capital Markets, n.4/2009.

11. The exceedance curve provides the probability of a loss of a certain size could occur this year.

12. Catastrophe modelling firms construct a loss exceedance curve by simulating thousands of hypothetical catastrophic event scenarios with varied geographical locations and event characteristics. The scenarios are then applied against the portion of the cedent's book of business covered by the bond.

13. As explained above, the SPV places the proceeds collected from the investors in the bond into a trust that invests in fixed-income securities. The SPV then swaps the investment earnings of the trust against a LIBOR rate minus a fixed spread.

14. The dominance of B and BB ratings is also observed when factoring in the notional value of CAT bonds issued. See GC Securities (2008), The Catastrophe Bond Market at Year-End 2007, Table 8, p. 28.

15. The ratings are those obtained at the time of issuance for each CAT bond. The distribution of ratings reflects a simple average (by number of CAT bonds), and is not weighted by notional value of the CAT bonds.

16. See GC Securities (2008), op. cit., Figure 9, p. 34.

17. After Katrina hit, the doubts were driven by a perceived under-estimation of losses; catastrophe modelling firms revisited their assumptions about hurricane activity rates, and property vulnerabilities, embedded in the CAT models that they had used to rate CAT bond offerings prior to the occurrence of the hurricane.

Chapter 8

Development of CAT-linked Securities

We can draw from observations made in chapter six of this report about the nature of natural catastrophe risks and their economic costs, the general conditions for market growth and liquidity in securitised markets and the possible roles of CAT-linked securities, to identify the key drivers of, impediments to, and issues in the development of, a CAT-linked securities market.

8.1. Drivers of the development of CAT-linked securities

a) Demand for additional risk transfer capacity

Chapter six documents the need by insurers and reinsurers for additional risk transfer or risk financing capacity. Growing CAT bond issuance in the pre-financial crisis environment supports the statements made in that chapter: for instance, in 2007, the record year for issuance, many insurers already participating in the CAT-linked security market tapped the investment community again; for instance, Hartford, Liberty Mutual, SCOR and USAA executed their third, third, fourth and eleventh catastrophe bonds respectively. Allstate, Travelers and Chubb are among the major primary insurers who established shelf programs for the first time. Also, in 2007, after a long absence from the CAT bond market, State Farm sponsored a US$1.1 billion CAT bond. Finally, issuance of CAT-linked securities by reinsurers remained strong, with re-insurer transactions outpacing insurer-sponsored transactions.[1]

When asked about future growth in the CAT-linked securities markets, some industry participants foresee demand for additional risk transfer capacity emerging from second-tier insurance companies, and from reinsurance companies that can synthetically "blend" their insurance clients' risk portfolios and transfer the blended risk to capital markets. Industry contacts also mentioned the possible role of state catastrophe pools that may securitise their extreme event risk rather than finance it with taxpayer money.

Demand for additional risk transfer capacity and securitisation may emerge from countries that have huge exposure to catastrophe risks, a constrained financial ability to absorb the financial impacts of financial disasters, and/or an inexistent or inefficient reinsurance market infrastructure. Recent illustrations are the newly launched MultiCat Program and the recently established Caribbean Catastrophe Risk Insurance Facility (CCRIF), both promoted by the World Bank. MultiCat is a CAT-bond issuance platform that allows governments and other public entities to access international capital markets, while the CCRIF functions as a mutual insurance company controlled by participating Caribbean governments (with some support from donor partners and guidance from the World Bank).[2]

b) Broader investor base and portfolio diversification benefits

Diversification of market participants is a key driver of growth in securitised markets. In the last two years, the number of investors in the CAT-linked securities market has increased and diversified, as a result of a better understanding of the functioning of this market and of more sophisticated assessments of the financial impacts of catastrophe risks. The CAT bond market has a growing core of experienced investors including money managers, hedge funds, dedicated CAT funds, banks, reinsurers, life insurers, non-life insurers, and some money funds, (i.e., see figure 8.1a and 8.1b for a breakdown by investor group and country in transactions placed by Swiss Re).

Since CAT bond structures trade over the counter, the secondary market is less transparent than the primary market and liquidity estimates vary considerably. Industry estimates of market participation range from scores to hundreds of investors. Figure 8.1a shows that a large proportion of the capital raised by Swiss Re has come primarily from dedicated CAT funds, money managers, and hedge funds, i.e., those groups financed approximately 84 percent of the CAT-linked issues[3]. Figure 8.1b shows that investor base for CAT bonds placed by Swiss Re has been largely U.S. and European.

Figure 8.1a. **Investor base**[4]

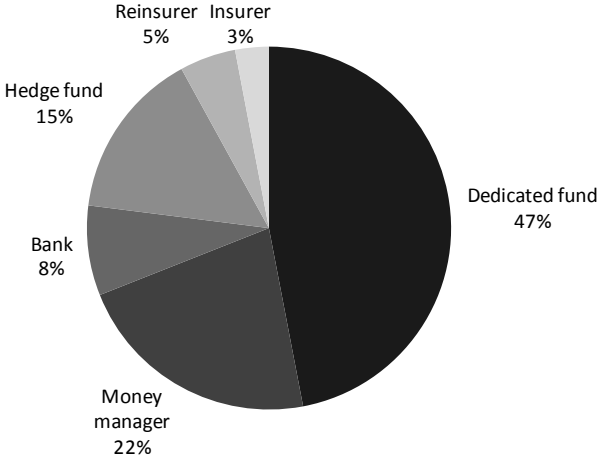
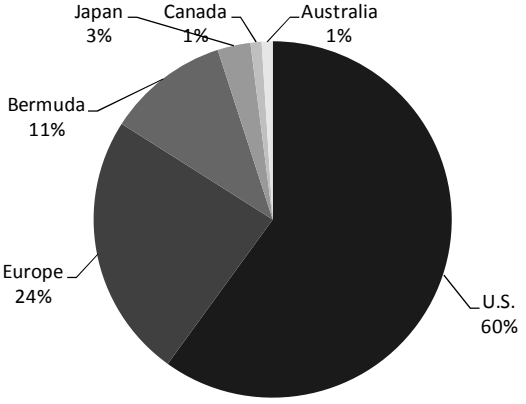


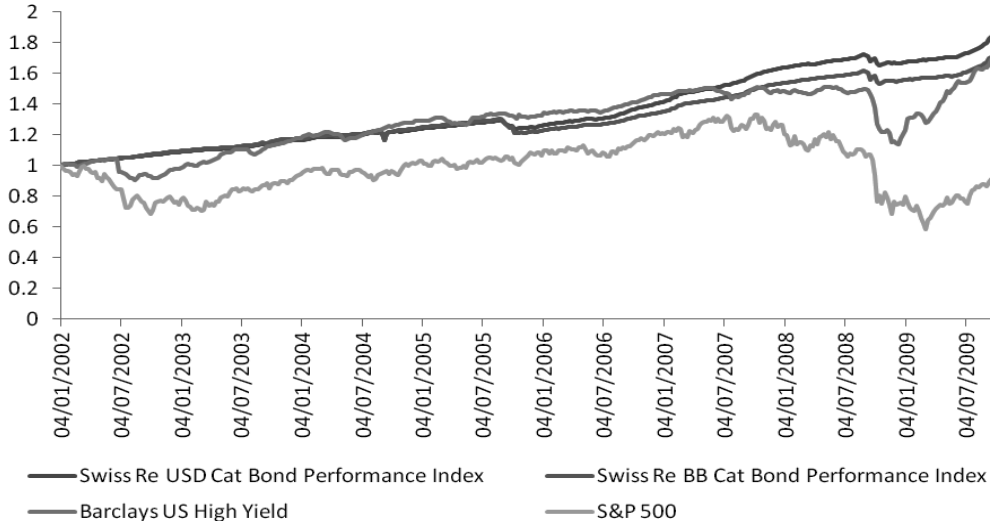
Figure 8.1b. **Investor base by country**



Source: Swiss Re Capital Markets, as of October 14, 2009

The risk-return profile of CAT instruments is a determinant of demand. All managers of institutional portfolios must decide whether to include an asset such as a CAT bond based on its expected return and its correlation. We can see in Figure 8.2 below that CAT bonds as a whole have historically provided rates of return greater than BB-rated corporate bonds, as measured by the Barclays U.S. High Yield Bond ETF, though the situation is more nuanced when making the comparison with the universe of BB-rated CAT bonds, where returns on (U.S.) high-yield bonds have for some periods exceeded the relevant BB CAT bond index; overall, however, CAT instruments have provided more stable returns and offered sufficiently attractive (and often excess) returns to attract capital market investors.

Figure 8.2. **CAT Bond Performance (Swiss Re CAT Bond Performance Index)**[5]



Source: Swiss Re Capital Markets, as of 9 October, 2009.

Corporate capital has always been present in the aftermath of a large disaster for the right risk-return profile. For instance, in 1992, following the occurrence of Hurricane Andrew, a large injection of capital in the form of newly formed reinsurance entities in Bermuda was observed. Similarly, the occurrence of Hurricane Katrina provided the catalyst for growth in the CAT-linked securities market. Today, there are many dedicated CAT funds investing solely in CAT risks. Examples of such funds are: Stark Investments, Fermat, Nephila, Magnitar, Pulsar and Coriolis. Finally, hedge funds such as Citadel Investment Group, Fortress and JWM have focused on equity participation by investing in sidecars and other equity-related instruments.

That said, it is observed, however, that the most recently issued CAT bonds have tranches with ratings primarily in the B to BBB range. Lower ratings-higher yields securities may attract investors like hedge funds or CAT funds from a risk-reward standpoint, but may deter investors looking for A to AAA-rated securities. Investors in highly rated securities constitute the vast majority of investors in other securitised markets, such as the MBS or ABS markets.

Moreover, it is worth noting while individual and less sophisticated investors can, in theory, assume CAT risk via participation in mutual funds, only a few mutual funds, to date, specialise in natural disaster risk. While it seems obvious that both better price transparency and greater transparency in the underlying risks are crucial to enhanced secondary market trading, the institutional community shows little interest in opening up the CAT-linked securities market to smaller or individual investors. In addition, the high costs of CAT risk assessment may be prohibitive to some investor types.

CAT-linked securities have historically provided a favourable risk and return profile to investors and, more importantly, have provided them with a means of reducing portfolio risk. More specifically, there is evidence that CAT bonds exhibit low correlations with other asset classes. For example, Froot (Froot, Murphy, et al 1995)[6] estimates of the correlation coefficients between CAT exposures and other asset classes ranged from – 0.13 and + 0.21 but none were statistically different from zero. The favourable risk-return profile of this class of securities demonstrates that the CAT-linked securities may be used to reduce the risk of a portfolio and increase its expected return. More recently, Heike and Kiernan (2002) have shown "that the addition of a small allocation of cat bonds to a BB high-yield portfolio, represented by the Lehman Brothers BB High Yield Index, reduces the portfolio's return volatility and boosts its expected return".[7] Hence, portfolio diversification provides a rationale for the growing investor base for this asset class.

The recent sub-prime mortgage and credit market crisis in U.S. financial markets further highlights the attractiveness of zero-beta assets, like CAT-linked securities, in investor portfolios. Institutional investors have recently become re-acquainted with the dangers of holding securities collateralised with highly correlated assets and have shied away from mortgage-collateralised bonds or CDO, while turning to the CAT-linked market.

c) Advances in technology and modelling of CAT risk

As mentioned in chapter six, advances in technology and modelling also contribute to better public understanding and acceptance of securitised products. Today, thanks to advances in catastrophe modelling and risk assessment methodologies, both bond sponsors and institutional investors have a more sophisticated understanding of the financial impact of the risk embedded in various CAT-linked structures. In response to the financial impact of Katrina on the insurance and reinsurance industries in 2005, the leading CAT modelling firms, i.e., AIR, EQE and RMS, further refined their modelling techniques. This increased awareness of potential losses has helped increase the search for capacity in the insurance industry and has driven sponsorship of CAT-linked securities. In addition, catastrophe modelling firms have introduced two views of Atlantic hurricane risk (Standard and Warm SST-conditioned in the case of AIR, and Near- and Long-term in the case of RMS and EQUECAT).

The development of software technology aimed at facilitating the management of portfolio of catastrophe risks can also be observed. For instance, AIR has been using its software tool, CATRADER®, since 2001 to help investors structure and evaluate securitised CAT transactions and enable the testing of portfolio optimisation strategies. RMS has also released a licensed software product "Miu" that allows investors and issuers to quantify and tailor a portfolio of catastrophe risk positions packaged in any form: CAT bonds, OTC derivatives, sidecars, ILWs, and various forms of reinsurance. The equivalent EQECAT's product is called eCAT.

d) Broader sponsor base: corporate/sovereign issuers

At the beginning, CAT risk securitisation transactions were sponsored only by insurance and reinsurance companies, but the investor base grew over time. Besides insurers and reinsurers, there have been few corporate issuers of CAT bonds to date: Tokyo Disney, Universal Studios and Électricité de France are among a handful of corporations that have sponsored CAT-linked securities. Industry sources attribute such low interest to three factors:

- First, for most corporations, insurance costs are generally cheaper than the costs of transferring natural disaster risk via capital markets. Insurance pricing benefits corporate buyers because the insurer can pool and spread corporate risks.
- Second, while the pooling argument breaks down when peak risks arise, very few corporations around the world have peak risk exposures.
- Finally, applicable accounting rules may deter corporations from issuing CAT-linked securities.[8]

As noted in chapter six, some level of public sector participation may facilitate the growth of securitised markets. To date, government participation in the CAT-linked securities market has remained very limited.

In this respect, it is interesting to note that the World Bank recently launched the MultiCat Program, a CAT-bond issuance platform aimed at providing governments and other public entities with easier access to international capital markets to insure themselves against certain risk posed by natural hazards. The MultiCat Program is designed to allow participants to buy coverage for multiple perils, countries and regions. Perils that can be covered include: earthquakes, floods, hurricanes and other wind storms. In developing this project, the World Bank worked closely with the Government of Mexico that already had an experience as sovereign issuer in the catastrophe bond market with the 2006 US$160 million single-peril CAT-Mex transaction covering earthquake risk.

In October 2009 Mexico was the first sovereign sponsor to use the newly established MultiCat platform. A US$290 million multi-peril series of notes was issued to cover certain seismic and weather-related risks. The transaction,[9] whose lifespan is three years, was structured in four classes, covering six geographical zones of Mexico and three risks: earthquake and hurricanes from the Pacific and Atlantic Oceans, using the following parametric triggers:

- Class A (earthquake), divided in three subzones (A, B and C):
  - Zone A, trigger Mw>=7.9
  - Zone B, trigger Mw>= 8.0
  - Zone C, trigger Mw>= 7.4
- Class B (hurricane Pacific)
  - Zone 1, trigger central pressure <=944mb
- Class C (hurricane Pacific)
  - Zone 2, trigger central pressure <=944mb

- Class D (hurricane Atlantic)
  - Zone 1, trigger central pressure <=920mb

The transaction, whose collateral is invested in U.S. Treasury Money Market Funds (TMM), experienced robust demand across each of the four tranches and was upsized from the original offering size of US$250 million to the final offering of US$290 million.[10]

It is important to note that Mexico undertook a comprehensive catastrophe risks management strategy for private and public sectors before deciding to make use of CAT-linked securities.

The recently established CCRIF provides another example of possible ways in which governments may indirectly access CAT-linked securities capital markets. The CCRIF pools catastrophe reserves from participating governments, and transfers some of its natural disaster risks to reinsurance markets or capital markets via the use of CAT-linked instruments.

Those governments that have a constrained financial ability to absorb the economic impacts of natural hazards could tap CAT-linked securities markets either by directly issuing CAT-linked securities (as in the case of Mexico) or by creating multi-governmental facilities similar to CCRIF. The latter would allow these governments to share the costs of accessing reinsurance and capital markets and the costs of the CAT modelling technology, with a view to transferring extreme event risks from the pooling facilities to capital markets via the issuance of CAT-linked securities.

Since, as discussed, CAT risk securitisation transactions very often entail some degree of basis risk, it becomes crucial to determine the objectives pursued by the sovereign sponsor. The CAT bonds issued in May 2006 and October 2009 on behalf the Mexican government, for instance, are mainly aimed at providing the necessary liquidity for emergency response measures, not at covering the losses caused by a severe earthquake or hurricane. A similar objective is pursued by the CCRIF, which allows Caribbean governments to purchase parametric insurance coverage that will provide them with an immediate cash payment after the occurrence of a major hazard event, thus enabling them to overcome the liquidity crunch that may follow a disaster and start recovery operations without delays.

In OECD countries where private insurance and reinsurance markets are well developed and their activity is organised and coordinated in the context of an integrated disaster risk management strategy,[11] governments could consider developing pools of reserves from private insurers to cover extreme (uninsurable) event catastrophes risks, and finance a portion of these pools via the issuance of CAT-linked securities, rather than via the use of taxpayer money. However, any such government intervention should be based on a cost-benefit analysis given the potential to crowd out private sector solutions.

Moreover, in countries that have high exposure to catastrophe risks, a constrained financial ability to absorb the financial impacts of financial disasters, and/or an inexistent or inefficient reinsurance market infrastructure, governments should investigate the extent to which CAT-linked securities would provide one of the means of hedging the risk of uninsured economic losses.

At a more general level, it should be noted that an increasing number of sponsors are now fully integrating CAT-linked securities into their overall risk management strategy rather than seeking capital market protection as a defensive or last resort tool. As recently

pointed out by market observers, the record market activity of 2007 demonstrated a fundamental shift in the perception of the capital markets as a risk transfer solution. Industry sources corroborated this view and observed an increased desire by sponsors to evaluate all risk transfers mechanisms equivalently. In 2007, several sponsors, who had until then avoided what they perceived to be costly CAT bond structures, issued CAT bonds, despite the fact that the reinsurance market was in a soft cycle. In the current crisis environment, the situation is less clear.

8.2. Impediments to the development of CAT-linked securities

Each existing CAT-linked structure has its own weakness. Overall, there are common factors that may have limited the growth and liquidity of CAT-linked securities and derivatives markets.

a) Market fragmentation / lack of standardised transactions

A certain degree of standardisation in market capital structures is critical for the development of CAT-linked securities. In chapter six, it was noted that standardisation enhances market liquidity and helps investors manage their portfolios more efficiently. Yet, it was observed previously that there is a variety of CAT bond structures, with indemnity structures being predominant. There is thus some fragmentation in the CAT-linked capital markets. In addition, and to a certain extent, CAT-linked capital structures seem to have become more complex with an evolution from fairly simple CAT bond structures, to CRO (reminiscent of CDO in credit markets), to sidecars.[12] However, secondary market liquidity generally increases as more standardised structures (i.e., structures with a payoff triggered by an index of pooled risks) appear in the capital markets.

It seems that, after a couple of years spent on introducing more complex instruments, CAT-linked securities market participants have come to the realisation that simpler CAT bond structures may remain the dominant form of CAT-linked securities. Despite the diversity of triggers, CAT bonds are more ”standardised” than other capital structures as evidenced by the increased number of shelf registrations.

From the sponsor’s standpoint, industry loss triggers tend to have less embedded basis risk than parametric triggers. Yet a bond or a derivative instrument triggered by an industry loss will not offer immediate payout to investors, as losses will develop over weeks and possibly months, especially losses resulting from large events like Hurricanes Andrew or Katrina. In addition, the methodology for collecting and aggregating insured losses may be deemed by some to be inadequate. For instance, some CAT-linked securities market participants feel that the existing industry loss triggers (i.e., PCS) are inadequate in their estimation of U.S. natural catastrophe insured losses, despite their widespread use in CAT-linked securities. If this is the case, then a proper assessment of these triggers should be carried out and, if there is scope for material improvement, consideration should be given to the development of a new methodology for gathering industry loss and industry market exposure information for catastrophe losses.

In Europe, PERILS AG *(Pan-European Risk Insurance Linked Services)* was founded in January 2009 and incorporated as a joint stock company in Zurich, Switzerland.[13] The company, whose aim is to aggregate and provide industry-wide European catastrophe insurance data as a subscription service, is backed by a group of major insurance,

reinsurance and intermediary companies,[14] each with equal shareholding. The methodology envisioned by the group in collecting industry loss data is similar to that used by PCS. PCS estimates industry losses by surveying U.S. insurers who had exposure in the disaster zone once the catastrophe occurred. It collects information on the number and average size of direct claims that an insurer expects to pay and aggregates this information across insurers. The European group would attempt to collate the same information, but based on industry loss and insured exposure numbers from disaggregated data collected by CRESTA zone, i.e., more at a U.S. county level.[15]

b) Lack of standardised data-gathering

One of the constraints on the development and expansion of the CAT-linked securities market has been the need to have a high quality CAT loss model for that region and peril. As the availability of such models has expanded since the late 1990s, so the range of countries and perils served by CAT-linked securities issuance has itself expanded. For example, the first European windstorm securitisation in 1998 was based on the availability of trusted second-generation CAT loss models for the peril. The decision for the risk modelling companies to build a CAT model for a new country and peril is based first on the commercial assessment that the insurance and reinsurance interest in that territory is of sufficient size to merit the investment. The quality of the model will then chiefly be determined by the depth and detail of the historical record and the availability of high quality information on recent loss data for calibrating vulnerabilities relevant to the local building stock. Inevitably, therefore, there are many developing countries and perils for which there is no CAT model, or a model considered too rudimentary to support issuing a CAT-linked security. In a developing country, without relevant institutions of meteorology and geology, there will also typically be far less actual monitored observational and historical data on which to base the model. CAT models only perform well if insurers are themselves able to collect high-quality data on the insured when they underwrite the risk, and in many territories the insurers themselves do not have the tools to collect such data.

As a result, issuance of CAT-linked securities may remain limited for some peril types and geographic areas because the available CAT models do not exist, or are not considered sufficiently robust. These problems will be particularly exacerbated for indemnity CAT-linked securities structures, as there will also likely be distrust of exactly what data has been available to be fed into the model for the analysis as well as exactly how claims management will be maintained in the aftermath of a major catastrophe. The development of global, open source disaster risk assessment models promoted by the OECD through the Global Earthquake Model (GEM) initiative constitutes an important first step in this direction; other natural perils should be considered as well.[16]

For this reason, parametric CAT-linked securities structures tend to be favoured for developing countries by rating agencies and investors. Parametric triggers have always tended to be more attractive to sophisticated investors, who understand that the modelling for these triggers will involve significantly less uncertainty than for indemnity deals. It is easier for an investor to understand the basis of the modelling than industry loss triggers, in that they do not assess the insured exposure and vulnerability of the building stock, or undertake a comprehensive assessment of all the sources of loss, which are required to capture the financial impact of a natural disaster.

In addition, capital market structures triggered by parametric measures can be settled within weeks of a potential loss, unlike indemnity or industry loss deals that may take up

to 18 months before the final loss is known. Even for the issuer, the advantage of the speed of settlement may be a significant factor in choosing a parametric structure. Also, by using second-generation parametric structures involving recorded measurements, it is possible to apply weightings to each instrumental value when constructing an overall index for the event to match the geography of the underlying portfolio of properties (and any localisation of vulnerability), so that it becomes possible to create an index that more closely matches the losses being modelled. This reduction of basis risk also makes such structures more attractive to the issuer. Second-generation triggers have been employed for issuing securitisations: in the U.S. for California earthquake, in Japan for earthquake and typhoon wind, in the U.K. for windstorm and flood (using flood heights preserved on buildings within the construction of the index), and in Western Europe for windstorm.

Given the relative advantages of second-generation parametric structures, the main deterrent to their wider use, especially in developing countries, concerns the availability of a suitable dense network of hazard (wind speed, river height and earthquake strong motion) recording stations and, most importantly, recording procedures. There may, for example, be no guarantee that wind speed recorders will continue to record through intense tropical cyclones, because the equipment will have been dismounted and stored to protect it from damage. Also, it is common that the duration of battery power to cope with an inevitable loss of offsite power is insufficient to record through the passage of the storm. River flow gauges are often destroyed in extreme floods, and earthquake strong motion instruments also rely on batteries that require renewal every few months. Therefore, the expansion of second-generation triggers to new territories requires that government agencies of meteorology, hydrology and seismology (or even private companies in these areas) have appropriate standards regarding the installation and management of their networks of instrumental recorders.

There are three required components in this respect. First the choice of instrumentation and instrument siting must be sufficiently resilient to withstand the strongest potential hazard. Wind speed recorders designed to monitor wind speeds at airports, for example, are generally insufficiently robust to withstand a hurricane. Second, instruments should be spaced every 10-20 kilometres to ensure that the overall hazard field of an earthquake or windstorm is fully captured and that there is redundancy of observation (where a station fails to record). Third, there needs to be a maintenance guarantee for the equipment, batteries must be checked and replaced regularly, and the recording procedures tested to ensure they operate under all conceivable adverse conditions.

A government that chooses to support this level of instrumentation, recording, and reporting will provide the foundation for the use of second-generation parametric triggers in risk transfer. In particular, in the developing world, where information on property values, building types, and locations may be much harder to obtain, such risk transfer structures may provide the only effective way of designing a satisfactory risk transfer mechanism that does not suffer from a potentially large basis risk – as can be the case with first-generation parametric structures based only on earthquake magnitude or tropical cyclone intensity and track.

As mentioned above, a new standardisation effort was recently made by a consortium of European insurance and reinsurance market participants that established PERILS, whose aim is to calculate, monitor, and distribute to subscribers industry indices that would track aggregate losses incurred from European wind risk and industry market exposures based on CRESTA[17] zones. PERILS has been established to aggregate and

provide industry-wide European catastrophe insurance data as a subscription service. The aggregated data sets will be derived from data voluntarily provided by European-based insurers. From January 2010, PERILS will provide two main products to subscribers which are likely to include insurers, reinsurers, brokers, risk modellers, banks and other insurance industry stakeholders. These two products are: *(i)* aggregated industry-wide insurance exposure data (insured values), which will be catalogued by risk type and CRESTA zones (defined European geographical zones for natural catastrophe insurance). The data will be provided on an annual basis; (*ii*) industry loss estimates per risk type and CRESTA zones, following large natural catastrophe events. Overall, the combination of consistent industry exposure portfolio data and corresponding event loss information is likely to enhance the modelling of natural catastrophe risk. Greater transparency on industry losses will also further facilitate the establishment of accurate and robust loss triggers for catastrophe bond structures, ILWs and other capital markets products.

c) Lack of transparency in the underlying risk and valuation complexity

To date, the CAT-linked securities market has remained opaque to the general public. CAT-risk transferred to investors via CAT-linked securities is assessed by complex risk models developed by specialised firms: valuation of CAT-risks, therefore, requires specialised knowledge and an understanding of such models. Transparency and reliability of risk modelling are a crucial factor in the development of this market. As mentioned above, advances in catastrophe modelling and risk assessment methodologies allow bond sponsors and institutional investors to progressively develop a more sophisticated understanding of the financial impact of the risk embedded in various CAT-linked structures.

Furthermore, there is no public dissemination of bond offerings or prices as transactions occur OTC. As noted above, the CAT-linked securities market is likely to remain opaque if only open to institutional investors. This said, the institutions currently involved in the CAT-linked securities market might not perceive market opacity as an impediment to market growth because it is not an issue for them. They circulate lists of bond offerings and related pricing among themselves or their customers, as is common in the OTC market. They can argue that information on bond offering and bond prices is available, but that it is not publicly disseminated.

Exchange-traded CAT-linked derivatives markets have also remained opaque, with the exception of the CCFE. The CME and NYMEX do not post price and volume information on their websites. Real-time price quote providers also do not carry this information. By contrast, the CCFE provides price and volume information on its website. Opening access of the CAT-linked securities market to a broader base of investors would require public dissemination of offerings, prices, and other information related to the risk associated to investing in CAT-linked securities.

8.3. Issues in the development of CAT-linked securities

a) Cost comparison

The jury is still out on how costly CAT-linked securities are, from an issuance standpoint, compared to traditional reinsurance or ILW. In its report on managing large-scale risks, the Wharton Risk Management and Decision Processes Center[18] notes that

"from a single rate-on-line prospective, it is true that insurance-linked securities bear a higher cost than that of reinsurance or retrocession. However, there are exceptions for specific risks like higher tranches of retrocession and peak exposures in high-risk prone areas".

Typically, the one-time costs associated with issuing CAT bonds are higher than those that apply to regular debt securities. Most CAT-linked securitisation transactions have been structured via the use of SPVs that are generally based offshore. Although SPVs tend to simply operate trust accounts, there are significant transactions costs associated with the issuance of CAT bonds, such as higher fees charged by rating agencies which devote more time and manpower in analysing CAT bond structures than regular debt structures, and fees charged by CAT modelling firms. Yet overall, the legal fees associated with issuing CAT bonds have declined with the increasing proportion of shelf registrations of CAT-linked securities (Lane and Beckwith 2007).

Indemnity-triggered bond transactions are generally - but not always - costlier than non-indemnity-triggered bond transactions. As noted by Guy Carpenter,[19] indemnity triggered bonds first require the payment of a higher risk premium to the investor relative to non-indemnity bonds. The size of the premium is a function of the type of business covered and the investors' confidence in the sponsor's underwriting, risk management, and loss and claims adjustment process. Second, there are additional costs embedded in indemnity-based structures resulting from disclosure requirements, the level of detail required on the underlying insured exposure in terms of nature and locations of the properties and their insurance coverage required to model the risk, and perceived legal exposure.

In any case, it is very difficult to accurately compare the cost of traditional reinsurance and the cost of CAT-linked securities[20], since:

- CAT bonds are often multi-year programs that address price volatility issues;[21]
- CAT bonds, especially the most recent structures, entail lower counterparty risk than traditional reinsurance;[22]
- Non-indemnity CAT bonds may allow for a much faster settlement of the payments due in the event of loss, with advantages to both sponsors and investors and a saving of time and cost;
- Non-indemnity CAT bonds entails some degree of basis risk, which can be reflected in the pricing of these instruments;
- CAT bonds rarely include reinstatement provisions, a typical feature of traditional reinsurance.

b) Trade-off between moral hazard and basis risk

Securitisation of risk becomes more successful when the capital structure provides an equal playing field between risk transferors and risk takers. In the CAT-linked market, there could be a lack of "dual" coincidence of wants between the insurer and the investor. As explained previously, CAT-linked securities may have a payout tied to indemnity or non-indemnity triggers (i.e., parametric triggers or industry loss triggers).

Indemnity-triggered instruments appeal to sponsors because they reduce or eliminate basis risk. On the other hand, non-indemnity based capital structures may be more attractive to an investor than indemnity instruments, as the use of an industry loss index

trigger or a parametric trigger minimises moral hazard costs. Index structures also are likely to lower investors' costs in evaluating company-specific underwriting and financial results. Company-specific capital structures, moreover, might be conducive to adverse selection and moral hazard. Adverse selection in the context of insurance securitisation reflects the fact that an insurer could securitise the most unattractive parts of its portfolio and keep the most profitable ones. Moral hazard relates to the fact that the insurer who transfers its risks to the investor via the capital market might no longer have an incentive to limit its losses.

Although relatively new in insurance markets, basis risk is well known in the financial markets, as it represents a risk inherent in all commodity and financial transactions based on a standardised financial asset or commodity, or on an index of these. The issue per se is not the existence of basis risk, however, but its assessment and quantification. Once thoroughly quantified, if possible, basis risk in a financial transaction can be minimised and almost eliminated. For instance, it is common to use derivative instruments to eliminate basis risk in security or commodity portfolios via "over-hedging" or "under-hedging".[23]

The novelty here is that, with respect to CAT-linked securities, it is much more difficult to assess the anticipated impact of a catastrophic event on an insurer's portfolio than to assess the market risk or interest rate risk of a specific security and to compare it to that of a standardised hedge instruments like a futures contract. [24]

In a 1999 report commissioned by the National Association of Insurance Commissioners (NAIC), the American Academy of Actuaries argues that it is possible to statistically identify and measure the basis risk embedded in hedging transactions performed with index-based securities.[25]

In addition, empirical evidence has supported the hedging effectiveness of non-indemnity instruments, despite the existence of basis risk.[26,27] However, these studies must be assessed with caution. Findings can vary based on the statistical method used, e.g., simulation models versus analysis of historical data, and on the source of basis risk embedded in a specific derivative transaction. Recent research has also focused on the benefits of index-triggered bonds in comparison with indemnity-triggered bonds. In a highly stylised model, MacMinn and Richter (2004) show that, under some circumstances, reinsurers who issue bonds to hedge against brevity risk (i.e., the risk of premature death) achieve greater shareholder value by utilising index-triggered securities instead of indemnity-based securities.

As noted above, recent history in the CAT-linked securitisation market shows increased confidence by issuers of CAT bonds in index-based triggers; see Figure 7.3 for historical issuance of bonds by trigger type. Sponsors, with the help sometimes of reinsurance brokers, have spent a lot of time and resources understanding their exposures to basis risk. Meanwhile, investors have become increasingly comfortable with indemnity-based capital structures. Some of them now tend to recognise indemnity risk as another risk component in a transaction, provided that they have a sufficient grasp of catastrophe modelling techniques and a good level of comfort with bond sponsors.

While moral hazard exists in indemnity-based capital instruments, CAT bonds can be structured to minimise its impact. For instance, a structure involving co-insurance may help to mitigate moral hazard. This explains why, in dollar issuance terms, the CAT bond market is now almost evenly split between indemnity versus non-indemnity triggered securities in terms of issuance.

Finally, a reinsurer can, by acting as an intermediary between a sponsor and investors in a CAT-linked securities transaction, bridge the gap between the different trigger preferences of these counterparties. On the basis of its risk warehousing and risk assessment capacity, a reinsurer can transform an indemnity-based upstream risk transfer contract into non-indemnity based downstream CAT-linked security and manage the associated basis risk. Basis risk sensitive sponsors are thereby provided with access to the CAT-linked securities market, which fosters market growth and – due to the non-indemnity downstream trigger – standardisation.

c) Regulatory and solvency issues

The future development of CAT-linked securities markets also depends on how lawmakers will address a number of key accounting, solvency and regulatory issues going forward. In this respect, key questions include:

To what extent should regulated insurance and reinsurance companies be allowed to obtain capital relief for transfers of CAT-risks by way of securitisation on terms that are consistent with other methods of transferring risks, such as traditional reinsurance or retrocession?

To what extent should a SPV providing protection to the sponsor of a CAT bond transaction be regulated?

Regarding the first question, comparable levels of capital relief should, in principle, be allowed for comparable levels of risk transfer, irrespective of the legal form of the transaction and the amount of capital relief should reflect the amount of risk transferred.[28] In practice, market fragmentation, lack of standardised transactions, complexity in the valuation of the securitised CAT-risk, and the incidence of basis risk may induce insurance regulators to take a very prudent approach.

With respect to the second question, in theory, if the SPV writes the equivalent of a reinsurance contract to the sponsor, it should be treated as a reinsurance undertaking from a regulatory (e.g., authorisation process, licensing requirements, requisites to carry out the activity) and solvency (e.g., capital requirements, rules on investment of assets covering technical provisions) perspective. However, it should be noted that an SPV will usually enter into a single transaction – or a series of transactions within a shelf offering program – and will not conduct a diversified operating business. Moreover, CAT bond transactions, especially the most recent structures, are highly collateralised, so that counterparty default risk is kept at a minimum.

While a clear and reliable regulatory framework aimed at ensuring that ISPVs are able to fulfil their obligations towards the investors and the sponsor is certainly desirable, since it would guarantee the effectiveness of risk transfer for the purposes discussed above, the structural and functional differences between an ISPV participating in a CAT-linked securities transaction and a traditional reinsurance undertaking should be clearly recognised and reflected in the applicable regulatory and solvency regime.

In this regard, it is interesting to note recent developments that occurred at the European level. In the European Union ("EU"), the Reinsurance Directive (Directive 2005/68/EC) ("RID") authorised Member States to implement, if they wish, insurance SPVs (or "ISPVs") into local laws and it enabled domestic regulators to establish a "light touch" authorisation and regulatory regime for ISPVs, defined as: "*…an undertaking...which assumes risks from insurance…or reinsurance undertakings and*

which fully funds its exposures to such risks through the proceeds of a debt issuance or some other financing mechanism whereby the rights of the providers of such debt...are subordinated to the undertaking's reinsurance obligations ...".

According to the RID, ISPVs are not reinsurance undertakings, but they do conduct reinsurance-like activities. The RID expressly requires that an ISPV 'fully funds' its insurance risk exposure through the proceeds of financing mechanisms 'subordinated' to its reinsurance obligations. While apparently simple, the concept that an ISPV must be "fully funded" is not straightforward and it may give rise to different interpretations, with significant practical impact.[29]

It is important to note that ISPVs established in one EU Member State – and regulated by the authority of such State, according to the home country control principle – can assume risks from insurance undertakings established in other Member States and regulated by the authority of such other State. Therefore, Members States that choose not to allow ISPVs to be established within their territories still have to introduce detailed rules setting the conditions for the use of amounts outstanding from an ISPV as assets covering technical provisions (i.e., they must specify to what extent and under what conditions insurance undertakings established in such State are allowed to obtain capital relief for transfers of risks by way of securitisation to ISPVs established in another State). Such rules may be qualitative or quantitative and they may vary across EU jurisdictions, so that harmonisation is not assured in this respect.[30]

According to many commentators, one of the main legal impediments to structured finance solutions in the European insurance sector has been the lack of simple transformer structures that ally tax efficiency and flexible regulatory and prudential requirements, whilst allowing for the issue of debt securities and providing reinsurance coverage. Regulators in the EU have either imposed restrictions on these structures or have not recognised that certain transformer structures ought to be regulated in a different way from traditional reinsurance companies. The implementation of the RID should help removing some of the regulatory hurdles that have prevented the insurance industry from fully taking advantage of capital markets. For this reason, it is useful to provide a brief overview of the RID implementation measures adopted in the U.K. and in France.

In the U.K., as part of the implementation of the RID, the FSA has taken the opportunity to facilitate the creation of a market in the U.K. for insurance special purpose vehicles. Before the RID, an ISPV in the U.K. – as elsewhere in Europe – would have to be authorised, supervised, and indeed taxed, as a full reinsurance company, and would need to maintain a regulatory capital surplus in the same way. The new regime introduced in the U.K. recognises the relatively lower levels of risk associated with the structure of SPV transactions. The authorisation requirements are minimal, with little documentation required that would not already be produced as part of setting up the SPV. Supervision takes place through the oversight of the ceding company, rather than separate supervision of the ISPV. Concerning the solvency requirement for an ISPV, the FSA took the view that the term 'fully funded' simply means that the ISPV's reinsurance liabilities must be capped at the value of the assets available to fund those liabilities.

In France, the implementation of the RID allowed SPVs, established under the form of the '*organisme de titrisation'*, to acquire or transfer insurance or reinsurance risks under certain conditions.[31] The *Autorité de contrôle de l'assurance et des mutuelles* (ACAM) must authorise the establishment of the ISPV, bearing in mind that the rules applicable to such vehicles are designed to result in a much lighter and quicker procedure than that applicable to insurance companies. Under French law, the ISPV is neither an

insurance nor a reinsurance undertaking. Furthermore, the law expressly states that the agreements entered into by an ISPV do not qualify as insurance contracts, with all of the related regulatory and tax consequences. ISPVs are not subject to minimum solvency margin or capital requirements, other than that their assets must be equal or greater to their liabilities, meaning that: *(i)* once the initial funds necessary to cover the ISPVs reinsurance liabilities have been raised in the capital markets, the corresponding proceeds and other assets must remain sufficient throughout the life of the ISPVs to cover the reinsurance risks they bear and *(ii)* the repayment of the capital markets investors is subordinated to the payments due by the ISPVs to the ceding company (or other insurer creditors) in the event of the materialisation of the underlying insured risks. Moreover, under certain conditions: *(i)* amounts recoverable from the ISPV by the ceding insurer (or other insurance creditor) may be considered as reinsurance or retrocession in calculating the ceding insurer's solvency margin requirements and *(ii)* amounts outstanding from the ISPV may be treated as reducing, or included as assets covering, technical provisions.

Finally, it should be noted that the future implementation of the Solvency II regime, currently in preparation, is expected to further broaden the scope of admissible risk transfer mechanisms accepted by European regulators,[32] especially for those insurance undertakings that will take advantage of the option to use internal models to assess their solvency capital requirements.[33]

d) Market transparency and liquidity issues

Industry sources indicated that secondary market activity in CAT bonds has improved in the recent years; however, it is difficult to establish a reliable bond turnover to issuance ratio. Trading in CAT-linked exchange–traded derivatives has been very low.[34] Low liquidity in CAT-linked securities may be explained by the absence of a true (electronic) trading platform open to any investor type. The CAT bond market is essentially an OTC market with dealers firms and other investors communicating by phone or via e-mails. Data providers like Bloomberg or Reuters do not disseminate any price or yield information on CAT bonds. As a result, the CAT-linked securitisation market has suffered from a lack of price transparency.

Transparency in the underlying market is also crucial to secondary market trading. While some sophisticated investors know that insurance companies' historical loss records may not be extremely helpful in understanding and quantifying the risk associated with future catastrophe perils, other investors, including individual investors, value depth and frequency of market information. The lack of standardisation in insurance companies' catastrophe risk exposure records throughout the U.S. industry and the absence of public disclosure of such information may be impairing secondary market trading in CAT-linked securities.

This report has previously noted that *(a)* only qualified or institutional investors have access to the CAT-linked securities market and *(b)* only investors with a high level of sophistication are likely to access the CAT-linked securities market and exchange-traded derivatives markets. However, facilitating access to the CAT-linked securities market to retail or individual investors (via secondary market trading or via mutual funds) may raise public policy issues, in light of investor protection objectives embedded in U.S. securities laws and in the recent *Markets in Financial Instruments Directive* in the European Union.

The assessment of risk in CAT-linked securities requires a high level of sophistication and an understanding of the nature and (non) predictability of catastrophe risks. Should

catastrophe risk end up in the hands of individual investors whose investment decisions may be based on more traditional risk/return assessment measures than the ones used in the context of CAT risks? Although CAT risks may be uncorrelated with other risks in an investor's portfolio, the nature of these risks makes measurement of the expected rate of return obscure simply because they are difficult to predict. Hence, it becomes difficult for an investor to distinguish an investment from a speculative plunge. The problem can become even more difficult when considering more than one CAT instrument because the nature of the instrument makes risk sensitive to spatial location as well as other characteristics that are not common in diversification decisions. These observations suggest that having an appropriate level of financial education and understanding of CAT risks is a pre-requisite for retail investor access to the CAT-linked securities market.

The current lack of trading activity in exchange-traded derivatives may be better explained by a more fundamental reason: in general, securitisation of markets starts with the development of standardised cash instruments (like CAT bonds). After liquidity occurs, derivatives are designed as tools to hedge exposure to the cash instruments. As noted above, to date there are few signs of standardisation in the CAT-linked security market. Each transaction is unique and cannot be standardised without significant basis risk. Consequently, there is no perfect easy hedging between the cash and derivative markets. This makes trading in the derivatives markets less attractive to potential holders of catastrophe bonds.[35]

Notes

1. GC Securities (2008), op. cit,, p. 26. According to Guy Carpenter, reinsurer-sponsored CAT bond transactions have typically outpaced insurer-sponsored transactions.
2. More details are provided, in Chapter 8.1. d).
3. In the aftermath of the collapse of Lehman in 2008, dedicated insurance-linked securities funds increased their market share, while generalist (multi-strategy) hedge funds reduced their participation, mostly through large redemptions.
4. Figures 4.1a and 4.1b are based on Swiss Re CAT bond placements.
5. The Swiss Re CAT bond performance index tracks the aggregate performance of USD denominated catastrophe bonds, The index captures all rated and unrated CAT bonds, outstanding perils, and triggers, and seeks to capture the universe of CAT bonds. The Swiss Re BB CAT bond performance index tracks the aggregate performance of USD denominated, BB-rated catastrophe bonds rated by Moody's and S&P.
6. See also Litzenberger, R. H., D. R. Beaglehole, et al. (1996).
7. See also Samuelson, P. A. (1967) and MacMinn, R. D. (1984).
8. "Pure" non-indemnity triggers in general do not achieve the desired effects in the corporate accounts (EBITA protection, elimination of earnings volatility due to mark-to-market measurement). However, some sort of dual trigger (non-indemnity trigger

enriched by indemnity element) could offer a viable solution in overcoming these potential regulatory obstacles.

9. The World Bank Treasury acted as arranger for the transaction, and appointed Swiss Re Capital Markets Corporation and Goldman Sachs as co-lead managers and joint bookrunners and Munich Re as advisor.

10. The term sheet is the following: Class A, size: 140 million US$, expected loss: 4.65%, rating (S&P): B, coupon: TMM*+1150 bps / Class B, size: 50 million US$, expected loss: 4.07%, rating (S&P): B, coupon: TMM*+1025 bps / Class C, size: 50 million US$, expected loss: 4.22%, rating (S&P): B, coupon: TMM*+1025 bps / Class D, size: 50 million US$, expected loss: 2.39%, rating (S&P): BB-, coupon: TMM*+1025 bps.

11. See Monti A. (2008), "Policy Approaches to the Financial Management of Large-Scale Disasters", in 'Financial Management of Large-Scale Catastrophes', op. cit.

12. It seems, however, that sidecars are popular structures in "hard" insurance markets and much less so in "soft" markets as evidenced by the dwindling amount of sidecar structures observed in 2007. Side cars are meant to provide temporary sources of risk capital that enable investors to profit from hard markets and then exit.

13. See http://www.perils.org.

14. AXA, Allianz, Groupama, Guy Carpenter, Munich Re, Partner Re, Swiss Re, Zurich.

15. Initially, PERILS will focus on European wind events for which total insured losses exceeded the threshold of EUR 200 million. Expansion into other geographies and insurance-relevant perils such as earthquake and flood are planned for the future.

16. GEM is a public/private partnership initiated and approved by the Global Science Forum of the OECD. GEM aims to be the uniform, independent standard to calculate and communicate earthquake risk worldwide; see http://www.globalquakemodel.org

17. Catastrophe Risk Evaluation and Standardizing Target Accumulations (CRESTA); see http://www.cresta.org

18. Doherty, N. A., G. M. F., et al. (2008), Managing Large-Scale Risks in a New Era of Catastrophes: Insuring, Mitigating and Financing Recovery from Natural Disasters in the United States, Wharton Risk Management and Decision Processes Center.

19. See GC Securities (2008), op. cit., p. 16.

20. See World Economic Forum (2008), op. cit., p. 23.

21. The volatility of reinsurance and retrocession prices impacts the market for CAT-linked securities. At larger volatility levels, the multiyear CAT bond gains a strategic advantage by providing coverage at a known price. Price stability in risk coverage enhances the insurer or reinsurer's ability to invest in new business or expand current business. This then allows the creation of value at an advantageous time that might not otherwise be possible. Equivalently, the CAT bond solves a corporate underinvestment problem: see Froot, K. A., D. S. Scharfstein, et al. (1993), Garven, J. R. and R. D. MacMinn (1993), and MacMinn, R. D. (2005). See also Helfenstein and Holzheu (2006) who argue that the multi-year nature of CAT bonds provides fixed-cost coverage over a multi-year period, while reinsurance premiums are much more sensitive to insurance cycles.

22. Often catastrophe reinsurance claims for peak perils coincide with times of industry distress, while CAT bond proceeds are invested in highly rated securities, thus reducing counterparty risk.

23. The terms "over-hedging" and "under-hedging" refer to the process of transacting a higher or lower number of derivative contracts than the number that would be necessary for a company to perfectly hedge its exposure. Over-hedging and under-hedging examples using catastrophe insurance options can be found in the CBOT PCS Catastrophe Options User's Guide (1995, p. 35-36).

24. In this respect, it is interesting to note that sometimes reinsurers act as intermediaries between the sponsor and the investors in a CAT-linked securities transaction, bridging the gap between their different trigger preferences. On the basis of its risk warehousing and risk assessment capacity, a reinsurer has the ability to transform an indemnity-based upstream risk transfer contract into non-indemnity based downstream Cat-linked securities and to manage the associated basis risk. Basis risk sensitive sponsors are thereby provided with an access to the CAT-linked securities market.

25. American Academy of Actuaries Index Securitization Task Force (1999), "Evaluating the Effectiveness of Index-Based Insurance Derivatives in Hedging Property/Casualty Insurance Transactions", American Academy of Actuaries.

26. See, for instance, Major, J. A. (1999). Also see Harrington, S. and G. Niehaus (1999).

27. A detailed discussion of the topic is beyond the scope of this report. An overview and discussion of the regulatory and accounting treatment of insurance-linked instruments can be found in Bouriaux (2001).

28. CAT-linked securities, insurance and reinsurance, and other ART instruments should receive a regulatory, accounting, and fiscal treatment based on their relative merits and risks. For instance, Bouriaux (2001) compares risk transfer alternatives offered by the capital and insurance markets based on the risks associated to each alternative: basis risk, credit risk, and collateralisation. She notes some inconsistencies in their accounting treatment. Generally, critics of a favourable accounting treatment for non-indemnity insurance-linked securities argue that, unlike reinsurance, these instruments do not achieve full transfer of risk partly because of the existence of basis risk and partly because of the partially funded nature of some of these transactions (i.e., exchange-traded derivatives). Bouriaux points out that (a) basis risk can be identified and quantified and (b) that, in some instances, reinsurance transactions can be less than fully collateralised and funded and yet, in the U.S., the NAIC grants them a favourable accounting treatment.

29. For example, in the U.K. the term 'fully funded' simply means that the ISPV's reinsurance liabilities must be capped at the value of the assets available to fund those liabilities. Moreover, there must be full subordination of the finance providers to the claims of the ceding insurer or other insurance creditor towards the ISPV. In Germany, the present value of the ISPV's assets must, at any time, be higher than the maximum potential claims of the ISPV arising under the underlying insurance risks. In order to meet such test, the ISPV may enter into hedging agreements. In France, ISPVs must be fully funded, i.e. at any time their maximum liabilities resulting from the underlying insurance risks, net of hedging agreements, must not exceed their assets. Moreover, ISPV investments are subject to quality tests, i.e., very high quality/liquid investments. Further, agreements entered into by ISPVs in order to

transfer insurance risks cannot impose unlimited commitments on the ISPVs. See Touraine H., European Insurance Securitisation Vehicle; Where do we Stand, What are the Issues?, Freshfields Bruckhaus Deringer LLP, November 2008.

30. The text of the Solvency II proposal adopted on 22 April 2009 expressly recognizes that: "(63b) Appropriate rules should be provided for special purpose vehicles which assume risks from insurance and reinsurance undertakings without being an insurance or reinsurance undertaking."

31. The new 'organisme de titrisation' – which is a revised, amended and enhanced evolution of the prior 'fonds commun de créances' (French securitisation vehicle) – can be created either as a co-ownership ('fonds commun de titrisation') or as a limited liability company ('société de titrisation').

32. "Under the new Solvency II framework, European insurance and reinsurance undertakings can use securitisation in the same way as they use reinsurance to meet their capital requirements which should have a positive effect on supply and facilitate the development of the insurance securitisation market. These techniques can be used to obtain commensurate solvency capital relief, provided that insurance undertakings can demonstrate that they understand the nature and limitations of such techniques, and provided that there is a real transfer of risk." See CEIOPS (2009), Insurance Linked Securities Report CEIOPS -DOC-17/09.

33. Solvency II will introduce economic risk-based solvency requirements across all EU Member States for the first time. These new solvency requirements will be more risk-sensitive, comprehensive (e.g., not focussed on the liability side of the balance sheet (insurance risks) but also the asset side, and consideration of other types of risks such as market, credit, and operational risks), and sophisticated than in the past, thus enabling a better coverage of the real risks run by any particular insurer. Solvency II requires states to permit the establishment of insurance special purpose vehices (Article 209) subject to prior supervisory approval, with the Commission expected to adopt implementing measures to ensure a harmonised EU approach. For further information, see: http://ec.europa.eu/internal_market/insurance/solvency/index_en.htm.

34. It is important to learn lessons from the CBOT's experience in the mid-nineties. While the CBOT offered a trading venue for its CAT-linked futures and options, the rigid membership structure of the exchange created a barrier to entry for the risk cedent (the insurer), leaving the product to be traded among members who may not have had a great expertise or interest in pricing insurance contracts. In addition, the CBOT open outcry trading venue was clearly inappropriate for such products. Some of these problems are alleviated now that derivatives exchanges have demutualised and now offer electronic trading platforms open to all investor types. Yet, the NYMEX and CME derivatives instruments show minimal trading volume. The IFEX futures contracts also show low liquidity, but the presence of two market makers (Deutsche Bank and Swiss Re) may help.

35. That said, it should be noted that the currently listed derivatives have been designed not as "traditional" tools to hedge price risk, but more like over-the-counter instruments. For instance, IFEX designed its binary options to replicate industry loss warrants. As a result, these contracts may never be heavily traded and their success or failure should be more accurately measured with statistics on open interest rather than on trading volume. Open interest refers to the number of exchange-traded derivatives contracts that are still "open", i.e. number of positions that have not yet been liquidated.

Chapter 9

Recommendations for Policy Makers

Based on the analysis in this report, and to the extent that they believe that the growth in CAT-linked securities markets should be encouraged, governments should consider acting, individually and collectively, on the following set of recommendations, namely:

9.1. Promote the collection and dissemination of high-quality data on CAT risks and losses according to harmonised criteria

a. Encourage a greater level of detail and harmonisation in the parametric data collected and made available by national meteorological, seismological, and hydrological agencies on catastrophe events.[1]

b. Encourage and sponsor national agencies of meteorology, hydrology, and seismology to install hazard monitoring equipment and recording systems able to capture the parameters of extreme events when they happen, at sufficient density of instrumentation and guarantee of recording that these readings can be employed for developing second-generation parametric trigger structures.[2]

c. Encourage a greater level of detail and harmonisation in the collection and dissemination of data concerning insurance market exposure to CAT risks.[3]

d. Assist in the creation and fostering of mechanisms as necessary to help track insurance industry losses resulting from a catastrophic event.

9.2. Promote transparency in the CAT-linked securities market

a. Promote public dissemination of offerings, prices, triggers, trading volumes and other information concerning transactions in both the primary and the secondary market for CAT-linked securities.[4]

9.3. Consider the opportunity to use CAT-linked securities to transfer a portion of the CAT risk currently borne by governments

a. Governments should examine and assess the appropriateness of using CAT-linked securities to transfer some of their CAT risk to capital markets.

b. Based on a cost-benefit analysis, governments of different countries should jointly evaluate the opportunity to securitise pooled risks within a region.

c. The evaluation of the costs and benefits of different capital market tools should be preceded by the clear identification of the specific policy objective pursued by the government (e.g., obtaining liquidity for emergency rescue and response measures in the aftermath of a catastrophe, covering the economic losses sustained by public assets and critical infrastructures as a result of a disaster).

9.4. Examine the accounting, solvency and prudential rules governing the CAT-linked securities market to remove any unnecessary impediments

a. The nature and extent of the risk transfer provided by CAT-linked securities must be carefully examined and assessed, in accordance with the principle of substance over form. Comparable levels of capital relief should, in principle, be allowed for comparable levels of risk transfer, irrespective of the legal form of the transaction and the amount of capital relief should reflect the amount of risk transferred.

b. The differences between an ISPV participating in a CAT-linked securities transaction and a traditional reinsurance undertaking should be clearly recognised and reflected in the applicable regulatory and solvency regime.

9.5. Encourage research on areas worthy of further investigation

a. The role of CAT-linked securities as diversification tools in asset portfolios requires more study. Further research is warranted as the market has greatly developed in the recent years, providing additional yield and return statistics. The impact of moral hazard on pricing indemnity-triggered CAT bonds, the quantification of basis risk in CAT-linked capital market structures, and the trade-off between basis risk and moral hazard all require further investigation. For instance, developing a methodology on how to structure CAT-linked securities in order reduce both basis risk and moral hazard would be valuable.

b. The development of securities to hedge basis risk should be studied. To date, in non-indemnity based CAT-linked securities, very few market participants are willing to take the basis risk away from the sponsor. Research on this topic may be valuable to firms seeking a "niche" in the CAT-linked securities market.

9.6. Encourage further education on CAT-linked securities

a. The demand and supply in the CAT-linked securities market depend on the education of potential professional investors and sponsors. The acquisition of the requisite education, i.e., knowledge to participate, in the market is one of the most important barriers to entry and so to growth.

b. An understanding of the CAT-linked securities market by governments and regulators is necessary for the establishment of an appropriate legal, regulatory, and tax framework for these securities.

Notes

1. Such structures, which may help to reduce basis risk, and are able provide settlement for a CAT-linked security within weeks of the occurrence of a catastrophe event would facilitate the expansion of CAT-linked security issuance especially in second tier and developing countries in which it will not be possible, to collect sufficient information on exposures and losses.

2. For tropical cyclone in all regions, this data should not only include the central pressure and maximum wind speed of the storm at regular (typically 6 hourly) intervals along the track but also parameters related to the size of the storm. For earthquakes, earthquake maps of strong ground motion (employing strong ground motion data) should be developed as well as intensity maps. For floods, floods maps of the extent, height of flooding, etc. should be developed for all principal areas affected. Standardising these outputs across different agencies would help provide a more universal currency for the exchange of parametric information on catastrophes.

3. The gathering, harmonisation, and public dissemination of insurance market exposure data are crucial to quantify basis risk inherent to capital market structures with payouts triggered by an industry loss index. The wider availability of industry insurance data, to the extent that it does not violate proprietary information, will help to bring confidence to using loss indices based on industry losses and also help insurers themselves understand the basis risk between their own losses and those of the whole market.

4. For instance, Goldman Sachs and Guy Carpenter keep historical records of CAT bond issuance and details about each offering, but Goldman Sachs' records remains proprietary. Guy Carpenter posts historical information on catastrophe bond issuance on its website, with some details on each offering, but does not provide price or trigger information.

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