

## **Role of Insurance in Mitigating Natural Catastrophic Risks**

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### **Abstract**

Scientific evidence indicates that a warming world will be accompanied by more changes in the intensity, duration, and frequency of climate and geological extremes. In recent decades, there has been a significant increase in natural hazards that have negatively affected the U.S. economy. Based on the response to recent hurricanes, the U.S. is not well enough prepared to deal with the financial management of large natural disasters. The main goal of this paper is to address the theory and practice for utilizing insurance as a supportive tool for mitigation of the negative financial effects associated with extreme natural events. Under this paper, the author reviews concepts pertaining to climate change and insurance for natural catastrophes. It is shown that a set of risk analysis and quantification problems make it difficult to design and implement realistic preparedness and response policies for catastrophes risk management at the regional, national, and international levels. Moreover, it is evident that the insurance industry fails to mitigate natural hazards because of the mismatch between the size of annual premiums and the size of maximum annual losses. Consequently, the author outlines the theoretical foundations for development of public policies that integrate both the financial and socioeconomic dimensions to effectively manage natural catastrophes. It is perceived that this approach provides ways for accurately deciding on who should be responsible for payment of insurance premiums and creating provisions of reinsurance for natural catastrophic risks. This should serve as a leading step towards integrated societal resilience in management and insurance for natural catastrophes.

### **Keywords**

Natural catastrophic risk, Insurance, Reinsurance, Public policy

### **1. Introduction**

The term "weather extremes" signifies individual weather events that are unusual in their occurrence and either lie in the upper/lower ten percentile of a suitable probability distribution or have a major destructive potential (CCSP, 2008). There are strong indications that humans are gradually but definitely changing the climate of the earth. Emissions from fossil fuels and greenhouse gases are altering the atmosphere, leading to an uncertain future of global warming (CCSP, 2008; Linnerooth-Bayer, 2000). The negative consequences of this changing atmosphere are even fostered by (1) the increasing concentration of population in high-risk zones; (2) the greater susceptibility of modern industrial societies to catastrophes; and (3) the accelerating deterioration of natural environmental conditions (Linnerooth-Bayer 2000; Brouwers *et al.*, 2001). As a result, the nature of catastrophic weather events has significantly changed where the number of natural catastrophes has risen by a factor of three throughout the time period from 1950 and the corresponding economic losses, after being adjusted for inflation, have risen by a factor of nine (Brouwers *et al.*, 2001).

In recent decades, there has been a significant increase in natural hazards that have negatively affected the U.S. economy. According to the National Association of Insurance Commission (NAIC, 2005), a list of such devastating catastrophes includes (1) Hurricane Hugo in 1989 which caused \$6.4 billion in insured losses in South Carolina; (2) Hurricane Andrew in 1992 that destroyed Florida, resulting in \$20.9 billion in insured losses; (3) the Northridge earthquake in 1994, which burdened insurers with \$15.9 billion in California; (4) the four Hurricanes Charlie, Ivan, Frances, and Jeanne in 2004, which caused \$21.9 billion of damages in Florida; (5) Hurricane Katrina in 2005 which resulted in insured loss estimates approaching \$46 billion; and (6) hurricanes Wilma and Rita in 2005 that caused estimated losses of \$7.2 billion and \$4.7 billion, respectively.

Scientific evidence indicates that a warming world will be accompanied by more changes in the intensity, duration, and frequency of climate and geological extremes (CCSP, 2008). The American International Group (AIG) which is the largest insurer in the U.S. issued a statement in 2006 that: “*climate change is increasingly recognized as an ongoing, significant global environmental problem with potential risks to the global economy and ecology, and to human health and well being*” (Kunreuther and Michel-Kerjan, 2007). Thus, the direct impact of extreme natural events on the U.S. economy is substantial.

## **2. Goal and Objectives**

The main goal of this paper is to address the theory and practice for utilizing insurance as a supportive tool for mitigation of the negative financial effects associated with extreme natural events. Under this paper, the author reviews concepts pertaining to climate change and insurance for natural catastrophes. Moreover, the author outlines the conceptual foundations for development of public policies that integrate both the financial and socioeconomic dimensions to effectively manage natural catastrophes. It is perceived that this approach provides ways for accurately deciding on who should be responsible for payment of insurance premiums and creating provisions of reinsurance for natural catastrophic risks. This should serve as a leading step towards integrated societal resilience in management and insurance for natural catastrophes.

## **3. Background Information**

### **3.1 Insurance for Natural Catastrophes**

Insurance does not decrease the global losses from an untoward event, but rather spreads its financial impact by enabling those at risk to pay a relatively small premium so that they can be protected against a large loss that has a small chance of occurring (Kunreuther and Pauly, 2006). Kunreuther and Michel-Kerjan (2007) investigated factors to determine the insurability of a risk as well as the extent of coverage offered by the private sector to provide protection against extreme events when there is significant uncertainty surrounding the probability and consequences of a catastrophic loss. Two conditions must be met before insurance providers are willing to offer coverage against an uncertain event: the first is that the provider must be able to identify, quantify, and estimate the chances of the event occurring and the extent of losses likely to be incurred and the second condition is that the insurer must be able to set premiums for each potential customer or class of customers (Kunreuther *et al.*, 2007). Insurance does not cover climate change, but does cover a series of pre-specified perils and causes, some of which could occur as a result of climate change or be affected by it (Kunreuther and Michel-Kerjan, 2007). Botzen and Van Den Bergh (2008) state that social welfare improves when insurance companies take responsibility with government for part of the risks associated with climate change.

The insurance industry fails to mitigate natural hazards because of the mismatch between the size of annual premiums and the size of maximum annual losses (Jaffee and Russell, 1997). An obligatory

homeowner's insurance policy will not radically change this situation because most mortgage agreements stipulate wind and flood insurance; however, it will still diversify risk and reduce the likelihood of liberal disaster assistance in a better manner (Kunreuther and Michel-Kerjan, 2007). Jaffee *et al.*, (2008) suggested long-term insurance (LTI) as an alternative to the standard annual homeowners policy using principles of mortgage market as a benchmark to increase social welfare by reducing insurers' administrative costs, lower search costs and uncertainty for consumers, and provide incentives for long-term investment in mitigation measures to protect property. In order to increase funds in insurance markets, Lewis and Murdock (1996) solves the problem of viability through federal reinsurance that is based on the auctioning of multiple peril catastrophe call spread options that cover industry losses. Another way to increase viability of insurance companies to hazards insurance is through accumulating their own capital using retained earnings, specially designed capital market instruments, and by capital provided through government programs (Jaffee and Russell, 1997). Also, Michel-Kerjan and Morlaye (2008) suggest employment of insurance-linked securities (ILS) instead of insurance and reinsurance for management of catastrophic risks.

Kunreuther *et al.*, (2007) state that because insurance policies are usually renewed annually, insurers are faced with the problem of how to set premiums and what coverage to offer in the coming year. This can be a difficult challenge, given the inability to distinguish between random weather patterns and systematic changes in climate in the short run (Kunreuther and Michel-Kerjan, 2007 and Kleindorfer and Kunreuther 1999). Moreover, the analysis of insurability would not be complete without considering all parties associated with the environment in which insurers make decisions including: reinsurers, insurance commissioners, rating agencies, modeling firms, and investors. This integrated look helps decision makers to decide whether to provide coverage against certain risks and, if so, how much to offer and what price to charge (Kunreuther *et al.*, 1995; Kunreuther *et al.*, 2007). All of the aforementioned difficulties are coupled with the usual insurance problems of adverse selection and moral hazards (Doherty, 2000).

#### **4. Proposed Public Policy Strategies Framework for Catastrophes Management**

It is perceived that the insurance industry can make a significant positive impact in financial relief of natural disasters through reducing exposure to losses and mitigating potential damages (Kunreuther, 1999). To achieve this, it is essential to develop integrated public policy strategies that meet and exceed expectations by avoiding many of the pitfalls that have been observed following recent catastrophic events. These strategies should be subsidized by government, insurance/reinsurance companies, and property owners, and should be tailored to the logistic, environmental, and financial conditions in locations that are prone to natural hazards (Kunreuther, 2006-a; Kunreuther and Michel-Kerjan, 2007; Botzen and Van Den Bergh, 2008). The development of such strategies is a highly complex and dynamic problem due to the need to incorporate different stakeholders, the insufficiency of historic data for predicting extreme natural events, and the large degree of uncertainty underlying the occurrence and consequences of natural catastrophes (Ermolieva *et al.*, 2001). In fact, as a result of this inherent uncertainty and complexity, natural hazards do not cyclically repeat themselves (Linnerooth-Bayer, 2000). The situation is further aggravated by the current technical advancements that constantly change the physical and economical landscape making knowledge about catastrophic management unreliable (Kunreuther, 2006-b). Also, an important social aspect of the problem is that people who did not witness previous experiences underestimate the negative affect evoked by natural catastrophic risks, which demotivates any mitigation behavior (Kunreuther, 1996; Kunreuther and Roth, 1998; Siegrist and Gutscher, 2008). The aforementioned risk analysis and quantification problems make it difficult to design and implement realistic preparedness and response policies for catastrophes risk management at the regional, national, and international levels.

A successful strategy for catastrophe insurance should decide on (1) what can and cannot be done as a function of the nature of the risk; (2) the type of coverage provided by the insurer; and (3) the premium

structure (Jaffee *et al.*, 2008). Thompson (1990) and Pahl-Wostl (2002) indicate the three views that should be represented in any public managerial policy for insurance are (1) *state protectionism* where there is extensive government post disaster relief that is combined with voluntary cross-subsidized insurance; (2) *individual responsibility* where the government compensates victims by an amount other than state protectionism and an additional risk-based insurance is introduced; and (3) *holistic development* where the role of private insurers is reduced and a governmental disaster fund is financed by mandatory flat-rate contributions from property owners, and the government subsidizes insurance premiums for low income households. Thus, the stakeholders associated with the management of natural catastrophic risks would usually include government, insurance/reinsurance companies, and property owners.

Daniels *et al.*, (2006) highlights that the basic principles in any effective hazard management strategies should consider (1) *equal treatment* where all beneficiaries should be treated equally; (2) *risk analysis* where public and private organizations should consider the likelihood of disasters in developing emergency plans; (3) *cost-benefit analysis* where public and private organizations should assess costs and benefits of alternative policies; (4) *samaritan's dilemma* where there will be fewer economic incentives for those in hazard-prone areas to reduce their risks because they assume that the federal government will always provide significant assistance; (5) *uninsured losses* where policies that implicitly anticipate high rates of uninsured losses should not be tolerated unless one public sector will respond with financial assistance; (6) *assisting low income residents* where subsidies should be provided to low income residents in hazard-prone areas; (7) *mitigation measures* where disaster management programs should encourage those at risk to adopt mitigation measures; (8) *loss distribution* where the disaster management strategy must consider who is most likely to suffer losses and how the costs are distributed; (9) *relocation of residents* where policy makers need to consider the economic, psychological, and social effects on disaster victims; and (10) *governance* where policy makers should devise effective public policies that avoid creating large bureaucracies, establishing complex programs, or incurring excessive costs.

Also, Michel-Kerjan (2008) and Kunreuther *et al.*, (2007) stated two guiding principles for any effective policy for reducing future disaster losses:

- *Risk-based premiums* where insurance premiums (whether public or private coverage) should, to the extent possible, reflect the underlying risk associated with the events against which coverage is bought in order to provide a clear signal to individuals and businesses of the dangers they face when locating in hazard-prone areas and encourage them to engage in cost-effective mitigation measures to reduce their vulnerability to disasters;
- *Integrating affordability issues* where any special treatment given to lower income residents in hazard-prone areas who cannot afford the cost of living in those locations should come from general public funding and not through insurance premium subsidies.

Based on the aforementioned financial and socioeconomic guidelines, this long term research project makes case for the need to develop series of public policy strategies for catastrophes risk management. It is expected that the developed policies will decide on the financial responsibility for insurance premiums and will create provisions of reinsurance for natural catastrophic risks, which serves as a leading step towards integrated societal resilience in management and insurance for natural catastrophes.

## **5. Conclusions and Future Work**

Pursuant to this study, it is shown that a set of risk analysis and quantification problems make it difficult to design and implement realistic preparedness and response policies for catastrophes risk management at the regional, national, and international levels. Moreover, it is evident that the insurance industry fails to

mitigate natural hazards because of the mismatch between the size of annual premiums and the size of maximum annual losses.

This paper presented the conceptual foundations for development of public policies that integrate both the financial and socioeconomic dimensions to effectively manage natural catastrophes. It is perceived that this approach provides ways for accurately deciding on who should be responsible for payment of insurance premiums and creating provisions of reinsurance for natural catastrophic risks. This should serve as a leading step towards integrated societal resilience in management and insurance for natural catastrophes.

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