

Chapter 1 – Introduction: Needs, Stakeholders, and Government Initiatives

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1.1 Need to Manage Risk

The problem of preparing for a natural disaster is not a new one. Around the world and particularly in the more-developed countries, governments, individuals and corporations know they should prepare for a "big earthquake" or a "large hurricane" or an "extensive flood." Yet, they often do not take the necessary steps to prepare for a disaster. Only after a disaster occurs do they recognize the importance of preparing for these types of extreme events.

A major earthquake or hurricane can result in loss of life and serious damage to buildings and their contents. Bridges and roads can be damaged and closed for repair over long periods of time. Disaster victims may need to be relocated to temporary shelters or reside with friends or relatives for days or weeks. Businesses may have their activities interrupted due to facility damage or lack of utility service. For some businesses, this may result in insolvency. In August and September 2004, these challenges were obvious when Florida and other states as far north as New Jersey and Pennsylvania were deluged by Hurricanes Charley, Frances, Ivan, and Jeanne.

The need to prepare for these types of extreme events is evident when evaluating the economic consequences of natural disasters. Figure 1.1(a) and Figure 1.1(b) depict the losses due to great natural catastrophes from 1950 to 2002 throughout the world. A great natural catastrophe is defined as one where the affected region is "distinctly overtaxed, making interregional or international assistance necessary. This is usually the case when thousands of people are killed, hundreds of thousands are made homeless, or when a country suffers substantial economic losses, depending on the economic circumstances generally prevailing in that country" (Munich Re, 2002). These

figures include data on the overall economic and insured losses worldwide (in 2002 dollars) from earthquakes, floods, windstorms, volcanic eruptions, droughts, heat waves, freezes, and cold waves.

Figure 1.1(a) suggests a good deal of variation in losses with time. The figure illustrates that in certain years, such as 1976, 1988, 1995, and 1999, there are peaks in the amount of loss. Furthermore, the amplitude of the peaks seems to be increasing over time. This trend is expected to continue as higher concentrations of population and built environment develop in areas susceptible to natural hazards worldwide. Additionally, worldwide losses during the 1990's exceeded \$40 billion dollars each year with the exception of 1997. Losses were as high as \$170 billion in 1995, primarily due to the large-scale earthquake that destroyed portions of Kobe in Japan in January of that year. Insured losses matched this growth during the same timeframe.

The volatility and trend in losses can be seen in the United States as well. Figure 1.2(a) and Figure 1.2(b) show the economic and insured losses from significant United States catastrophes from 1950 through 2002 with losses adjusted to 2002 dollars. U.S. catastrophes are deemed significant when there is an adjusted economic loss of at least \$1 billion and/or over 50 deaths attributed to the event (American Re, 2002).

There are peaks in losses due to catastrophic events, as in worldwide losses (most prominently in 1989, 1992, and 1994), and the upward trend over the past 50 years is evident when broken down by decade, as seen in Figure 1.2(b). The losses from individual disasters during the past 15 years are an order of magnitude above what they were over the previous 35 years. Furthermore, prior to Hurricane Hugo in 1989, the insurance industry in the United States had never suffered a loss of over \$1 billion from a single disaster. Since 1989, numerous disasters have exceeded \$1 billion in insured losses. Hurricane Andrew devastated the coastal areas of southern Florida in August 1992, as well as damaging parts of south-central Louisiana causing \$15.5 billion in insured losses. Similarly, on the west coast of the United States, insured losses from the Northridge earthquake of January 1994 amounted to \$12.5 billion.

Residential and commercial development along coastlines and areas with high seismic hazard indicate that the potential for large insured losses in the future is substantial. The ten largest insured property losses in the United States, including the loss from 9/11, are tabulated in Table 1.1 adjusted to 2001 dollars (Insurance Information Institute, 2001). The increasing trend for catastrophe losses over the last two decades provides compelling evidence for the need to manage risks both on a national, as well as on a global scale.

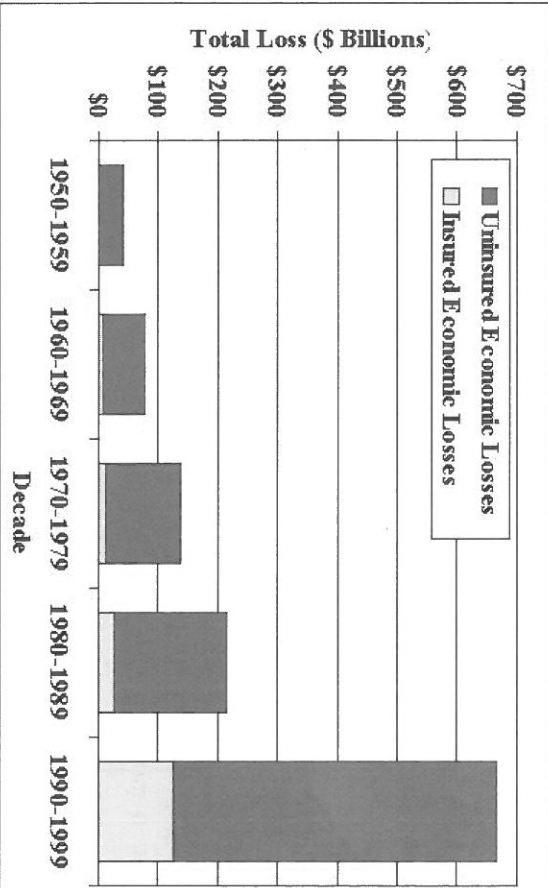
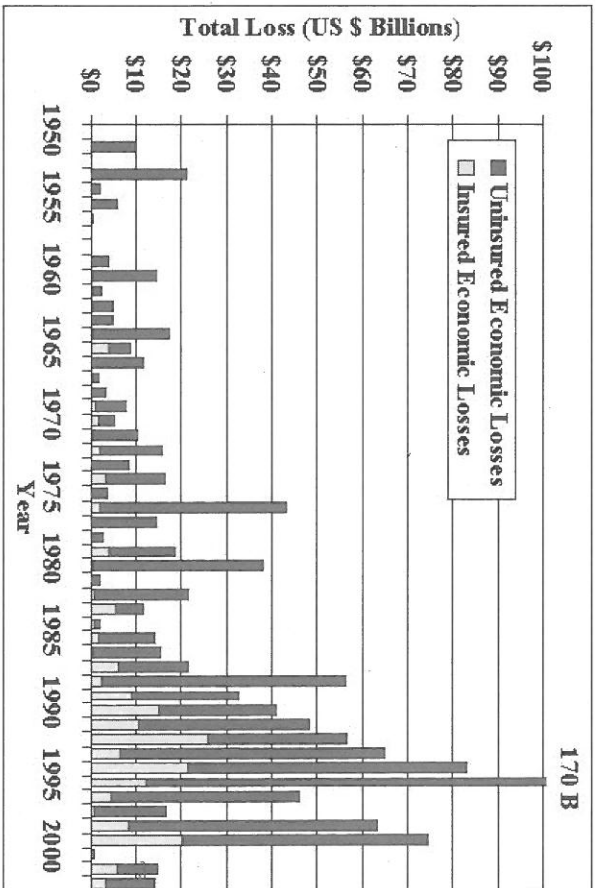


Figure 1.1. Losses due to great natural catastrophes worldwide: (a) by year; and (b) by decade (developed by the Geoscience Division of Munich Re).

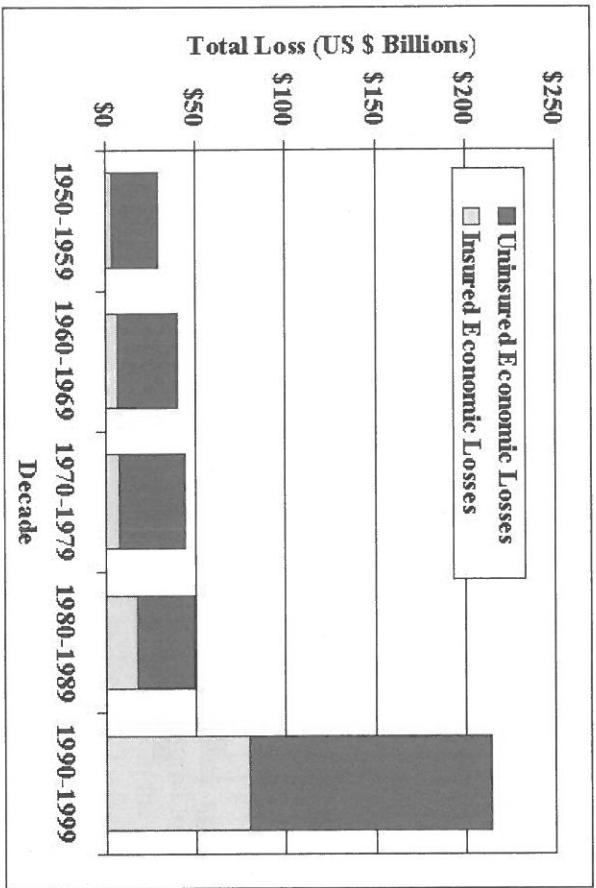
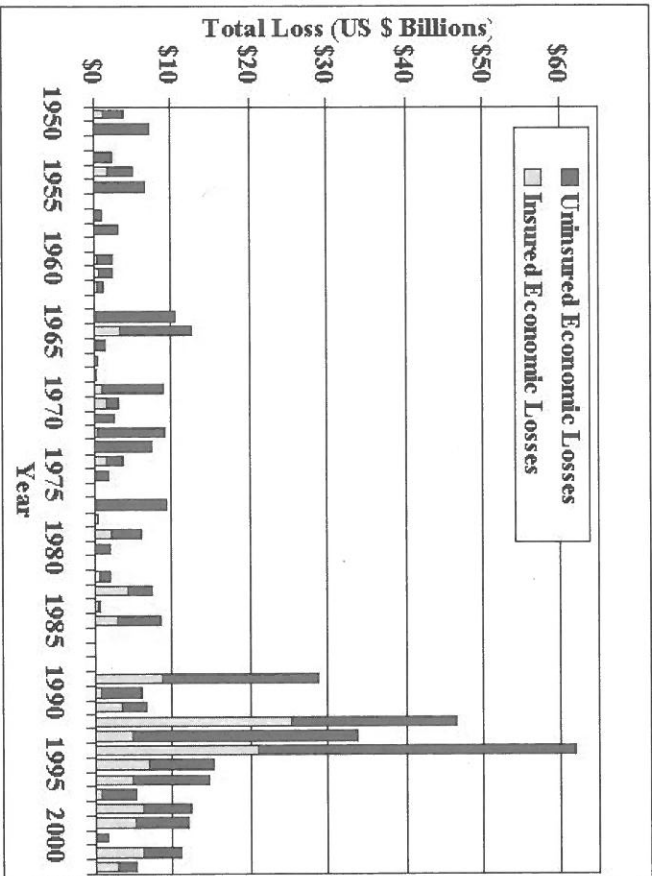


Figure 1.2. Losses due to significant U. S. natural catastrophes: (a) by year; and (b) by decade (developed by the Geoscience Division of American Re).

Table 1.1. Top 10 U.S. insured property losses (US \$ billions)

| Event | Dollars at year of occurrence | 2001 dollars |
|-------------------------------|-------------------------------|---------------------|
| World Trade Center (2001) | \$20.3 | \$20.3 ¹ |
| Hurricane Andrew (1992) | \$15.5 | \$19.6 |
| Northridge Earthquake (1994) | \$12.5 | \$14.9 |
| Hurricane Hugo (1989) | \$4.2 | \$6.0 |
| Hurricane Georges (1998) | \$2.9 | \$3.2 |
| Tropical Storm Allison (2001) | \$2.5 | \$2.5 |
| Hurricane Opal (1995) | \$2.1 | \$2.4 |
| Hurricane Floyd (1999) | \$2.0 | \$2.1 |
| 20-state winter storm (1993) | \$1.8 | \$2.1 |
| Oakland Firestorm (1991) | \$1.7 | \$2.2 |

(Source: Insurance Information Institute)

1.2 Private Sector Stakeholders in the Management of Risk

The magnitude of economic and insured losses from natural disasters raises various questions. Who are the individuals affected by these events? What options are available to them to assess their risk? What factors influence their choices for dealing with these risks and actively managing their risk? By examining the perspectives of these individuals and groups, one can develop more effective risk management strategies for reducing potential losses from such disasters.

Figure 1.3 illustrates the key stakeholders in the management of risk that are discussed in this book. Each of the stakeholders' goals and perceptions of the risk lead them to view natural hazards from a unique perspective.

At the bottom of the pyramid are the property owners who are the primary victims of losses from natural disasters. They have to bear the brunt of the losses unless they take steps to protect themselves by mitigating or transferring some of the risk. Insurers form the next layer of the pyramid. They offer coverage to property owners against losses from natural disasters. Insurers themselves are concerned with the possibility of large claim payments from a catastrophe and turn to reinsurers, the next layer of the

¹ Some major claims are still in dispute; this does not include liability claims. Total insured losses due to the 9/11 attacks (including liability) are estimated around \$35 billion as of July, 2004.

pyramid, to transfer some of their risk. At the top of the pyramid are the capital markets, which in recent years have provided financial protection to both insurers and reinsurers through financial instruments, such as catastrophe bonds. Of course, there are exceptions to this pyramid structure. For example, there have been two catastrophe bond issues (Concentric Re, covering Tokyo Disneyland, and Studio Re, covering Universal Studios) that offered direct protection to these property owners in place of traditional insurance arrangements.

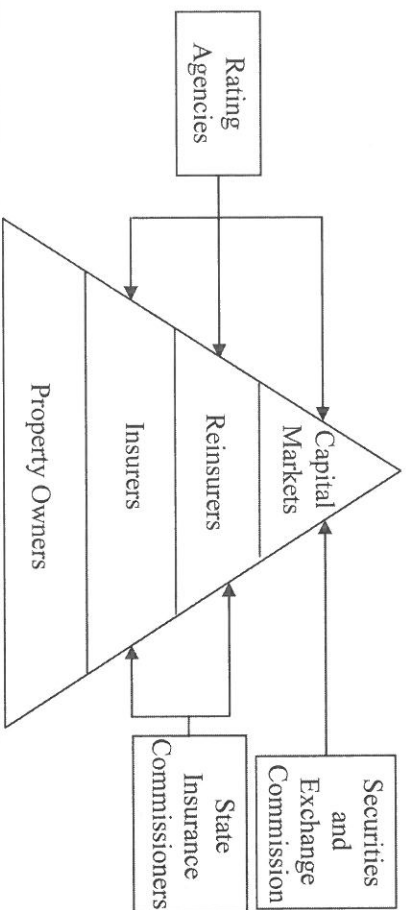


Figure 1.3. Key private sector stakeholders in the management of risk

The insurance rating agencies and state insurance commissioners are the two institutions that regulate the insurance industry. Rating agencies provide independent evaluations of the financial stability of the insurers and reinsurers. State insurance commissioners are primarily concerned that the rates charged by insurers are fair and that insurers in the market will remain solvent following a disaster. The Securities and Exchange Commission (SEC) regulates capital markets and catastrophe bonds and are given bond ratings by organizations such as Fitch, Moody's Investor Service, and Standard & Poor's.

In the following sections, risk management strategies are discussed from the perspective of each stakeholder in the pyramid.

1.2.1 Property Owners

Owners of commercial and residential structures have a range of risk management strategies from which to choose. They can reduce their risk by retrofitting a structure to withstand wind or earthquake loading, transfer part of their risk by purchasing some form of insurance, and/or keep and finance their risk.

The ways in which particular individuals decide to manage risk is often a function of their perceptions. Despite a front-line position in facing the

financial impacts of natural disasters, the average homeowner is one of the least active stakeholders in the process. For most, the choices are whether or not to buy insurance – if this is an option – and whether to take actions that would make their home more resistant to damage. Many homeowners do not take action even when the risk is abundantly clear and loss-reducing measures are available. It is often the case that these homeowners feel that a disaster will not affect them.

A commercial property owner's risk perception and strategies to manage risk are different from those of residential owners. A commercial establishment must concern itself not only with life safety and insolvency issues, but also with the impact of a natural hazard on the operation of its business. Often, there are extra expenses as a business tries to remain viable after a catastrophe. The company is concerned about business interruption loss – the loss or reduction of income due to the suspension of operations resulting from a natural disaster. Business owners in hazard-prone regions are normally quite interested in purchasing coverage against this type of risk.

1.2.2 Insurers

An insurer provides protection to residential and commercial property owners for losses resulting from natural disasters. Losses due to damage from fires (resulting from lightning during thunderstorms) and wind (resulting from tornadoes and hurricanes) are covered by a homeowner's insurance policy, normally required by lenders as a condition for a mortgage. In the U.S., loss due to water damage (resulting from floods) is covered under the National Flood Insurance Program (NFIP), a public-private partnership between the government and the insurance industry established in 1968. Losses due to damage from ground movement (resulting from earthquakes and landslides) are covered by a policy endorsement or by a separate policy. This separate policy is issued either by the private sector or, in California, through a state-run, privately funded earthquake insurance company, the California Earthquake Authority (CEA) that was created in 1996.

Losses from natural disasters can have a severe impact on an insurer's financial condition. Insurers, therefore, want to limit the amount of coverage they provide to property owners in hazard-prone areas. An important concern for insurers is the concentration of risk. Those who cover a large number of properties in a single geographic area face the possibility of large losses should a natural disaster occur in the area. An insurer views a portfolio with this type of highly correlated (or interrelated) risks as undesirable. Subject to regulatory restrictions, an insurer limits coverage in any given area and/or charges higher premiums in order to keep the chances of insolvency at an acceptable level.

1.2.3 Reinsurers

Reinsurers provide protection to private insurers in much the same way that insurers provide coverage to residential and commercial property owners. They traditionally supply indemnity contracts against unforeseen or extraordinary losses. In this type of arrangement, the reinsurer charges a premium in return for providing another insurance company with funds to cover a stated portion of the losses it may sustain. Most insurers, especially smaller or geographically concentrated firms, purchase reinsurance for covering natural hazard losses. Indeed, the failure to do so will likely adversely affect their financial rating and/or attract the attention of insurance regulators.

Similar to insurers, reinsurers concern themselves with concentration of risk. Hence, they too limit their exposure in catastrophe-prone areas to keep the chances of insolvency at an acceptable level. One way they achieve this is to pool the risks of several different insurers who have independent exposures in different high hazard regions. Thus, a reinsurer could take on Insurer A's hurricane risk in Florida, Insurer B's earthquake risk in California and Insurer C's earthquake risk in Tokyo, Japan. By diversifying across a number of regions and risks, the reinsurer is able to collect sufficient premiums to cover relatively large losses from a single disaster while at the same time reducing the likelihood of a catastrophic loss.

1.2.4 Capital Markets

The capital markets have recently emerged as a complement to reinsurance for covering large losses from disasters through new financial instruments known as catastrophe bonds (see Chapter 9). Several factors have led to this development. The shortage of reinsurance following Hurricane Andrew and the Northridge earthquake made it possible for insurers to offer bonds with interest rates high enough to attract capital from investors. In addition, the prospect of an investment uncorrelated with the stock market or general economic conditions is attractive to capital market investors. Finally, catastrophe models have emerged as a tool for more rigorous estimates of loss, so that disaster risk can be more accurately quantified than in the past.

Catastrophe bonds enable an insurer or reinsurer to access needed funds following a disaster. If the losses exceed a trigger amount, then the interest on the bond, the principal, or both, are forgiven. To justify the risks of losing their principal and/or interest, capital market investors demand a large enough risk-adjusted return to invest in these bonds. These investors include hedge fund managers, pension fund managers, insurers, and others, who concern themselves with the impact of the investment on their portfolio. In turn, the institutions that issue catastrophe bonds worry about their reputation should a major disaster negatively impact their investors' return.

1.2.5 Rating Agencies

Rating agencies, such as A.M. Best Company, Standard & Poor's, Moody's Investors Service, and Fitch, provide independent evaluations of reinsurers' and insurers' financial stability and their ability to meet their obligations to policyholders. The rating assigned to an insurer has significant consequences on how they do business. Many states have minimum rating requirements for an insurer to write business in their territory; similarly, insurers are less willing to cede risk to a poorly rated reinsurer. A poor rating has an impact on the premium a company can charge or the coverage it can sell, and is likely to have a negative effect on the share price of publicly traded firms.

A.M. Best Company, for example, assigns ratings through a quantitative analysis of a company's balance sheet strength, operating performance, and business profile (A.M. Best, 2001). Since at least 1997, A.M. Best Company has required insurance companies to complete a rating questionnaire that includes information on catastrophe exposures. Catastrophes play a significant role in evaluating a company's exposure, since these events could threaten the solvency of a company. Modeled loss results at specified return periods (100-year windstorm and 250-year earthquake), and the associated reinsurance programs to cover them, are important components of the rating questionnaire. A.M. Best Company's approach has been an important step forward in the incorporation of catastrophe risk into a company's capital adequacy requirements.

Investors also rely on the evaluations of catastrophe bonds by those rating agencies. These firms evaluate the quality of the risk analysis used in support of the issuance of a bond and require a variety of stress tests to check the sensitivity of the modeled losses. The resulting ratings influence the marketability and the price of a catastrophe bond. In addition, the rating can limit the potential buyer pool since some institutional investors will not participate in bonds with an unacceptable rating.

1.2.6 State Insurance Commissioners

In the United States, insurance is regulated at the state level with the principal regulatory authority residing with insurance commissioners. For insurers, two important and somewhat conflicting goals of this regulation are solvency regulation and rate regulation. Reinsurers are subject to the solvency regulation; however, they are not subject to rate regulation. Solvency regulation addresses the same concerns as rating evaluation: Is the insurer sufficiently capitalized to fulfill its obligations to its policyholders if a significant event occurs? A primary concern is the authorized control level of risk-based capital, the minimum amount of capital required below which the state has the authority to take action against the company.

Rate or market regulation attempts to ensure fair and reasonable

insurance prices, products, and trade practices. Rate regulation focuses on whether insurance rates are equitable and nondiscriminatory. In all states, insurance companies are required to obtain a certificate of authority or license to underwrite policies. A license bureau provides a screening that in principle should protect the public from economic loss caused by misrepresentation, dishonesty, and incompetence of individuals seeking to sell insurance.

Solvency and rate regulation are closely related and must be coordinated to achieve their specific objectives. Regulation of rates and market practices will affect insurers' financial performance; solvency regulation ensures adequate capital. In this regard, the regulator plays a vital role in ensuring that a viable insurance market is functioning with coverage offered to consumers at affordable prices.

1.2.7 Other Stakeholders

Lenders play an essential role in managing natural disaster risk. Except for the uncommon case in which the owner pays for property outright, banks and other financial institutions enable individuals in the United States to purchase a home or business by providing mortgages. The property is the collateral in the event that the owner defaults on the mortgage.

Lenders thus have a vital stake in the risk management process, as they are unlikely to recover the full value of a loan on a piece of property destroyed by catastrophe. The 1994 Northridge earthquake, for example, generated \$200-\$400 million in mortgage-related losses in the Los Angeles area (Shah and Rosenbaum, 1996). Following Northridge, Freddie Mac experienced an unprecedented number of earthquake-related defaults on condominiums. As a consequence, the company retained a risk modeling firm to develop underwriting criteria that would identify high risk areas. Buyers of condominiums in these areas seeking a mortgage would then be required to buy earthquake insurance (Lehman, 1996). Interestingly enough, in 1996, the California State Legislature sought to bar this requirement, citing an undue burden on condominium owners. As a result, Freddie Mac changed its policy to require that a condominium buyer (a) purchase earthquake insurance; (b) purchase a property located in a low-risk area; or (c) pay an additional fee with the mortgage loan.

Real estate agents, developers, engineers, contractors, and other service providers also play a supporting, yet important role in the management of risk from natural disasters. In hazard-prone regions, federal or state regulations require real estate agents to inform the new owner of potential hazards. Examples include the location of a home relative to an earthquake fault line or within a 100-year flood plain. Unfortunately, it is sometimes unclear how information on natural hazard risk is being used in the purchase process. One study showed that despite the California requirement that purchasers of residential property within a certain distance of a known

earthquake fault be told about the hazard, most home buyers did not understand or recall the risk warning (Palm, 1981).

Engineers and contractors can aid in the management of risk in high hazard areas. For example, structures designed and built to high standards, with inspections by reputable building officials during construction, provide good protection against life and property loss in the next earthquake or hurricane. Life and property loss are often attributable to inadequate design and construction practices. The problem of building and selling property in hazard-prone regions is exacerbated when disreputable building contractors bypass costly wind and seismic-resistant designs.

1.3 Government's Role in Management of Risk

Federal, state and local government often take the lead in managing risk from natural disasters. Policy makers at all levels of government have developed a set of programs for reducing risks from these disasters. In addition, they prioritize funding following a severe earthquake, flood, tornado, or other extreme event.

1.3.1 Types of Programs

Federal Level

At the national level, the Federal Emergency Management Agency (FEMA) coordinates many of the planning and response aspects related to catastrophes. Although specific programs come and go, FEMA has historically taken the lead in developing strategies for mitigation. For example, in December 1995, the agency introduced a National Mitigation Strategy with the objective of strengthening partnerships between all levels of government and the private sector to ensure safer communities.

This strategy was developed with input from state and local officials as well as individuals and organizations with expertise in hazard mitigation (FEMA, 1997). One of its key features was to create disaster-resistant communities through the Project Impact program. The program, begun in 1997, encouraged communities to "bring interested parties together to identify their potential natural hazards, assess the community's vulnerability, prioritize hazard risk reduction measures and communicate success to the residents" (FEMA, 2000). In 2001, over 250 communities participated in Project Impact.

Federal legislation that promotes natural disaster mitigation is another way to manage catastrophe risk. The Earthquake Loss Reduction Act of 2001 (HR.2762/S.424) and the Disaster Mitigation Act of 2000 (Public Law 106-380) are two such examples. The Disaster Mitigation Act, the latest amendment to the Robert T. Stafford Disaster Relief and Emergency Assistance Act, seeks to reduce losses to publicly owned buildings following

disasters. While the federal government still provides funds to cover the majority of the cost to repair public facilities in the event of a disaster, there is a clause in the Disaster Mitigation Act of 2000 noting that the "President shall promulgate regulations to reduce the Federal share of assistance" if the eligible facility "has been damaged, on more than one occasion within the preceding 10-year-period, by the same type of event; and the owner of which has failed to implement appropriate mitigation measures to address the hazard that caused the damage to the facility." The message from the federal government is clear: local and state government officials are encouraged to mitigate.

The Earthquake Loss Reduction Act of 2001 takes a different approach to encourage mitigation. The legislation aims to "provide a number of incentives, including grants and tax credits, in order to encourage responsible state and local governments, individuals, and businesses to invest in damage prevention measures before an earthquake strikes" (Feinstein Press Release, March, 2001). As of May 2004, the Senate finance committee was still reviewing this legislation. Due to the concern of the federal government over terrorism risk, this legislation may not have the priority it had prior to 9/11.

The federal government also provides financial assistance to natural disaster victims through the Small Business Administration's (SBA) Disaster Loan Program. Over the years, the SBA has provided loans and sometimes forgiveness grants to cover homeowner and business losses from natural disasters. During the period between the Alaska Earthquake of 1964 and Tropical Storm Agnes in June 1972, the SBA was very generous in the type of disaster relief it provided. For example, those suffering uninsured losses after Agnes were eligible to receive \$5,000 forgiveness grants and 30-year loans at 1% interest. In recent years, the SBA has not been as generous; disaster loans in 2003 were offered at interest rates just slightly below the existing market rate.

State Level

At the state level, an office of emergency services or a department of public safety promotes natural disaster preparedness. Additionally, seismic safety commissions have been established by earthquake-prone states to prioritize earthquake research and public policy needs. Building codes that include criteria for wind or earthquake resistance and legislation for land use management endeavor to reduce risk.

Incentive programs have been instituted to reduce losses from disaster events, especially in hazard-prone states. A good example of such legislation is California's Proposition 127. Passed in November of 1990, the law states that seismic retrofits to property completed on or after January 1, 1991, and completed on or before July 1, 2000, will not increase the property tax for a

homeowner until ownership changes. The state concluded that these improvements constitute such a significant reduction in the risks to life and safety, that they should be exempt from additional property tax.

Local Level

At the local level, communities enforce building codes and have developed economic incentives, such as tax relief, for those who retrofit. Local communities have developed programs to promote awareness, provide training, and encourage self-help actions through neighborhood emergency response teams. For example, the city of San Leandro, California has set priorities to retrofit both unreinforced masonry buildings (URMs) and older wood-frame homes. The Home Earthquake Strengthening Program is a comprehensive, residential seismic strengthening program that provides homeowners with simple and cost-effective methods for strengthening their wood-frame houses for earthquake survival. The program includes earthquake-strengthening workshops for residents, a list of available earthquake contractors, as well as a tool-lending library for homeowners should they wish to do the work themselves.

Table 1.2 provides a set of examples of leadership activities at the different levels of government: for defining and prioritizing risks, for alleviating risks through legislative means, and for encouraging reduction of earthquake risk. These programs bring together diverse groups of people around a common issue, and provide needed encouragement and resources.²

1.3.2 Federal Disaster Insurance

The federal and state governments in the United States now play a major role in supplementing or replacing private insurance with respect to floods, hurricanes, and earthquakes. This coverage is limited to certain key stakeholders, mainly residential property owners.

Flood Insurance

Insurers have experimented over the years with providing protection against water damage from floods, hurricanes and other storms. After the severe Mississippi Floods of 1927, they concluded that the risk was too great. With the need for this type of coverage evident, Congress created the National Flood Insurance Program (NFIP) in 1968, whereby homes and businesses could purchase coverage for water damage. The stipulation for this financial protection was that the local community make a commitment to regulate the location and design of future floodplain construction to increase safety from

² See Grossi and Kunreuther (2000) for more details on earthquake programs and Moss (2002, Chapter 9) for a more general discussion of the role of the public sector in providing disaster assistance.

flood hazards. The federal government established a series of building and development standards for floodplain construction to serve as minimum requirements for participation in the program.

Table 1.2. Government leadership in managing earthquake risk (Grossi and Kunneuhert, 2000)

| | Define and Prioritize Risk | Legislation to Alleviate Risk | Encourage Risk Reduction |
|---------------------------|--|---|--|
| Federal Government | National Earthquake Hazards Reduction Program (NEHRP) | Robert T. Stafford Disaster Relief and Emergency Assistance Act | Federal Emergency Management Agency's Project Impact |
| State Government | State Seismic Safety Commissions California Earthquake Hazards Reduction Act | California Unreinforced Masonry Building Law | California Proposition 127 |
| Local Government | Home Earthquake Strengthening Program (San Leandro, CA) | Earthquake Hazard Reduction Ordinance (Los Angeles, CA) | Tax Transfer Rebate (Berkeley, CA) |

In the NFIP, private insurers market flood policies and the premiums are deposited in a federally operated Flood Insurance Fund, which then pays all legitimate claims. To encourage communities to participate in the program, and to maintain property values of structures, those residing in the area prior to the issuance of a flood insurance rate map (FIRM) have their premiums subsidized. New construction is charged an actuarial premium reflecting the risks of flood as well as efforts in mitigation (Interagency Flood Plain Management Review Committee, 1994). Additionally, the Community Rating System (CRS) was created in 1990 to recognize and encourage flood mitigation activities. The communities that are the most involved in floodplain management activities receive the greatest premium reduction; households or firms located in a community with no active risk management strategies receive no premium reductions (Pasterick, 1998).

Actuarial premiums are charged to property owners living outside the 100-year flood plain (i.e., the area where the annual chance of a flood occurring equals or exceeds 1%) or to those living within 100-year areas who build or substantially improve structures after the federal government provides complete risk information from the flood insurance rate map. Over time, the percentage of homes requiring a subsidy has declined. Whereas 41% of the 2.7 million policies were subsidized in 1993, only 30% of the 4.3 million policies were subsidized in 2000.

SIDEBAR 1: Loss estimation and policy in Oregon

For most of the 20th century, the lack of significant earthquakes in Oregon resulted in the state having minimal seismic requirements in its building code. Since the late 1980's, however, new scientific evidence reveals that massive earthquakes occurred offshore repeatedly before white settlement in the 19th century, most recently in 1700, and will likely reoccur (Clague and others, 2000; Atwater and Hemphill-Haley, 1997). While current building codes now reflect this consensus, the legacy of the older regulations leaves a building stock largely unprepared for significant earthquakes.

The Department of Geological and Mineral Industries (DOGAMI), Oregon's state geological survey, has been active in assessing the potential financial impact from the earthquake hazard. In addition to identifying and assessing sources of earthquake activity, DOGAMI has been using the federal government's loss estimation model, HAZUS, to quantify potential losses due to earthquakes on both the local and statewide levels (Wang and Clark, 1999; Vinson and Miller, 2000).

The HAZUS study was a catalyst for action within the state government. The Department of Administrative Services, which handles risk management for state-owned facilities, increased the level of earthquake insurance coverage following discussions with DOGAMI. With the growing awareness of the earthquake threat, the Oregon State Legislature drafted several bills in 2000 addressing the need for earthquake preparedness (SB 13) and retrofitting of critical structures such as schools (SB 14), hospitals, and fire stations (SB 15). HAZUS-derived statistics from Wang and Clark (1999), estimating \$12 billion in losses and 8,000 casualties from a M8.5 offshore earthquake, were quoted in support of these bills. All three bills easily passed the State Legislature in 2001.

An important part of the bill's implementation will be the further incorporation of loss estimation tools. Funding for these propositions is not infinite and ideally should be allocated to targets where it will provide the most quantifiable benefit. DOGAMI will be involved in assessing the loss of life and property in communities most at risk and prioritizing these projects to optimize reduction of these losses (Beaulieu, 2001).

In January of 2003, Congress reauthorized the NFIP through the 2003 fiscal year. Also during this time, other legislation was introduced to amend the National Flood Insurance Act of 1968 to reduce losses to properties for which repetitive flood insurance claim payments have been made. At the time of the legislation's introduction in January of 2003, it was referred to subcommittee.

Hurricane Insurance

The need for hurricane insurance is most pronounced in the state of Florida. Following Hurricane Andrew in 1992, nine property-casualty insurance companies became insolvent, forcing other insurers to cover these losses under Florida's State Guaranty Fund. Property insurance became more difficult to obtain as many insurers reduced their concentrations of insured property in coastal areas.

During a special session of the Florida State legislature in 1993, a bill was enacted to handle the insurance availability crisis. It stipulated that insurers could not cancel more than 10% of their homeowners' policies in any county in one year, and that they could not cancel more than 5% of their property owners' policies statewide for each year the moratorium was in effect. At the same time, the Florida Hurricane Catastrophe Fund (FHCF) was created to relieve pressure on insurers to reduce their exposures to hurricane losses. The FHCF, a tax-exempt trust fund administered by the state of Florida, is financed by premiums paid by insurers that write insurance policies on personal and commercial residential properties. The fund reimburses a portion of insurers' losses following major hurricanes, and enables insurers to remain solvent while renewing most of their policies scheduled for non-renewal (Lecomte and Gahagan, 1998).

Earthquake Insurance

Historical earthquake activity in California convinced legislators that this risk was too great to be left solely in the hands of private insurers. In 1985, a California law required insurers writing homeowners' coverage on one to four unit residential buildings to also offer earthquake coverage. Since rates were regulated by the state, insurers felt they were forced to offer coverage against older structures in poor condition, with rates not necessarily reflecting the risk.

Following the 1994 Northridge earthquake, huge insured property losses created a surge in demand for coverage. Insurers were concerned that if they satisfied the entire demand, as they were required to do by the 1985 law, they would face an unacceptable level of risk and become insolvent following the next major earthquake. Hence, many firms decided to stop offering coverage, or restricted the sale of homeowners' policies in California.

In order to keep earthquake insurance alive in California, the State legislature authorized the formation of the California Earthquake Authority (CEA) in 1996. At the CEA's inception, all claims were subject to a 15% deductible. This meant that with full insurance on a house valued at \$200,000, the property owner would have to pay the first \$30,000 of repairs from future earthquake damage. In 1999, the CEA began offering wrap around policies, defined as policies with a 10% deductible, or additional contents coverage, or both. As of July 31, 2003, the CEA had 735,909 policies in force with total premiums of \$428 million. Approximately 18% of those insured purchased a wrap around policy (California Earthquake Authority, 2003). In 2003, with insurers providing \$743 million in cash contributions and up to \$3.6 billion in possible future assessments, along with additional layers of funding from the reinsurance industry and lines of credit, the total CEA insurance pool capacity stood at \$7 billion.

1.4 Summary of Chapter

This chapter provided an overview of the history of natural disasters and the nature of natural hazard risk, with a focus on the United States. Special emphasis was given to property owners at risk, the capital market, reinsurers, and insurers who provide financial protection, and the role that rating agencies and state insurance commissioners play in regulating these groups. With insured losses expected to grow in the future, this chapter serves as an introduction to the current role catastrophe models can play in helping insurers and other key stakeholders to manage this risk.

As government often takes on the responsibility of providing funds to cover damage from catastrophic disasters, it has an economic incentive to mitigate the risks from these events. While the state and federal governments often play this role, all the supporting entities in the management of risk (reinsurers, regulators, capital markets, lenders, engineers, contractors, real estate agents, and developers) have an opportunity to promote mitigation efforts and assist in the recovery after an event.

Insurers and property owners are the two stakeholders given principal consideration during the remaining chapters of this book. The next chapter presents a framework for characterizing their decision processes in choosing between competing risk management strategies. It is used throughout this book to illustrate existing and emerging solutions for managing catastrophe risk.

1.5. References

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