The Role of Insurance in Risk Management for Natural Disasters: Back to the Future

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Insurance today is not effectively meeting two of its most important objectives:

- Providing information to those residing in hazard-prone areas as to the nature of the risks they face
- Incentivizing those at risk to undertake loss reduction measures prior to a disaster

When factory mutual insurance companies were formed in the mid-1800s these were their two central goals. Inspections were undertaken prior to issuing an insurance policy and were continued on a regular basis after coverage was in force. High risks had their policies canceled; premiums reflected risk and were reduced for factories that instituted additional risk reduction measures. In many cases, factory mutual companies would provide coverage only to firms that adopted specific loss prevention methods. For example, one company, the Spinners Mutual, only insured risks where automatic sprinkler systems were installed [Bainbridge (1952)].

This paper proposes a strategy for using insurance coupled with other policy tools to take steps to return to its 19th century roots in dealing with the risks facing property owners in hazard-prone areas. More specifically, I will address the following question:

What role can the private and public sectors play in reducing losses from future natural disasters, recognizing the limitations of individuals in dealing with low-probability, high-consequence (LP-HC) events and the challenges the insurance industry faces in providing coverage against these risks?

To answer this question it is helpful to understand why residents in hazard-prone areas often ignore future disasters so information can be presented in ways that they are more likely to pay attention to the hazard. Private insurance coupled with other policy tools can then encourage investment in loss reduction measures. The public sector has a role to play by providing assistance to deal with affordability issues and offering financial protection to insurers against catastrophic losses.

How We Behave When Faced with LP-HC Events

In his thought-provoking book, *Thinking, Fast and Slow*, Daniel Kahneman has characterized the differences between intuitive and deliberative thinking based on research over the past 30 years [Kahneman (2011)]. *Intuitive thinking* (System 1) operates automatically and quickly with little or no effort and no voluntary control. It is often guided by emotional reactions and simple rules of thumb that have been acquired by personal experience. *Deliberative thinking* (System 2) allocates attention to effortful and intentional mental activities where individuals undertake trade-offs, recognize relevant interdependencies and the need for coordination.

Choices are normally made by combining these two modes of thinking and generally lead to good decisions when individuals have considerable past experience as a basis for their actions. The same
cannot be said with to actions in response to LP-HC events. Empirical studies have revealed that many individuals engage in intuitive thinking and focus on short-run goals when dealing with unfamiliar LP-HC risks [Cutler and Zeckhauser (2004); Krantz and Kunreuther (2007); Kunreuther, Pauly and McMorrow (2013)]. They often exhibit systematic biases such as the *availability heuristic*, where the judged likelihood of an event depends on its salience and memorability [Tversky and Kahneman (1973)]. There is thus a tendency to ignore rare risks until after a catastrophic event occurs. This is a principal reason why it is common for individuals at risk to purchase insurance only after a large-scale disaster. For example, a recent field survey of the risk perception of homeowners in New York City revealed that most homeowners underestimated the likelihood of water damage to their property from hurricanes. This may explain why only 20 percent of those who suffered damage from Hurricane Sandy had purchased flood insurance before the storm occurred [Botzen, Kunreuther, and Michel-Kerjan et al. (2015)].

When deciding whether to invest in measures to reduce losses to one’s property, homeowners normally do not engage in deliberative thinking by comparing the upfront costs of the measure with the expected discounted benefits over the life over the structure. There are three principal reasons that residents in hazard-prone areas have limited interest in mitigation measures: (1) they underestimate the risk and perceive the likelihood of a disaster to be below their threshold level of concern, (2) the loss reduction measures involves a high upfront cash outlay due to budget constraints and (3) they are myopic and focus on short time horizons. Decision makers’ resistance is likely to be compounded if they are concerned that if they move in the next few years, the property value of their home will not reflect the expected benefits from investing in loss reduction measures because the new owner will not be concerned about the risk of a disaster [Kunreuther, Meyer and Michel-Kerjan (2013)].

**Using Choice Architecture to Address Intuitive Thinking**

If those residing in hazard-prone areas perceive the likelihood of losses to be below their threshold level of concern they will have no interest in purchasing insurance or investing in loss reduction measures. One way to address this problem is to recognize that people’s decisions depend in part on how different options are framed and presented—i.e., the use of *choice architecture* [Thaler and Sunstein (2008); Johnson et al (2012)]. In the context of LP-HC events, framing refers to the way in which likelihoods and outcomes of a given risk are characterized.

With respect to the likelihood dimension, people are better able to evaluate low-probability risks when these are presented via a familiar concrete context. For example, individuals might not understand what a one-in-a-million risk means but can more accurately interpret this figure when it is compared to the risk of an automobile accident (1-in-20) or lightning striking your home on your birthday (less than one-in-a-billion).

Probability is more likely to be a consideration if it is presented using a longer time frame. People are more willing to wear seat belts if they are told they have a 1-in-5 chance of an accident over a 50-year lifetime of driving, rather than a 1-in-100,000 chance of an accident on each trip they take [Slovic, Fischhoff, and Lichtenstein (1978)]. Similarly, a homeowner or manager considering
earthquake protection over the 25-year life of a home or factory is far more likely to take the risk seriously if told that the chance of at least one severe earthquake occurring during this time period is greater than 1-in-5, rather than 1-in-100 in any given year [Weinstein, Kolb, and Goldstein (1996)]. Studies have shown that even just multiplying the single-year risk so the numerator is larger—presenting it as 10-in-1,000 or 100-in-10,000 instead of 1-in-100—makes it more likely that people will pay attention to the event [Slovic, Monahan, and MacGregor (2000)]. Studies have also found that comparisons of risks—rather than just specifying the probability of a loss or an insurance premium—are much more effective in helping decision makers assess the need for purchasing insurance [Kunreuther, Novemsky, and Kahneman (2001)].

Another way to frame the risk so that individuals pay attention is to construct a worst-case scenario about the financial consequences of being uninsured if they were to suffer severe damage from a flood or earthquake. One could then provide them with information on the likelihood of the event occurring over the next 25 years rather than just next year.

**Reducing Losses from LP-HC Events**

If people pay attention to the risk of an LP-HC, then insurance coupled with other policy tools can incentivize property owners to invest in loss reduction measures. Risk-based premiums will give property owners accurate signals as to the degree of the hazards they face and will provide them with financial incentives to invest in cost-effective mitigation measures in the form of premium reductions that reflect the lower expected claims payments from future disasters. Today disaster insurance in hazard-prone areas is often subsidized due to state regulations or through government insurance, such as the National Flood Insurance Program. If premiums are now increased, property owners are likely to complain that they cannot afford coverage. Premiums need to reflect risk for an insurance program to take in sufficient revenue over time to cover expected claims payments while at the same time encouraging investment in loss reduction measures.

**Means-tested vouchers.** One way for insurance premiums to be risk-based and at the same time address affordability issues is to provide means-tested vouchers to cover the costs of protecting one’s property. Several existing public sector programs could serve as models for developing such a voucher system: the Food Stamp Program, the Low Income Home Energy Assistance Program (LIHEAP) and Universal Service Fund (USF). The amount of the voucher would be based on current income or wealth using a specific set of criteria that are outlined in a recent report by the National Research Council [NRC (2015)] on affordability of flood insurance. As a condition for the voucher, the property owner could be required to invest in mitigation. If the property owner were offered a multi-year loan to invest in mitigation measure(s), the voucher could cover not only a portion of the resulting lower risk-based insurance premium, but also the annual loan cost. An empirical study of homeowners in Ocean County, NJ reveals that the amount of the voucher is likely to be reduced significantly from what it would have been had the structure not been mitigated, as shown in Figure 1 for property in a 100-year coastal hazard flood area (the V zone) and a 100-year inland hazard area (the A zone) [Kousky and Kunreuther (2014)].
Well-enforced building codes. Risk-based insurance premiums and means-tested vouchers could be coupled with well-enforced building codes. Following Hurricane Andrew in 1992, Florida reevaluated its building code standards, and coastal areas of the state began to enforce high-wind design provisions for residential housing. Homes that met the wind-resistant standards enforced in 1996 had a claim frequency that was 60 percent less than homes that were built prior to that year. The average reduction in claims from Hurricane Charley to each damaged home in Charlotte County built according to the newer code was approximately $20,000 [Institute for Business Home and Safety (2007)].

Homeowners who adopted cost-effective mitigation measures could receive a seal of approval from a certified inspector that the structure meets or exceeds building code standards. A seal of approval has the potential of increasing the property value of the home by informing potential buyers that damage from future disasters is likely to be reduced because the mitigation measure is in place.

Multi-year insurance. Insurers could consider designing multi-year insurance (MYI) contracts of three to five years with the policy tied to the structure rather than the property owner. The annual risk-based premium would remain stable over the length of the contract. Property owners who cancel their insurance policy early would incur a penalty cost in the same way that those who refinance a mortgage have to pay a cancellation cost to the bank issuing the mortgage. Insurers would now have an increased incentive to inspect the property over time to make sure that building codes are enforced, something they would be less likely to do with annual contracts. For a private insurer to want to market coverage, there needs to be sufficient demand to cover the fixed and administrative costs of developing and marketing the product. A web-based experiment revealed
that a large majority of the responders preferred a 2-year insurance contract over two 1-year contracts and increased the aggregate demand for disaster insurance [Kunreuther and Michel-Kerjan (2015)].

Features of a Private-Public Partnership for Insuring LP-HC Events

The history of flood and earthquake insurance provides guidelines for developing a private-partnership for insuring extreme events. Few insurers offer residential policies against floods in the United States and earthquakes in California today. Following the severe Mississippi River floods of 1927 no private insurer offered flood coverage, thus leading to the formation of the federally-run National Flood Insurance Program (NFIP) in 1968. The state-run California Earthquake Authority was formed in 1996 to provide homeowners with coverage against seismic risks after private insurers concluded after the Northridge earthquake of 1994 that the insured claims from another severe earthquake in California would be too large for them to handle financially.

For private insurers to want to market coverage against these and other extreme events, the public sector will have to deal with issues of affordability, catastrophic losses and develop standards and regulations that that are well enforced. The proposed features of such a program for residential property in hazard-prone areas would involve:

- Risk-based premiums, based on accurate hazard maps and damage estimates, would give private insurers an incentive to market coverage.
- To address the affordability issue, means-tested vouchers would be provided by the public sector to those who undertook cost-effective mitigation measures.
- Premium discounts would be given to homeowners to reflect the reduction in expected losses from undertaking cost-effective mitigation measures. Long-term loans for mitigation would encourage these investments
- Well-enforced building codes and seals of approval would provide an additional rationale to undertake these loss-reduction measures. Land-use regulations could restrict property development in high hazard areas.
- A multi-year insurance (MYI) policy with stable annual premiums tied to the property would prevent policyholders from canceling their policies if they did not suffer losses for several years.
- Private reinsurance and risk-transfer instruments marketed by the private sector would cover a significant portion of the catastrophic losses from future disasters.
- Federal reinsurance provided to insurers so they are protected against extreme losses.

The benefits of this proposed program would be significant: less damage to property and potentially higher property values, lower costs and peace of mind to homeowners knowing they are protected against future disaster, more secure mortgages for banks and financial institutions, and lower disaster relief assistance by the public sector borne by the general taxpayer.

The National Flood Insurance Program (NFIP) that comes up for renewal in 2017 provides a target of opportunity for taking steps to move in the direction of a more effective private-public...
partnership. Guidelines for modifying the NFIP so that the private insurance sector can be more involved, addressing affordability issues and encouraging investments in cost-effective mitigation measures are discussed in two recent reports by the National Research Council (2015a; 2015b). Changes in the NFIP program could serve as a model for dealing with other extreme events.

Future Studies and Research Needs

Future research is needed to understand how choice architecture can be applied to LP-HC events. Field and controlled experiments in behavioral economics reveal that consumers are more likely to stick with the default option rather than going to the trouble of opting out in favor of some other alternative. Many examples of this behavior are detailed in *Nudge* [Thaler and Sunstein (2008)]. To date, this framing technique has been applied to situations where the outcome is either known with certainty, or when the chosen option (such as a recommended 401(k) plan), has a higher expected return than the other options [Madrian and Shea (2001), Thaler and Benartzi (2004)]. It is not clear whether people who fail to purchase insurance coverage would reverse course if having insurance against an extreme event were the default option, given the intuitive thinking that individuals employ for these types of risks.

To determine the price of risk-based premiums there is a need for more accurate data. In the United States, FEMA is now updating their flood-risk maps as recommended in a study by the U.S. Government Accountability Office (2008) and by recent federal legislation on the National Flood Insurance Program. The impact of changing climate patterns on future damage from flooding due to sea level rise and more intense hurricanes also needs to be taken into account.

Studies are also needed as to ways that other policy tools, such as well-enforced building codes to encourage good construction practices, can complement insurance. Enforcing building codes for all residences in Florida could reduce by nearly half the risk-based prices of insurance under climate change projections with respect to hurricane damage in 2020 and 2040 [Kunreuther, Michel-Kerjan and Ranger (2013)]. In this regard, Chile serves an example for the United States to emulate. The country passed a law that requires the original construction company to compensate those who suffer any structural damage from earthquakes and other disasters if the building codes were not followed. Furthermore, the original owner of a building is held responsible for damage to the structure for a decade, and a court can sentence the owner to prison [Useem, Kunreuther and Michel-Kerjan 2015].

The case for making communities and their residential property more resilient to natural disasters by investing in loss reduction measures is critical given increased economic development in hazard-prone areas [National Research Council (2012)]. For insurers to be part of such a strategy in the spirit of the factory mutuals, there is a need for support from other key interested parties. These include real estate agents, developers, banks and financial institution, and residents in hazard-prone areas as well as public sector organizations at the local, state and federal levels.
REFERENCES


