



Financing Recovery After a Catastrophic Earthquake or Nuclear Power Incident

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Summary

On August 23, 2011, a rare, powerful magnitude 5.8 earthquake and aftershocks hit Mineral, VA, shutting down two North Anna Power Plants located about 7 miles from the earthquake's epicenter. The earthquake was felt from Georgia to southeast Canada. Other earthquakes have also occurred in the area, as well as in surrounding areas. For example, on July 16, 2010, a 3.6 magnitude earthquake occurred in Gaithersburg, MD, about 110 miles from the epicenter. Seismologists report that although Virginia is classified as a "moderate" seismic risk zone, since 1977, the state has experienced 160 earthquakes, of which just 16% were felt. According to the U.S. Geological Survey (USGS), this earthquake was the strongest earthquake to hit the entire states since the 5.8 magnitude tremor in 1897.

Separately, on March 11, 2011, a massive 9.0 magnitude earthquake struck off the coast of Honshu, Japan. It was the most severe and likely the costliest earthquake to hit Japan in the 130 years of recorded history. The Japan earthquake and tsunami caused more than 10,000 casualties, widespread property and infrastructure damage, blackouts, fire, and nuclear meltdowns. The nuclear crisis has compounded the challenges faced by a nation struggling to clean up and recover from the earthquake and tsunami. Two weeks later, the disaster triggered a crisis at the nuclear power facility; Japan's government said there was a leaking reactor core at the Fukushima Dai-ichi nuclear reactor complex, releasing radioactive contamination into the atmosphere and groundwater.

In the aftermath of the recent East Coast earthquake (and shut down of the North Anna nuclear power plants) and Japan's technological and natural disaster, U.S. policymakers are asking if it could happen here and, if so, how associated costs would be financed. In the event of a major natural disaster, several catastrophe risk financing and insurance issues could arise, including (1) the need to revisit the nature, extent, and timing of potential earthquake and tsunami hazards in the United States; (2) the adequacy of nuclear third-party liability insurance capacity; and (3) the challenges of financing recovery from natural disasters and making earthquake insurance more affordable. The latter challenge is largely a function of the national financial markets' capacity to absorb the cost and economic burden of a devastating mega-earthquake.

Given the economic devastation in Japan, there is heightened congressional interest in finding ways to reduce disaster risk for homeowners, insurance companies, financial firms, and both federal and state governments. This report examines earthquake catastrophe risk and insurance in the United States in light of recent developments. It examines both traditional and non-traditional approaches for financing recovery from earthquake losses as well as challenges in financing catastrophe losses with insurance. The report also explores the feasibility of a federal residential earthquake insurance mechanism and assesses policy implications of such a program. Finally, the report examines legislation introduced in the 112th Congress that addresses issues related to earthquakes, including S. 637, the Earthquake Insurance Affordability Act. S. 637 would authorize the U.S. Treasury to guarantee up to \$5 billion in bonds available to certified public entities, like the California Earthquake Authority (CEA), following a catastrophic seismic event. The entity would have to exhaust its claims-paying ability before the federal guarantee becomes available. The measure is designed to reduce earthquake insurance rates by reducing the need to purchase reinsurance. The bonds would be repaid with premiums.

This report will be updated as events warrant.

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This report examines catastrophic earthquake risk and insurance issues facing the United States in light of the recent devastating Japan earthquake and tsunami. It examines both traditional and non-traditional approaches for financing recovery from earthquake losses as well as challenges in financing catastrophe losses with insurance. Much of earthquake disaster and nuclear-accident liability is currently borne by taxpayers. This report explores the feasibility of a federal residential earthquake insurance mechanism and concludes with policy implications of such a program.

Introduction

Earthquakes and other seismic hazards (e.g., tsunamis and volcanic eruptions) are simultaneously a global phenomenon and a specific threat to the U.S. economy, its citizens, the built environment, and the insurance industry. Most Americans live in areas considered “seismically active,” although the degree of vulnerability to earthquake risk varies greatly. Each year about 5,000 earthquakes occur in the United States, but only a relatively small percentage cause injuries or damage to property.¹ The U.S. Geological Survey (USGS) estimates that 40 states are subject to risk of earthquakes or volcanic eruptions. Several factors determine the extent of loss of property and life, including the amount of seismic energy released, duration of shaking, distance from epicenter, population and building density, and time of day.

On March 11, 2011, a massive 9.0 magnitude earthquake struck off the coast of Honshu, Japan. Although the earthquake was just the most recent seismic event to strike the planet, it represented both the most severe and costliest earthquake to strike in Japan in the 130 years of recorded history. The Japan earthquake and tsunami caused more than 20,000 deaths, widespread property and infrastructure damage estimated at about \$235 billion by the World Bank, blackouts, fire, and nuclear meltdowns.² The release of radioactive contamination into the atmosphere and groundwater has compounded the challenges faced by a nation struggling to clean up and recover from the destructive earthquake and tsunami.

In the aftermath of the Japan earthquake, tsunamis, and nuclear incident, U.S. policymakers are asking whether a similar disaster could happen here and how the public and private sectors would finance the costs associated with such an event. In light of a magnitude 5.8 earthquake that struck the East Coast of the United States on August 23, 2011, there is heightened concern that a devastating earthquake could trigger a nuclear power plant accident, but the likelihood of such an event is generally considered minimal. Although the earthquake triggered the shutdown of North Anna Nuclear Power Plants, there was no apparent damage to the plants. Proponents assert that the nuclear facilities were designed for this kind of a seismic event.

Partly for this reason, with the exception of small business disaster loans, the federal government generally does not budget for future natural disasters. The United States has an economic structure in place to respond to emergencies after their occurrence and address issues of

¹ Geologists know very little about what causes earthquakes in some parts of the eastern United States; there is no clear association among seismicity, geological structure, and surface displacement. In contrast, seismic activity in the western United States, the mid-Atlantic, central Appalachian, and the Atlantic Coastal Plain regions are associated with movement along known earthquake faults.

² See *Japan Earthquake – Mourning the Death/Destruction and Returning to Normal*, located at <http://earthquake-report.com/2011/03/28/japan-earthquake-mourning-the-deathdestruction-and-returning-to-normal-life-part-8/>.

vulnerability to extreme events—but the nation has not established significant economic reserves for remediation and response. Federal law places most earthquake, tsunami, and nuclear-accident liability disaster recovery financing on the shoulders of taxpayers through ad-hoc supplemental appropriations for disaster relief assistance and tax credits—after accounting for private insurance and reinsurance that citizens finance through premiums.

This post-event catastrophe risk financing approach raises several broad questions:

- What are the appropriate roles of the private and public sectors in mitigating the possible consequences of a future earthquake, tsunami, or nuclear accident, and in providing the necessary funds for recovery?
- Is there a need for new institutional structures and (enforcement) mechanisms, as well as regulations and standards, for dealing with extreme events in an uncertain and increasingly interdependent world?
- What is the capacity of national financial markets to absorb the cost and economic burden of a devastating mega-earthquake or nuclear incident?

Given the economic devastation in Japan, there is heightened congressional interest in finding ways to reduce the direct and indirect impacts of extreme events and the social amplification of such risks (e.g., litigation and depressed economic activity) and ways to address these issues within a national risk management strategy. Whereas natural disaster losses have been financed on a post-event basis through taxpayer funded systems (e.g., the Robert T. Stafford Disaster Relief Act), the financing of recovery from a nuclear incident has been expected to be handled through nuclear recovery international liability (treaty) regimes and a federal government nuclear risk financing scheme. The earliest national liability laws were adopted in the United States in 1957 and in Europe in 1959.

The Price-Anderson Nuclear Industries Indemnity Act of 1957³ supports commercial nuclear power in two ways. First, the act sought to encourage private investment in nuclear power generation despite the possibility of massive liability from an accident and the uncertain probability of such an accident occurring. The method chosen to encourage private investment in commercial nuclear power plants was to provide federal indemnification in the event of any liability and by capping total “public liability” per nuclear accident.” Second, the act sought to make (insurance) funds available from reliable parties to pay up to the liability cap (rather than the power company declaring bankruptcy). It is argued, however, that by limiting the amount of primary insurance that nuclear operators must carry, the act reduces industry exposure to nuclear power’s unique safety and security risks, but also leaves taxpayers responsible for the damages through ad hoc government disaster relief assistance, and arguably gives the industry a competitive advantage over other energy alternatives. (Although other energy alternatives do not seem to pose similar widespread threats.)

Congress could decide to explore how risk analysis could be used to better understand the challenges associated with extreme events so that more effective planning could be undertaken to reduce potential losses following a disaster. Members might also consider public-private partnerships and alternative policy strategies and financial instruments to help the private sector

³ P.L. 85-256; 71 Stat. 576.

pre-fund and diversify disaster risk by financing catastrophic losses through insurance, reinsurance, and capital markets.

Recent Developments

East Coast Earthquake of 2011

On August 23, 2011, a rare, powerful magnitude 5.8 earthquake and aftershocks hit Mineral, VA, prompting the evacuation of buildings and the shutdown of two North Anna Power Plants located about 7 miles from the earthquake's epicenter.⁴ The earthquake was felt from Georgia to southeast Canada.⁵ Other earthquakes have occurred in the area, but not of this magnitude. According to the USGS, the recent earthquake was the strongest earthquake to hit the entire states since the 5.8 magnitude tremor in 1897. In addition, a 3.6 magnitude earthquake also occurred in Gaithersburg, MD (about 110 miles from the epicenter) on July 16, 2010. Seismologists report that although Virginia is classified as a "moderate" seismic risk zone, since 1977, the state has experienced 160 earthquakes, of which just 16% were felt.⁶ The recent event was reportedly 160 times bigger than the 2010 event in Gaithersburg. Total estimates of injuries or physical damage caused by the East Coast earthquake, and its aftershocks, are not readily available. Engineers and disaster experts are assessing the damages.

Japan Earthquake and Tsunamis

Although Japan's losses will reach historic levels, various experts report that the country's relatively strict building codes and early warning system prevented even further destruction and loss of life. Japan is generally considered one of the best prepared nations in the world for earthquakes and tsunamis. Earthquake and tsunami warning systems are extensive there and disaster drills are part of everyday life. Following the 1995 Kobe earthquake, Japan engaged vast resources in developing new techniques to make structures sturdier, including retrofitting older and more vulnerable buildings.

Japan's total economic losses are likely to be much higher than insured losses because property owners without coverage will likely assume most of the burden of losses. Early estimates of the disaster's cost provided by the World Bank place the total losses of houses, factories, and public infrastructure in the range from \$122 billion to \$235 billion (2.5% to 4% of GDP).⁷ The official Japanese government estimate of damage to housing, roads, utilities, and businesses across seven prefectures (states) is between \$198 billion and \$309 billion—a range that is in line with the World Bank's estimate.⁸ In addition, the Japan earthquake and tsunami will be a costly event for

⁴ According to the Nuclear Regulatory Commission, the North Anna nuclear power plants lost power from the grid and switched to four diesel generators.

⁵ The USGS received reports that the seismic waves were felt as far away as Montreal, Canada, and Jacksonville, Florida.

⁶ Joel Achenbach, "5.8 Virginia Earthquake Shakes East Coast, Rattles Residents," *Washington Post*, August 23, 2011, at http://www.washingtonpost.com/earthquake-rattles-washington-area/2011/08/23/gIQAATMOGZJ_print.html.

⁷ Victoria Kim, "Japan Damage Could Reach \$235 billion, World Bank Estimates," *Los Angeles Times*, at <http://articles.latimes.com/2011/mar/21/world/la-fgw-japan-quake-world-bank-20110322>.

⁸ See, *Japan Earthquake Damage*, at <http://earthquake-report.com/2011/03/23/japan-earthquake-damage-catdat-did-> (continued...)

the global insurance industry. On April 12, 2011, Risk Management Solutions (RMS), a private catastrophe modeling company, released a new report estimating that insurers will pay \$21 billion to \$34 billion in damages from the earthquake and tsunami in Japan, making the disaster the most costly for insurers since Hurricane Katrina in 2005.⁹ RMS said that the powerful earthquake and the subsequent tsunami resulted in property losses of \$18 billion to \$26 billion, the most costly earthquake loss in history. RMS estimates that life and health insurance claims related to the disaster will total between \$3 billion and \$8 billion.¹⁰ Japanese companies or cooperatives are expected to cover many of the home insurance claims while international insurers will cover many of the claims filed by businesses. RMS estimates that commercial and industrial payouts will represent 30% to 35% of property loss, or as much as \$9 billion.¹¹ Financing for Japan's recovery will likely come from the issuance of Japanese government construction bonds, adding to the nation's already high fiscal debt.¹²

The Japanese government is likely to cover some of the damage to residential buildings and pay the liability costs related to the damaged Fukushima Daiichi Nuclear Power Plant. The national government serves as a backup to domestic home insurance and provides insurance covering nuclear plants for major natural disasters.

Nuclear power plant operators in Japan are required to register with the General Insurance Association of Japan and participate in a nuclear insurance plan operated by the Japan Ministry of Education, Culture, Sports, Science and Technology. Damages or claims related to earthquakes and tsunamis are not covered by the insurance association. Under Japan's 1961 Act on Compensation for Nuclear Damage, nuclear facilities operators are not liable for damage caused by their reactors due to "a grave natural disaster of an exceptional character or by an insurrection."¹³ As a result, insurers of the nuclear power plant may not have to make payouts.

Japan's national earthquake program buys some external reinsurance coverage and local reinsurance programs are large and well-syndicated across most of the worldwide catastrophe markets. Historically, Japanese homeowners and businesses have been reluctant to buy earthquake insurance, which they perceive as too expensive. Consequently, the cost to insurers for residential property damage may be relatively limited.

U.S. Earthquake Risk Assessment and Exposure

Catastrophe risk management provides a policy framework for formal (e.g., decision analysis, cost-benefit analysis) and intuitive (e.g., rules of thumb) approaches to decision making. This

(...continued)

come-up-with-a-reliable-estimate-only-90-minutes-after-the-earthquake/.

⁹ *RMS Released Insured Loss Estimate for Tohoku Earthquake and Tsunami*, April 12, 2011, at http://www.rms.com/news/NewsPress/PR_041211_TohokuEQ.asp.

¹⁰ *Ibid.*

¹¹ *Ibid.*

¹² According to the *Central Intelligence Agency, The World Factbook*, Japan ranks first among nations in terms of public debt (i.e., cumulative total government borrowings) as a percentage of GDP, which stood at 225.8% in 2010. In contrast, the United States ranked 37th with 58.9%. Public debt is different from external debt, which reflects the foreign currency liabilities of both the private and public sector and must be financed out of foreign exchange earnings.

¹³ Act No. 147 of 1961.

promotes more effective planning to reduce potential losses and the direct and indirect impacts following a disaster. The first step in the risk management process is to define the event itself and the probabilities and consequences associated with it. Physical scientists and engineers provide data on the vulnerability of a region to different types of hazards and assess the risks to different structures and the surrounding environment. Although there are well-developed models specifying earthquake probabilities and consequences, many uncertainties remain regarding these risks, as well as nuclear damage risks.¹⁴ Nevertheless, policymakers use available information to develop a set of risk management strategies for dealing with extreme events.

The remainder of this report provides information and analysis on risk assessment for extreme events and explores the U.S. exposure to seismic risk and the various methods of financing recovery from such losses. Challenges associated with financing earthquake losses with insurance and the feasibility of a federal earthquake insurance scheme are examined. The report concludes with some policy options and questions and summarizes legislative proposals under consideration in Congress.

Risk Assessment

Risk assessment combines information about a physical hazard (e.g., frequency, intensity, location) with information on vulnerability (e.g., exposed population, structures, critical facilities) to determine the likely impacts of a hazardous event.¹⁵ This same risk assessment framework is used by scientists and engineers to develop uniform seismic hazard maps that provide a detailed description of the variations of shaking and damage, which is used to inform risk assessment and public policy on mitigation measures across the country.¹⁶ The important factors to be considered in assessing the seismic hazard are past earthquake data and earthquake source characteristics in the region.

Seismic hazards may be analyzed deterministically by considering a particular earthquake scenario, or probabilistically, by considering the uncertainties involved in earthquake size, location, and time of occurrence.¹⁷ The level of damage is directly proportional to the severity of ground acceleration. Calculating earthquake risk levels depends upon proximity to earthquake faults, the age and type of dwellings, and the soil types near those dwellings. Although progress has been made in the identification of earthquake risk, the delineation of local seismic hazards is still insufficient to accurately determine the risk in many areas. Earthquake maps are national-scale probabilistic estimates of maximum acceleration based on seismicity.

¹⁴For some hazards, like nuclear incidents and acts of terrorism, the estimation of the probability distributions is so uncertain that estimates of these risks are much less reliable. There is no universally accepted methodology for developing joint probabilities for multiple threats involving earthquakes, tsunamis, and nuclear incidents.

¹⁵ Risk is usually defined in terms of a probability, consequence, potential threat or the possibility of deviation from the expected.

¹⁶ Seismic hazard maps typically include the best available science, including information on fault slip rates, paleoseismologic data from fault trenching studies, earthquake catalogs, and strong-motion recordings from global earthquakes. Paleoseismology is used in the calculation of seismic hazards by looking at geologic sediments and rocks for signs of ancient earthquakes.

¹⁷ The seismic hazard maps do not include hazards from ground deformation such as liquefaction, landslides, or surface fault ruptures.

The U.S. Geological Survey National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, engineering design standards, estimating potential economic losses, preparing for emergency response, and insurance rates in areas of high risk. These probabilistic seismic hazard maps represent the best available science in earthquake hazards estimation for the United States; they are not intended for site-specific hazard analysis, but to provide a regional perspective on earthquake hazard.

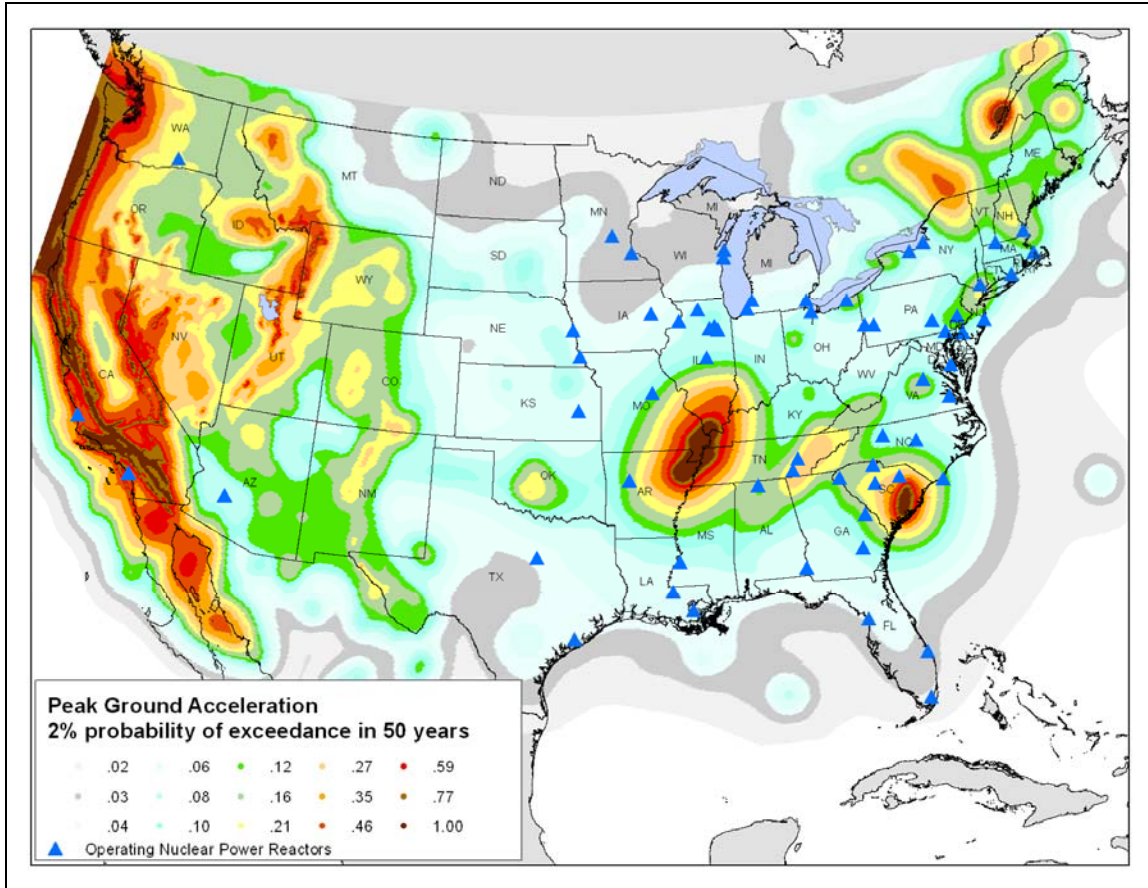
Exposure

Figure 1 depicts a probabilistic earthquake risk map showing maximum horizontal ground acceleration (force per unit of mass) with a 2% probability of being exceeded in 50 years and the sites of operating nuclear power reactors in the United States.¹⁸ It suggests that potentially damaging earthquakes could occur in many parts of the United States, including the Pacific coast; the Mississippi valley around New Madrid in Missouri; Utah; Idaho; South Carolina; and the New England region around Boston. Alaska, not shown on the map, is also subject to potentially damaging earthquakes. Scientists predict that there is a 90% chance of a major earthquake in California occurring in the next 30 years, with damage estimates ranging from \$60 billion to \$70 billion. Moreover, earthquakes can also strike in unexpected places. For example, in April 2002, a 5.1 magnitude earthquake struck the northeastern United States and parts of Canada. The event was centered on the town of Plattsburg, NY. In 1737 and again in 1884, New York City was hit by a 5.1 magnitude earthquake.¹⁹

¹⁸ The 2% probability of being surpassed in 50 years may be misleading because some parts of the country that have not experienced earthquakes for 200 years or more might be more susceptible to earthquakes than areas that have experienced recent earthquakes. The reason is that earthquake faults build up tension over long periods of time, which become earthquakes when that tension is released suddenly. It is theorized that relatively recent earthquake activity means that faults have released built-up tension—a lack of earthquake activity can mean that tension is still building and could be released at any time as an earthquake.

¹⁹ “When the Earth Moves,” *Reinsurance: Global Risk Analysis*, February 2005, p. 14.

Figure I. Probabilistic Earthquake Hazard Map of the United States
(Peak Ground Acceleration for 2% Probability of Exceedance in 50 Years)



Source: Nuclear Regulatory Commission and United States Geological Survey, at http://pubs.usgs.gov/of/2008/1128/pdf/OF08-1128_v1.1.pdf.

Table 1 shows that, on average, more than 3,000 earthquakes strike the United States each year. According to the USGS, only a relatively few earthquakes cause large economic losses because most are small and occur in sparsely populated areas. Most Americans live in areas considered “seismically active,” although the degree of vulnerability to earthquake risk varies greatly.²⁰

²⁰ A.M. Best Company, Inc., *2006 Annual Earthquake Study*, October 16, 2006.

Table I. Number of Earthquakes in the United States, 2000-2010

Magnitude	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
8.0 to 9.9	0	0	0	0	0	0	0	0	0	0	0
7.0 to 7.9	0	1	1	2	0	1	0	1	0	0	0
6.0 to 6.9	6	5	4	7	2	4	7	9	9	3	1
5.0 to 5.9	63	41	63	54	25	47	51	72	85	53	1
4.0 to 4.9	281	290	536	541	284	345	346	366	432	290	16
3.0 to 3.9	917	842	1,535	1,303	1,362	1,475	1,213	1,137	1,486	1,449	40
2.0 to 2.9	660	646	1,228	704	1,336	1,738	1,145	1,173	1,573	2,335	39
1.0 to 1.9	0	2	2	2	1	2	7	11	13	25	1
0.1 to 0.9	90	0	0	0	0	0	1	0	0	1	0
Below 0.1	15	434	507	333	540	73	13	22	20	18	0
Total	2,342	2,261	3,876	2,946	3,550	3,685	2,783	2,791	3,618	4,174	98

Source: United States Geological Survey, *Earthquake Facts and Statistics*, available at <http://earthquake.usgs.gov/earthquakes/eqarchives/year/eqstats.php>.

Table 2 shows the 10 costliest world earthquakes and tsunamis ranked by insured losses. **Table 3** shows the deadliest world earthquakes and tsunamis ranked by the number of fatalities. The world's deadliest seismic event occurred in Port-au-Prince, Haiti, on January 12, 2010, resulting in approximately \$8 billion-\$14 billion in economic losses but comparatively low insured losses. Because of Haiti's low income rates and limited insurance penetration, insured losses were a fraction of economic losses.²¹

Table 2. Ten Costliest World Earthquakes and Tsunamis Ranked by Insured Losses, 1980-2011

(\$ in billions; before March 11, 2011)

Rank	Date/Year	Location	Losses When Occurred	
			Total	Insured
1	January 17, 1994	Northridge, CA	\$44.0	\$15.3
2	February 22, 2011	Christchurch, New Zealand	20.0	10.0
3	February 27, 2010	Maule, Chile	30.0	8.0
4	September 3, 2010	Christchurch, New Zealand	6.5	5.0
5	January 17, 1995	Kobe, Japan	100.0	3.0
6	December 26, 2004	Sri Lanka, Indonesia, India	10.0	1.0
7	October 17, 1989	Loma Prieta, CA	10.0	.96
8	October 23, 2004	Niigata, Japan	28.0	.7

²¹ London-based Axco Insurance Information Services Ltd. estimates that total non-life insurance premiums in Haiti amount to less than \$20 million annually. See <http://www.claimsmag.com/News/2010/1/Pages/Haiti-Lacks-Insurance-for-Earthquake-Losses.aspx>.

			Losses When Occurred	
9	September 21, 1999	Nantou, Taiwan	14.0	.75
10	December 28, 1989	Newcastle, Australia	1.2	.67

Source: Munich Re. Geo Risks Research, NatCatService.

Table 3. Ten Deadliest World Earthquakes and Tsunamis Ranked by the Number of Fatalities, 1980-2011

Rank	Date/Year	Location	Losses When Occurred		
			Overall (\$millions)	Insured	Fatalities
1	January 12, 2010	Port-au-Prince, Haiti	\$8,000- \$14,000	NA	222,500
2	December 26, 2004	Sri Lanka, Indonesia, India	10,000	1,000	220,000
3	October 8, 2005	Pakistan, India, Afghanistan	5,200	5	88,000
4	May 12, 2008	Sichuan, China	85,000	300	84,000
5	June 20-21, 1990	Manjil, Iran	7,100	100	40,000
6	December 26, 2003	Bam, Iran	500	19	26,200
7	December 7, 1988	Spitak, Armenia	14,000	NA	25,000
8	August 17, 1999	Izmit, Turkey	12,000	600	17,100
9	January 26, 2001	Gujarat, India	4,500	100	15,000
10	September 19, 1985	Mexico City, Mexico	4,000	275	9,500

Source: Munich Re. Geo Risks Research, NatCatService.

Tsunami Exposure

Tsunamis occur infrequently in the United States. The communities at risk are along the U.S. West Coast, Alaska, and the Pacific region (Hawaii, American Samoa, Guam, Palau, the Federated States of Micronesia, and the Marshall Islands).²² According to the National Oceanic and Atmospheric Administration (NOAA), during the past 204 years, 24 tsunamis have caused damage in the United States.²³ Although tsunamis pose a particular risk to coastal communities on the Pacific coast, historical records indicate that tsunamis occasionally hit the U.S. northeastern coastal states along the Atlantic Ocean. Tsunamis caused property damages in Puerto Rico in 1918 and Newfoundland, Canada, in 1922. Scientists are also reportedly concerned about the Cumbre Vieja volcano in Las Palmas (Canary Islands). Some geologists believe that a significant volcano eruption in this area could send a tsunami into the eastern seaboard of North and South America.²⁴

²² Tsunamis can also travel upstream in coastal estuaries and rivers, and cause damage further inland than the immediate coast.

²³ For more information on the U.S. exposure to tsunamis, see answers to questions posed to Admiral Conrad Lautenbacher, Administrator of NOAA, available at <http://whitehouse.gov/ask/print/20050114.html>.

²⁴ Morgan O'Rourke, "Danger on the Coast: Coastal Catastrophe Risk," *Risk Management Magazine*, March 2005, p. (continued...)

Unlike tsunamis that can sometimes be predicted—often (in sufficient time to give a public warning) using underwater sensors, floating data buoys, and radar data from orbiting environmental satellites, earthquakes currently cannot be predicted. However, scientists believe that one day earthquakes will be just as predictable as hurricanes, tornadoes, and other severe storms.²⁵ Research to find ways to predict earthquakes is currently being conducted by the USGS and other federal and state agencies, as well as universities and private institutions. Some experts, particularly those at the National Earthquake Information Center, believe that scientists will ultimately be able to forecast earthquakes. In August 2005, a joint team of scientists from Stanford University and the USGS completed drilling a 2.4-mile-deep hole in the San Andreas fault in California to establish the first continuous monitoring probe from inside an active earthquake zone. The study is designed to determine if and how earthquakes can be predicted.

Financing Recovery Following an Earthquake

Financing economic recovery after a major earthquake in the United States is likely to be costly, complex, and involve both private markets and government. With respect to earthquake losses, the federal government is effectively an insurer of last resort for catastrophe risk. The emergence of a public-private earthquake insurance program that does not now exist would involve tradeoffs between moral hazard, adverse selection, loss potential, subsidy, and cost of insurance.

Standard residential homeowners' insurance and commercial casualty insurance coverage would be the most likely to be triggered as a consequence of a catastrophic event. However, because insurance policies protect the insured against a specified loss and insurance policies fall into the realm of private contracts, insurers generally have the authority to determine the scope of the coverage that they offer. As a result, most homeowners' and Commercial General Liability (CGL) policies offered by private insurers are an "all risk" policy, under which only those events that are specified are excluded from coverage. For example, floods and earthquakes typically get special exclusionary treatment.

In the absence of an explicit national earthquake insurance program or requirement, financing disaster recovery comes primarily from state and federal government disaster aid, private and public insurance (where in-force), private loans, contingent financing, and personal savings. Insurance is arguably the most efficient form of pre-disaster risk financing to mitigate potential losses and reduce the financial vulnerability of property owners and governments to earthquake risk exposure. The insurance, and ultimately the reinsurance, sector currently supports most of the costs of natural disasters. However, the capacity of national insurance markets, even backed by international reinsurance, is finite, and the insurance industry may, therefore, not always be in a position to provide sufficient protection in the event of a major natural disaster without endangering its financial viability.

Since the late 1990s, a combination of financial product innovation and deregulation ushered in a new wave of risk management mechanisms, including contingent capital instruments, securitizations, and notes and bonds based on insurance-related events. The idea behind so-called

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²⁵ Center for Earthquake Research and Information, The University of Memphis, "100% Chance of an Earthquake Today," available at <http://www.ceri.memphis.edu/public/eqtoday.shtml>.

insurance-linked securities (ILS) was the issuance of securities that reference earthquake, hurricane, or windstorm risk to transfer exposures and create additional risk capacity. ILS transactions allowed domestic insurers to leverage retained capital to help increase insurance loss capacity and reduce their financial exposure to extreme events. Catastrophe bonds, for example, currently offer insurers and reinsurers an innovative approach to financing disaster losses by transferring some of the catastrophe risk to global financial markets.

The vast majority of businesses and individuals in seismic zones do not purchase earthquake insurance, preferring to take their chances rather than pay for protection at a cost that many consider too expensive for such a remote event. As a result, the government, through taxpayer-financed federal disaster assistance for disaster victim compensation, has become the de facto insurer of last resort and source of financial protection after a major disaster occurs.

Should a catastrophic earthquake hit the United States in 2011, there is a general consensus that a significant increase in capital is not likely to enter into the insurance market as it did after Hurricane Katrina in 2005. The reason is twofold: excess capital is not currently available in the world's financial markets and there is uncertainty about how and whether to socialize risk for natural disasters (earthquakes and tsunamis) and man-made disasters (nuclear power plant accidents). For example, concerns have been expressed about excessive taxpayer exposure to the risk of a nuclear catastrophe.

Residential Earthquake Insurance

Many people mistakenly assume that their residential insurance policies fully protect them against damage from earthquakes. This report's **Appendix** illustrates the earthquake hazard exclusion language in standard homeowners' insurance policies. Earthquake coverage is available either as an endorsement to an existing homeowner's or business owner's policy, or as a separate policy. It typically includes coverage for damage to the building's structure, contents or personal property, and loss of the structure's use. Commercial earthquake insurance typically also covers the loss of business income. Earthquake damage to vehicles is covered under the comprehensive automobile insurance policy.

According to the Insurance Information Institute, only about 12% of California residents currently have earthquake coverage, down from more than 33% in 1996. The relatively low coverage rate is due to a combination of factors:

- policy premiums are often viewed as too expensive;
- deductibles are perceived as relatively high, often 15% of the amount of the policy (not the loss);
- some homeowners lack knowledge that earthquake coverage is available or are misinformed concerning the terms of such insurance; and
- some homeowners lack incentives to take preventive action to reduce shaking losses, fire losses, and injuries.²⁶

²⁶ Howard Kunreuther and Paul R. Kleindorfer, "Managing Catastrophe Risk: Why Do Homeowners, Insurers, and Banks Not Use Simple Measures to Mitigate the Risk from Hurricanes and Earthquakes?" *Regulation*, vol. 23, iss. 4, March 8, 2001.

California is the only state that requires insurers that sell residential property insurance to offer earthquake coverage to their policyholders. After the 1994 earthquake in Northridge, CA, most insurers in California either stopped selling new homeowners' insurance policies or greatly restricted the sales of such policies. In 1995, as a result of insurers' reluctance to offer earthquake insurance because of the fear of insolvency, the California state legislature created a privately financed, publicly managed organization—the California Earthquake Authority (CEA)—to offer primary coverage for property losses arising from a seismic event. In offering earthquake coverage, insurance companies can become a member of the CEA and offer the CEA's residential earthquake policies, or they can manage the risk themselves. To date, companies that sell over two-thirds of the residential property insurance in the state have opted to become CEA participating companies. The CEA began providing residential earthquake insurance in December 1996 with a \$10.5 billion funding package.

The Role of Reinsurance

The insurance industry could not function in its present form without access to traditional reinsurance. Reinsurance is purchased by insurers to hedge their own insurance portfolios. Almost all insurers purchase reinsurance. A reinsurer assumes part of the risk and part of the premiums originally taken by the insurer, known as the primary insurer. Reinsurance is sold in layers. Reinsurers have their own reinsurers, called retrocessionaries.

Under a typical reinsurance transaction, a primary insurer transfers a layer of the risks (and some of the premiums) to a reinsurer who, in turn, accepts a layer of risk and passes the remaining risk to a retrocessionary. As an illustration, under a 300/100 “excess-of-loss” facultative reinsurance agreement²⁷ between the primary insurer and a reinsurer, if losses from a specific earthquake exceed \$300 million, the reinsurer will cover the next \$100 million in losses. An earthquake that costs less than \$300 million is paid entirely by the primary insurer. The reinsurer might choose to transfer to a retrocessionary a portion or layer of the \$100 million. In return for assuming risk, the reinsurer (or retrocessionary) receives a reinsurance premium and agrees to indemnify the insurer (or reinsurer) for claims falling within the terms of the reinsurance agreement.

After the Northridge, CA, earthquake of 1994, large national insurers encountered difficulty in obtaining layers of reinsurance coverage at prices that they considered affordable. As a result, insurers were forced to find alternative sources of capital to underwrite catastrophe risk, which they found in the U.S. equity and debt markets that offered insurers liquidity to expand their capacity to sell catastrophe insurance. Investors, for their part, are attracted to securities that transfer catastrophe risk to the capital markets—the so-called ILS. They are drawn to ILS because the level of return depends solely on the occurrence of a catastrophe that triggers payment and is insensitive to economic factors like interest rates and credit default that give rise to systemic risk in other types of fixed income investments. Some of the existing barriers to the expanded use of ILS are that they tend to be more expensive than traditional reinsurance because the risk premium that investors demand for assuming unfamiliar types of risk is expensive to structure. Although

²⁷ The two most common types of reinsurance arrangements are treaty reinsurance and facultative reinsurance. Under treaty reinsurance, the reinsurer agrees to assume a certain percentage, up to preset limits, of all risks falling into the categories agreed in advance between the two parties. By contrast, a facultative reinsurer agreement is used for very large risks that treaties cannot absorb, and unique risks for which it is difficult to establish a reinsurance treaty. Under the facultative reinsurance agreement, the reinsurer is free to decline to cover a particular risk.

the number of ILS transactions is still relatively small, the markets for these financial instruments are expected to grow.

Financing Recovery Following a Nuclear Incident

Nuclear energy plays an important role in the economy of the United States, but its generation involves certain risks. As the incident in Japan demonstrates, if a nuclear incident occurs, the damage to persons, property, and the environment can be substantial. Claims from a nuclear power incident could arise in several ways: (1) operating a reactor, (2) in the course of transporting nuclear fuel to a reactor site, (3) storage of nuclear fuel or waste at a site, and (4) the transportation of irradiated nuclear fuel and nuclear waste from the reactor. All property and liability insurance policies issued in the United States exclude nuclear accidents.

Three layers of defense exist to address potential nuclear damages: prevention, response, and the allocation of responsibility for repairing the damage and compensating victims. This is the function of nuclear liability law. The international liability regime relating to nuclear activities is quite unique. From the inception of the nuclear industry, countries realized that a special liability regime would be necessary, both nationally and internationally, due to the hazardous nature of nuclear activities and the complexities of the processes involved. The earliest national liability laws were adopted in the United States in 1957, and in Europe in 1959.

The centerpiece of nuclear legislation in the United States is the Atomic Energy Act of 1954, as amended. The federal government has assumed most of the responsibility for the regulation of nuclear energy. For example, federal legislation and administrative regulations govern facility licensing. States can regulate those nuclear activities that the federal government has chosen not to address so long as state regulation does not conflict with federal law.

Claims resulting from nuclear accidents are covered under the Price-Anderson Nuclear Industries Indemnity Act of 1957.²⁸ The 1957 act added Section 170 to the Atomic Energy Act of 1954 to address offsite nuclear accident liability and to encourage private industry to participate in the nuclear industry by assisting it with the costs of liability anticipated in the case of a nuclear incident occurring within the United States.

The act created a mixed system of compulsory commercial insurance coverage (to satisfy financial responsibility requirements) and emergency compensation funding to lessen the financial impact of post-accident litigation on holders of nuclear power plant licenses. It sought to ensure that adequate funds would be available to satisfy liability claims of members of the public for bodily injury, sickness, disease or death, or loss of or damage to property, or for loss of the use of property in the event of a nuclear accident involving a commercial nuclear power plant. The act helped encourage private investment in commercial nuclear power by placing a cap, or ceiling on the total amount of liability each holder of a nuclear power plant licensee faced in the event of an accident.

Recovery to accident victims is available through common law liability, coverage by private insurance, and government indemnification (reimbursement). Licensees must maintain financial security against offsite liability for a nuclear accident in an amount equal to that available through

²⁸ P.L. 85-256; 71 Stat. 576, 42 U.S.C. §2012.

private insurance. This effectively represents a subsidy to the nuclear power industry. Without this protection, it is widely believed that commercial nuclear power development would not have developed as it has.

All nuclear reactor operators must participate in the program. The statute requires operators to obtain the maximum amount of private insurance coverage available. Under existing policy, owners of nuclear power plants pay a premium each year for \$375 million in private insurance for offsite liability coverage for each reactor unit. This primary, or first tier, insurance is supplemented by a second tier. In the event a nuclear accident caused damages in excess of \$375 million, each licensee would be assessed a prorated share of the excess up to \$111.9 million. The “limit of liability” for a nuclear accident has increased the insurance pool to more than \$12 billion. With 104 reactors currently licensed to operate, this secondary tier of funds contains about \$11.6 billion. If 15% of these funds are expended, prioritization of the remaining amounts would be left to a federal district court. If the second tier is depleted, Congress is committed to determine whether additional disaster relief is required. Thus, the burden of exceeding the fund’s limits could fall on the accident victims if the government chooses not to intervene.

Under the Price-Anderson Act, victims of nuclear accidents are free to pursue tort claims for property damage and personal injuries against the reactor operators or any other potentially responsible party in accordance with state tort law. The only limitation imposed by the act on recovery in such lawsuits is in the form of the total monetary cap on insurance funding. In the event of “extraordinary nuclear occurrence”²⁹ the act requires all claims to be consolidated in federal court. The act creates strict liability in tort for licensees involved in nuclear incidents and abrogates the defense of contributory negligence. Each individual claimant still bears the burden of establishing causation and particularized proof of economic loss and intangible harm.³⁰

Challenges in Financing Extreme Event Losses

The 112th Congress may choose to assess whether existing sources of funding of catastrophe losses will be adequate to finance recovery from a mega-catastrophe earthquake or other extreme events. In the aftermath of mounting natural disaster losses over the past two decades, property and casualty insurers have sought to limit their exposure to catastrophe risk while simultaneously exploring new and innovative sources of capital aimed at financing catastrophe losses.

Although private insurers are skilled at handling high-frequency, low-severity “non-catastrophic” events, like auto and home losses, that follow a relatively predictable claims frequency and magnitude, they face substantially greater difficulty when attempting to price and insure low-probability, high-consequence (LP-HC) risk. The problem is the finite amount of protection (capacity) that the insurance industry can offer against highly correlated risk that can produce catastrophic losses. The amount of private catastrophe insurance coverage is limited by the potential magnitude of possible insured losses, the sporadic and unpredictable nature of these events, and the ability to accurately estimate future losses and price coverage. Moreover, existing regulatory and accounting systems also result in catastrophe reserves being taxed as profits,

²⁹ “Extraordinary nuclear occurrence” is defined as “any event causing a discharge or dispersal of source, special nuclear, or byproduct material...in amounts offsite, or causing radiation levels offsite,” 42 U.S.C §2014(j).

³⁰ 10 C.F.R §140.81.

discouraging insurers from accumulating loss reserves for catastrophes. Current tax laws discourage the establishment of financial reserve funds for a loss that has not yet occurred.

The private sector's coverage of catastrophe risk is limited by

- actuarial and rate-setting difficulties;
- industry capacity to meet the payout requirements resulting from a mega-catastrophic earthquake;
- difficulties in determining both the insurability of properties and the damages resulting from earthquakes;
- adverse selection and risk-spreading difficulties, including those associated with reinsurance;
- accounting and federal tax policy constraints on the accumulation of insurance company catastrophe loss reserves; and
- ineffectiveness of current loss-reducing activities (building-code enforcement and land-use zoning).

A general discussion of these interrelated challenges follows.

Actuarial and Rate-Setting Difficulties

One set of challenges facing private insurers involves actuarial and rate-setting difficulties that stem from the lack of sufficient data on past losses to accurately estimate probabilities of future losses and the potential for catastrophic losses that can jeopardize insurers' financial viability. Estimating future losses is difficult because earthquakes occur infrequently and the magnitude of losses is highly uncertain. Insurers must instead predict losses from technical studies and computer simulation models, which may arguably be no more reliable than actual prior historical loss data.

Insurers need to set a premium for each potential customer or class of customers to generate enough revenue to both cover the expected loss and earn a profit. Insurers must be able to estimate the frequency of specific events occurring and the magnitude of the loss should the event occur, a condition limited by the low-probability/high-consequence nature of earthquake risk and the difficulty in identifying what losses may occur. Insurance companies risk insolvency or being uncompetitive by underpricing or overpricing, respectively.

Adverse Selection and Risk Spreading

Insurers also face adverse selection and risk-spreading difficulties, including access to adequate reinsurance for earthquake peril. Their problem is that risk is not sufficiently spread over a larger geographical area, including areas which are relatively unlikely to suffer a catastrophic earthquake. Traditional insurance principles for insurability require that there is sufficient demand to yield appropriate levels of income revenue for insurers to supply the coverage. There is a tendency for mostly high-risk consumers to purchase policies. This results in a poor spread of risk and an inadequate premium base. Economists note that this "adverse selection" problem in insurance markets generally persists for two reasons: (1) the insured possess information on their particular risk, which is unknown to the insurer; and (2) consumers have short time horizons in

determining the expected benefits relative to the up-front costs (rates and deductibles), or compare costs with potential benefits and conclude that loss-reduction measures are not good investments.

Tax, Accounting, and Regulatory Constraints

Another set of challenges to financing catastrophe risks involves tax policy and regulatory constraints on the accumulation of insurance company catastrophe loss reserves and the industry's ability to raise external capital during times of financial crisis. Under current federal income tax provisions, premiums collected by insurers and placed in a reserve fund for catastrophes are treated as excess profits and taxed at the corporate income tax rate. Insurers view this as a major impediment to the marketing of earthquake insurance, and they have supported a longer loss carry-forward period or tax-free reserves for potential earthquake losses.³¹ Insurers might consider offering insurance coverage at a price level high enough to cover the high-end in the range of expected losses. The rate, however, would be so high that it may not be marketable to the average household and regulators may not approve extremely high catastrophe rates. At this point, insurers typically have opted to withdraw from lines of insurance in catastrophe-prone areas.³²

A high percentage of property owners in areas prone to earthquakes do not have earthquake insurance, relying instead on good fortune or federal emergency disaster relief assistance to cover uninsured losses. Researchers have found that Americans are reluctant to purchase earthquake insurance because of the high cost of insurance and low likelihood of a disaster.³³ Moreover, earthquake insurance is not required as a condition for federally secured mortgages, as it is currently in the case of flood insurance in federally designated flood zones. Fannie Mae and Freddie Mac require homeowners with federally backed mortgages to buy insurance for flood and windstorm damage, but not for earthquakes. Fannie and Freddie would arguably change the landscape for homeowners' property insurance if they required coverage for earthquakes. The penetration of earthquake insurance has been low, and the government, through disaster relief assistance, continues to serve as the predominant bearer of earthquake catastrophe risk.

In the event of a major disaster, lack of insurance or underinsurance against earthquakes could negatively affect bond and equity markets, the mortgage loan industry, and government budgets at all levels. With roughly 12% to 15% of exposed mortgage properties covered by earthquake insurance nationwide, a mega-catastrophe could leave a number of mortgages in default with lack of sufficient underlying market value. In the case of mortgages that are packaged and sold by federal mortgage agencies, uninsured losses are absorbed by the U.S. Treasury, a situation that could adversely affect the U.S. financial system and do little to help the owners of the distressed properties. In addition, federal, state, and local governments would likely be called upon to

³¹ For more information, see CRS Report RL33060, *Tax Deductions for Catastrophic Risk Insurance Reserves: Explanation and Economic Analysis*, by Rawle O. King.

³² In 1996, the California Legislature created the California Earthquake Authority (CEA) to sell residential property insurance in California. Insurers in the state can choose to offer their own privately funded earthquake insurance product or they can become a participating insurance company of the CEA. Only participating insurance companies can offer CEA earthquake insurance policies.

³³ Howard Kunreuther and Paul R. Kleindorfer, "Managing Catastrophe Risk: Why Do Homeowners, Insurers, and Banks Not Use Simple Measures to Mitigate the Risk from Hurricanes and Earthquakes?" *Regulation*, vol. 23, iss. 4, March 8, 2001.

expend funds in emergency response and recovery at the same time as they lose tax revenues. Meanwhile, federal policymakers have focused on finding ways to enhance the private sector's ability to spread risk.

Is Federal Earthquake Insurance Feasible?

As stated earlier, a basic principle of insurance is the reduction of overall risk by pooling or spreading individual, independent risks. Insurance companies typically price risks where the frequency and severity of potential claims are limited, estimable, and stable. This principle and insurance practice tends not to hold when a single event affects many insureds simultaneously, as in the case of a major earthquake. In the event of uninsured losses, the federal government has become the de facto bearer of much of the burden for the uninsured cost of repairing or reconstructing buildings damaged by catastrophic earthquakes. Another option would be to create a national catastrophe fund (federal residential earthquake insurance program) to ensure adequate capacity and solvency of the insurance industry to meet consumer demand for protection against earthquake risks, which could, over the long term, minimize federal outlays for uninsured losses.

Advocates of an explicit government insurance program argue that it would offer several advantages: limited insurer insolvency risk, the ability of the government to spread risk over time, financing of short-run losses by borrowing, and lower requirements for federal disaster relief. The disadvantages would be the potential burden on taxpayers, weak underwriting incentives to keep the cost of claims low, preemption of existing and future private sector capacity, difficulty in implementing or sustaining risk-based pricing in a political environment, and potential impediments to capital market innovations, such as catastrophe bonds and options, that securitize catastrophe risk.

Since the late 1960s, the prevailing view among federal and state legislators and regulators has been that earthquake risks could be managed and financed in the private sector. Congress explicitly chose not to implement a federal earthquake insurance program because the justification that the earthquake hazards could not be insured by the private sector had not been convincingly made. Policy debate during and after the 88th Congress following the 1964 earthquake and accompanying tsunami at Alaska's Prince William Sound led to the creation in 1968 of the National Flood Insurance Program (NFIP).³⁴ Congress, however, waited until 1977 before addressing earthquake hazards with the creation of the National Earthquake Hazards Reduction Program (NEHRP).³⁵ NEHRP established for the first time a federal policy to encourage research on and implementation of methods to reduce earthquake losses.

Substantial progress has been made in the fields of earthquake science and engineering following the implementation of NEHRP, particularly with respect to seismic hazard identification and strategies to reduce seismic vulnerability of facilities and systems through land use practices and

³⁴ The National Flood Insurance Program was established under the National Flood Insurance Act of 1968 (P.L. 90-448, title XIII, §1360, August 1, 1968, 82 Stat. 476, codified at 42 U.S.C. §§4001-4128).

³⁵ The NEHRP was established by the Earthquake Hazard Reduction Act of 1977 (P.L. 95-124; 91 Stat. 1098; Oct. 7, 1977). The NEHRP involves four agencies: Federal Emergency Management Agency (FEMA); National Institute of Standards and Technology (NIST); National Science Foundation (NSF); and United States Geological Survey (USGS). The goals of NEHRP are to (1) reduce earthquake losses, (2) improve techniques to reduce seismic vulnerability of facilities and systems, (3) improve seismic hazards identification and risk-assessment methods and their use, and (4) improve the understanding of earthquakes and their effects.

improvements in design and construction techniques. Disaster policy experts agree that despite the efforts of four federal agencies that collaborate under the NEHRP, one issue that has not been adequately addressed is the economic consequences of a catastrophic earthquake, and the efficiency and adequacy of present mechanisms for financing catastrophic earthquake recovery. NEHRP was not required to address this issue.

Policy Issues and Questions

The 112th Congress may choose to examine some of the following policy questions with respect to earthquake risk, insurance, and recovery:

- Is earthquake risk uninsurable in the private market?
- Is a federal residential earthquake insurance program feasible?
- What are the costs and benefits of government intervention in the catastrophe insurance market?
- Do benefits outweigh costs to taxpayers for providing a financial backstop for the insurance industry?
- Should federal earthquake insurance be compulsory, and, if so, what would be the enforcement mechanism?
- What role should land-use regulations and building codes have in mitigating disaster risk? Is current insurance regulation conducive to creating private sector incentives for mitigation?

Insurance market experts agree that the risk of a mega-catastrophic event could pose a significant capacity and liquidity problem for insurers who receive relatively stable premium flows but suddenly need large amounts of cash to cover disaster losses. A sudden loss of policyholder surplus, which is the statutory net worth or cushion available to insurers for handling the unexpected, could have an adverse effect on the financial strength of the property and casualty insurance industry. To better manage catastrophe risk, insurers have sought to raise premiums, impose a percentage deductible, and reduce the amount of concentration of their exposures. These changes have led to availability and affordability problems for many homeowners in disaster-prone areas.

The Japan earthquake and tsunami suggest several approaches to catastrophe risk and insurance issues, including (1) revisiting the nature and extent of earthquake and tsunami hazards in the United States and (2) addressing the challenges of financing recovery given limited capacity of national insurance markets to absorb the cost and economic burden of a devastating mega-earthquake. Given the economic devastation in Japan, there is heightened congressional interest in finding ways to reduce disaster risk for homeowners, insurance companies, financial firms, and federal and state governments. Members of Congress could decide to explore alternative policy designs and to consider ways to assist the private sector to pre-fund and diversify disaster risk by financing catastrophic losses through insurance, reinsurance, and capital from financial institutions and the investment community.

Finally, various government actions, such as those designed to increase access to federal disaster assistance or insurance, are likely to affect the behavior of individuals and firms in responding to catastrophe risk. For example, by reducing the financial risks of disaster-prone areas, new federal

policies could create financial incentives for some people to move into harm's way, which would increase the potential for catastrophic property damages and economic losses. Hence, Congress will find no shortage of issues to debate and resolve when considering proposals to establish a federal earthquake insurance program.

Legislation

On March 17, 2011, Senators Barbara Boxer and Dianne Feinstein introduced S. 637, Earthquake Insurance Affordability Act. S. 637 would authorize the U.S. Treasury to guarantee up to \$5 billion in bonds available to state certified public entities, like the California Earthquake Authority (CEA), following a catastrophic seismic event. The state entity would have to exhaust its claims-paying ability before the federal guarantee becomes available. The measure is designed to reduce earthquake insurance rates by reducing the need for insurers to purchase reinsurance. The bond would be repaid with premiums.

Appendix. Standard Property Insurance Earthquake and Flood Exclusion Language

We do not pay for loss resulting directly or indirectly from any of the following, even if other events or happenings contributed concurrently, or in sequence, to the loss:

(1) by earth movement, due to natural or man-made events, meaning earthquake including land shock waves, or tremors before, during or after a volcanic eruption, mine subsidence; landslide; mud-slide; mud flow; earth sinking; rising or shifting. Direct loss by Fire, Explosion, Sonic Boom, Theft, or Breaking of Glass resulting from earth movement, mine subsidence, landslide, mud-slide, mud flow, earth sinking, rising or shifting is covered.

(2) by water damage, meaning:

(a) flood, surface water, waves, tides, tidal waves or overflow of a body of water. We do not cover spray from any of these, whether or not driven by wind;

(b) water or sewage which backs up through sewers or drains; or

(c) water below the surface of the ground. This includes water which exerts pressure on, or flows, seeps or leaks through any of a building or other structure, sidewalk, driveway, foundation, or swimming pool.

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