



Insurance against Extreme Events: Pairing Short-Term Incentives with Long-Term Strategies

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Why do many homeowners purchase insurance only *after* experiencing a loss from a rare and extreme event, like an earthquake or a large hurricane?

Why do insurance companies classify certain types of risk as uninsurable? And why do insurance regulators prohibit insurers from setting premiums that reflect risk, particularly in locales that repeatedly suffer losses from natural disasters?¹

The short answer is that insurance today is misunderstood and hence is not effectively meeting its most important objectives—to inform those at risk about the hazards they face, to reduce damage from future disasters and to provide claims payments to policyholders who suffer losses. More specifically, insurers and their regulators are not providing transparent information to people residing in hazard-prone areas as to the nature of the risks they face, and consumers are not adequately incentivized to undertake loss reduction measures prior to a disaster. As a result, U.S. taxpayers have been on the hook for large losses from extreme events over the last few decades. The 2005 and 2012 hurricane seasons alone cost taxpayers nearly \$150 billion.

The evidence on the increased losses from natural catastrophes and more extreme weather trends suggests that the worst is yet to come. As of the end of 2012, there was \$35 trillion of insured exposure in the coastal states from Texas to Maine. If appropriate mitigation measures are not adopted, future hurri-

SUMMARY

- Consumers tend to purchase too little insurance or purchase it too late. Consequently, taxpayers wind up bearing substantial burdens for paying reconstruction costs from extreme events. The 2005 and 2012 hurricane seasons alone cost taxpayers nearly \$150 billion.
- There is much that can be done to better facilitate the role that insurance can play in addressing losses from extreme events, both natural and man-made.
- To better meet its objectives, insurance must implement two guiding principles. First, premiums should accurately reflect risk. But if this principle is put into effect, individuals in hazard-prone areas will face large, unexpected price increases, necessitating the second guiding principle: to ensure equity and affordability, special financial assistance should be made available to the homeowners who would no longer be able to afford their premiums.
- Other policy tools that can help reduce losses from extreme events include: choice architecture that will encourage individuals to purchase and maintain insurance; public-private partnerships to provide private insurers with federal reinsurance in the case of truly catastrophic disasters and to make low-interest loans and grants more available to property owners; and multi-year insurance policies tied to risk-prone properties.
- Collectively, these measures would lead to less property damage, lower costs to homeowners, more secure mortgages, and lower costs to the government and taxpayers for disaster assistance.



canes and floods are likely to replace Katrina and Sandy in the rankings of the most costly insured losses in the coming years.

In the United States, there is much that can be done to better facilitate the role that insurance can play in addressing these issues in the face of extreme events, both natural and man-made. In particular, short-term incentives and policy options are needed to improve the decision-making of consumers, insurance companies, and insurance regulators.

To be effective, insurance requires accurate risk assessment for setting premiums that reflect the likelihood and consequences of damage. Moreover, insurers should conduct regular inspections to ensure that property meets existing building codes; they can then offer premium discounts for those who undertake loss reduction measures. This is the way that factory mutuals operated when they were founded in the mid-1800s. Firms were given an insurance policy only after they were inspected and shown to be safe. Insurance premiums reflected the best estimates of the risk; improvements were rewarded with lower premiums reflecting the expected reduction in future claims. Firms that did not continue to keep their factories

TABLE 1: FIFTEEN MOST COSTLY INSURED CATASTROPHES (1970-2015)

\$ Billion	Event	Victims	Year	Area of Primary Damage
78	Hurricane Katrina; floods	1,836	2005	USA, Gulf of Mexico
41	9/11 Attacks	3,025	2001	USA
37	Earthquake (M 9.0) and tsunami	19,135	2011	Japan
35	Hurricane Sandy; floods	237	2012	USA
26	Hurricane Andrew	43	1992	USA, Bahamas
22	Northridge Earthquake (M 6.6)	61	1994	USA
22	Hurricane Ike; floods	136	2008	USA, Caribbean
16	Hurricane Ivan	124	2004	USA, Caribbean
15	Floods; heavy monsoon rains	815	2011	Thailand
15	Earthquake (M 6.3); aftershocks	181	2011	New Zealand
15	Hurricane Wilma; floods	35	2005	USA, Gulf of Mexico
12	Hurricane Rita	34	2005	USA, Gulf of Mexico, et al.
11	Drought in the Corn Belt	123	2012	USA
10	Hurricane Charley	24	2004	USA, Caribbean, et al.
10	Typhoon Mireille	51	1991	Japan

operating safely were warned that their insurance policy would be canceled unless they took corrective action.²

Choice architecture, public-private partnerships, and multi-year insurance policies all have a role to play here. At the same time, appropriate financial assistance programs must be developed for those whose risk-based premiums are so high that they cannot afford coverage.

INTUITIVE AND DELIBERATIVE THINKING

Decision-makers normally deal with risk by combining intuitive thinking with deliberative thinking. *Intuitive thinking* operates automatically and quickly, with little or no effort and no voluntary control. It is often guided by emotional reactions or simple rules of conduct that have been acquired by personal experience with events and their consequences. *Deliberative think-*

NOTES

¹ This issue brief is based on Kunreuther, H. (2015). The Role of insurance in reducing losses from extreme events: The need for public-private partnerships, *Geneva Papers on Risk and Insurance*, 1018-5895/15, Vol. 40, pp. 741-762.
² Bainbridge, J. (1952). *Biography of an Idea: The Story of Mutual Fire and Casualty Insurance*, Garden City, NY: Doubleday; Kunreuther, H. and Roth, R., Sr. (eds.) (1998) *Paying the Price: The Status and Role of Insurance against Natural Disasters in the United States*. Washington, D.C.: Joseph Henry Press.

³ Kahneman, D. (2011). *Thinking, Fast and Slow*, New York: Farrar, Straus and Giroux.

⁴ Botzen et al. show that only 20% of those who suffered damage from Hurricane Sandy had purchased flood insurance before the storm occurred. Botzen, W., Kunreuther, H. and Michel-Kerjan, E. (2015). Divergence between individual perceptions and objective indicators of tail risks: Evidence from floodplain residents in New York City. *Judgment and Decision Making* 10(4): 365-385.

⁵ Michel-Kerjan, E., Lemoine de Forges, S. and Kunreuther,

H. (2012). Policy tenure under the U.S. National Flood Insurance Program (NFIP). *Risk Analysis* 32(4): 644-658.

⁶ Premiums are higher after a disaster because insurers seek to recoup losses by raising rates.

⁷ Cummins, D.J. and Lewis, C.M. (2003). Catastrophic events, parameter uncertainty and the breakdown of implicit long-term contracting in the insurance market: The case of terrorism insurance. *Journal of Risk and Uncertainty* 26(2/3): 153-178.

⁸ For more details on a proposed voucher program based on



ing allocates attention to effortful and intentional mental activities where individuals undertake trade-offs implicit in benefit-cost analysis, and recognize relevant interdependencies and connectedness as well as the need for coordination in coping with extreme events.

Behavioral decision research and cognitive psychology teach us that intuitive thinking, guided heavily by emotions and focused on short time horizons and goals, is a common human response for dealing with low-probability, high-consequence events, oftentimes at the expense of adopting cost-effective deliberative strategies for mitigating future catastrophes.³

Consumers who engage in intuitive thinking often fail to purchase insurance, or buy it only after suffering losses from a disaster. Insurers who engage in intuitive thinking sometimes proclaim that a risk is uninsurable even when the data exists to assess the risk (as in the case of earthquake insurance), or when the risk is insurable only with the help of a federal backstop against large losses (as in the case of terrorism insurance). Regulators sometimes prevent insurers from charging premiums that reflect risk, which may suggest to those residing in hazard-prone areas that they are

safe from disasters when, in fact, they are not.

These conditions often lead the federal government to allocate large sums of disaster relief that result in taxpayers bearing substantial burdens for paying reconstruction costs from extreme events.

The history of flood insurance highlights the challenges we face today in encouraging property owners to invest in loss reduction measures. Following the Mississippi Flood of 1927, private insurers ceased offering flood coverage because they felt the risk was uninsurable due to the possibility of highly-correlated large losses. In the wake of Hurricane Betsy in 1965, the federal government established the National Flood Insurance Program (NFIP) in 1968. Since the inception of the NFIP, the federal government has been heavily subsidizing flood insurance premiums for existing homes in flood-prone areas so that insurance would be affordable and to protect property values. However, when premiums are subsidized there is no incentive for homeowners to undertake loss reduction measures, or for the federal government to provide discounts for those who invest in loss reduction measures.

Even though homeowners in

hazard-prone areas are required to purchase flood insurance as a condition for a federally insured mortgage, many homeowners do not purchase this coverage until after they suffer a loss.⁴ A large percentage of these homeowners later drop their coverage if they do not make a claim over the next few years. An analysis of the NFIP portfolio found that just 73% of the 841,000 new flood insurance policies purchased in 2001 were still in force one year later. The rate dropped to 49% after two years and only 20% after eight years.⁵ This behavior of ignoring potential disasters and overreacting to recent ones by purchasing policies when premiums are at their highest seems contradictory, but in fact it stems from the same source: a lack of information and incentives.⁶

The problem, in large part, lies in the widely held view that insurance is an investment from which individuals expect a return in the form of claims payments following a disaster. In reality, insurance is a protective measure should one suffer a loss. Homeowners should celebrate not having a loss because the financial consequences for an uninsured individual could be staggering. One open question is how to communicate to

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empirical data, see: Kousky, C. and Kunreuther, H. (2014). Addressing affordability in the national flood insurance program. *Journal of Extreme Events* 1(1): 1–28.
⁹ Thaler, R. and Sunstein, C. (2008). *Nudge: The Gentle Power of Choice Architecture*, New Haven, CT: Yale University Press.
¹⁰ Weinstein, N.D., Kolb, K. and Goldstein, B.D. (1996). Using time intervals between expected events to communicate risk magnitudes. *Risk Analysis* 16(3): 305–308.
¹¹ Thaler and Sunstein (2008).

¹² For more information, see <http://shoreuptc.org/>

¹³ For more details on the renewal of TRIA, see: Kunreuther, H., Michel-Kerjan, E., Lewis, C., Muir-Wood, R. and Woo, G. (2014). TRIA after 2014. Wharton Risk Management Center, University of Pennsylvania.

¹⁴ Kunreuther, H. and Michel-Kerjan, E. (2015). Demand for fixed-price multi-year contracts: Experimental evidence from insurance decisions. *Journal of Risk and Uncertainty* 51(2): 171–194.
¹⁵ Well-enforced building codes in Chile led to the relatively low

death toll from the 8.8 magnitude earthquake that shook the country in 2010. See: Useem, M., Kunreuther, H. and Michel-Kerjan, E. (2015) *Leadership Dispatches: Chile's Extraordinary Comeback from Disaster*. Stanford, CA: Stanford University Press.

¹⁶ Lewis, C. and Murdock, L. (1996). The role of government contracts in discretionary reinsurance markets for natural disasters. *Journal of Risk and Insurance* 63(4): 567–597.

¹⁷ Repetto, R. and Easton, R. (2012). Climate change and damage from extreme weather events. *Environment* 52(2): 22–33.



people that *the best return on an insurance policy is no return at all.*

Homeowners are not the only stakeholders to exhibit systematic biases and utilize simplified decision rules. Consider insurance and reinsurance companies in the presence of ambiguous risk. Most insurers instinctively stopped underwriting policies to cover losses from terrorist attacks after 9/11 because reinsurers refused to protect them against losses from another attack.⁷ Protection against terrorism was never explicitly priced in or excluded from commercial policies prior to that event, despite numerous attacks in the preceding decade. However, terrorism was deemed an uninsurable risk almost overnight, largely because there was no rule of thumb to instruct actuaries and underwriters on how to assess the likelihood or magnitude of the risk.

Regulators are also susceptible to intuitive thinking errors that can lead to inefficient outcomes. For example, state insurance regulators occasionally restrict insurers from setting premiums that reflect risk in an attempt to guarantee equity and fairness for homeowners, regardless of their varying levels of risk.

TWO GUIDING PRINCIPLES OF INSURANCE

Insurance fails to meet its objectives when it does not heed what should be its two guiding principles. As discussed in a previous Penn Wharton Public Policy Issue Brief (Vol.1 No. 9), the first principle states that *premiums should reflect risk* as a means of signaling to individuals how safe or exposed they are, as well as the extent

to which preventive or protective measures will reduce their vulnerability to losses and hence their premiums. If this principle is applied in hazard-prone areas where premiums are currently subsidized, some residents will face large, unexpected price increases, which leads to the second guiding principle.

If premiums should reflect risk, then *equity and affordability need to be considered.* Special financial assistance should be made available to the homeowners currently residing in hazard-prone areas who would no longer be able to afford their premiums. The assistance could come from means-tested vouchers⁸ or through other means such as tax credits or tax rebates. It should not be in the form of a subsidized insurance premium. This principle applies only to individuals with limited means who currently reside in hazard-prone areas. Those who choose to move to these areas would be charged premiums that reflect their true risk.

Risk-based insurance pricing opens the door for significant premium reduction potential if homeowners take steps to mitigate their property risks. Elevating a home within a floodplain, for example, could lead to greatly reduced insurance premiums, but such an investment is costly. To facilitate the process of mitigating one's home, vouchers or tax credits could be coupled with low-cost, long-term loans to spread the cost of mitigation over the life of the mortgage.

POLICY TOOLS TO IMPROVE DELIBERATIVE RISK MANAGEMENT POLICY

Beyond the two guiding principles of insurance, understanding decision-making under risk and uncertainty also is essential for insurers, regulators, and policymakers. The following list of policy tools provides structure for applying the guiding principles to reduce losses from extreme events in the long run.

1. CHOICE ARCHITECTURE

Decisions often depend on how options are presented and how probabilities are framed.⁹ For example, consumers better grasp the likelihood of suffering losses from an extreme event if the odds are given over a longer timeline. Homeowners are more likely to pay attention to their flood risk if they are told that they have a greater than 1-in-5 chance of experiencing at least one severe flood in the next 25 years rather than indicating to them that there is a 1-in-100 probability of a severe flood next year.¹⁰

Making insurance purchase the default option may also lead to better coverage for homeowners, as many experiments show that individuals tend to stick with pre-selected choices instead of opting out and seeking alternative options in situations where outcomes that are certain or where the default option carries the highest expected benefit.¹¹ This tool has not yet been tested on purchasing and maintaining catastrophe insurance.

2. PUBLIC-PRIVATE PARTNERSHIPS

There is a role for government to play in helping incentivize stakeholders.



For example, Public-Private Partnerships (PPPs) can assist individuals who cannot otherwise afford to invest in protective measures because of high upfront costs. Homeowners' resistance to undertaking mitigating action increases if they plan to move in the next few years because of their fear that the property value of their house will not reflect the expected benefits of their flood- or wind-proofing investments.

PPPs make mitigation measures accessible and affordable through low interest loans and grants that are currently offered by the Federal Emergency Management Agency (FEMA) to property owners in hazard-prone areas. In July 2014, Connecticut initiated its *Shore Up CT* program designed to help residential and business property-owners elevate buildings, retrofit properties with additional flood protection, or assist with wind-proofing structures on property that is prone to coastal flooding. This state program, the first in the United States, enables homeowners to obtain a 15-year loan ranging from \$10,000 to \$300,000 at an annual interest rate of 2-3/4 (two and three-quarters) percent.¹²

An innovation would be to market disaster insurance and the mitigation loan as a package tied to the property. This program would address both the mitigation and affordability issues simultaneously. Homeowners who invest in cost-effective loss-reduction measures would be given a premium discount to reflect the reduction in expected losses from disasters, which would more than pay for the cost of their home improvement loans. Net financial benefits from undertaking

the mitigation measure would then be obvious to the homeowner.

On the supply side, private insurers would be more willing to provide coverage against extreme events if the public sector covered part of the losses should the disaster be catastrophic. The Terrorism Risk Insurance Act (TRIA), passed after the 9/11 attacks, is a federal backstop for private insurers that limits catastrophic losses for insurance companies. American taxpayers will not be responsible for any payments until the total commercial losses from a terrorist attack exceed \$60 billion. In return for the federal reinsurance, insurers are required to make terrorism insurance available to all their commercial clients, even though firms are under no obligation to buy this insurance.¹³

Insurers' withdrawal from certain markets led to the establishment of government-backed programs such as the California Earthquake Authority and the National Flood Insurance Program (NFIP).

3. MULTI-YEAR INSURANCE POLICIES

A useful complement to incentivizing property improvement is a multi-year insurance (MYI) policy tied to the property. Insurers could consider designing three-to-five-year policies, to dissuade policyholders from canceling their policies if they did not suffer losses for several years. Property owners would benefit from stable annual premiums and would incur a penalty should they cancel their policy unless they sold their house during this period. MYI policies would also motivate insurers to inspect properties over time to ensure building code compliance—something they would

not do with annual contracts—and would decrease their marketing costs. Empirical evidence from a controlled experiment indicates that buyers prefer a two-year insurance contract to one-year contracts even with higher annual premiums. And just introducing the two-year option into the menu of choices increases aggregate consumer demand for disaster insurance.¹⁴ However, MYI policies are non-starters for insurers without their ability to charge risk-based premiums.

4. ADDITIONAL POLICY TOOLS

Other policy options for overcoming the challenges inherent in the intuitive thinking of consumers, insurers, and regulators include:

- Requiring homeowners in hazard-prone areas to carry coverage for catastrophic risk.
- Holding builders and original owners accountable for all disaster-related damage in the event of building violations. Chile does this, and the accountability period lasts up to a decade.¹⁵
- Providing seals of approval certifying that a property owner has taken steps toward mitigating disaster risk. These would be signals to potential buyers and would help to ensure that property values adequately reflect risk reduction investments.
- Auctioning (at the federal level) a limited number of annual catastrophe reinsurance contracts to private insurers, extending backstop protection for risks other than terrorism.¹⁶

The social welfare benefits of these strategies and policy tools are numerous. Collectively, they would lead to less damage to property, lower costs to insurers for protecting against cata-



strophic losses, more secure mortgages, and lower costs to the government and taxpayers for disaster assistance.

DATA NEEDED

In order to determine the price of risk-based premiums and affordability, there is need for more accurate data, a principal reason that FEMA is now updating their flood risk maps. Anonymized census data on household income and other factors such as percentage of income spent on mortgage would help to inform criteria for determining circumstances and methods on how financial assistance could be provided to address affordability issues.

One risk in particular that federal agencies and other organizations have greatly underestimated is climate change and sea level rise. Forecasting the potential damage from climate

change and sea level rise and preparing policy responses to extreme weather events require that risk management stakeholders more fully address assessment, mitigation, and affordability concerns sooner rather than later.¹⁷

CONCLUSION

The United States must capitalize on the concerns raised by Hurricane Sandy and the discussions for the renewal of the NFIP in 2017. The NFIP is \$27 billion in debt to the U.S. Treasury in the aftermath of hurricanes over the last decade, and the most accurate scientific models suggest that we are going to face even more extreme weather in the coming years. If premiums reflecting risk based on accurate, data-driven risk assessment can be augmented by public-private partnerships that

support mitigation loans, grants, and means-tested vouchers to ensure affordability, insurance in the United States could begin to reach its potential. Reducing the need for taxpayer money for future disaster relief should be a top priority for policymakers.

For risk-based insurance to be part of such a strategy, there is a need for support from key interested parties. These include real estate agents, developers, banks and financial institutions, and residents in hazard-prone areas, as well as public sector organizations at the local, state and federal levels. Insights from behavioral science, innovations from the insurance industry, and other policy tools can then aid in directing consumers, insurers, and regulators towards this vision of strategic disaster-risk management policy.



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Comeback from Disaster (with Michael Useem and Erwann Michel-Kerjan). Professor Kunreuther received the 2015 Shin Research Excellence Award from the Geneva Association and the International Insurance Society (IIS) in recognition of his outstanding work on the role of public-private partnerships in mitigating and managing risks.

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