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# Defining the Roles of the Public and Private Sector in Risk Communication, Risk Reduction, and Risk Transfer

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## Abstract

Insurance is an essential component of household and community resilience: it protects insureds financially against disaster losses, can encourage investments in cost-effective mitigation measures through premium reductions, and facilitates rebuilding of property and long-term recovery following a disaster via claim payments. Private insurers face challenges in providing protection against low-probability, high-consequence events, however, and the perceived market failures have led governments around the world to create various (quasi to fully) public insurance entities, often designed as public-private partnerships. This paper synthesizes findings from six papers and the resulting discussion at a November 2016 workshop, “Improving Disaster Financing: Evaluating Policy Interventions in Disaster Insurance Markets.” Participants evaluated disaster insurance programs for flood, earthquake, and terrorism losses, as well as comprehensive homeowners policies. This paper discusses the difficulties in providing protection against these types of disasters and suggests ways to improve public-private partnerships for disaster financing in three interrelated areas: (1) risk communication, (2) risk reduction, and (3) risk transfer. The paper concludes with a proposal for a comprehensive insurance program that could harness the benefits of both the public and private sectors.

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## Contents

<b>1. Introduction.....</b>	<b>1</b>
<b>2. The Disaster Insurance Gap .....</b>	<b>2</b>
2.1. Consumer Behavior .....	3
2.2. Insurer Behavior.....	4
2.3. Regulator Behavior .....	6
<b>3. The Emergence of Public Private Disaster Insurance Partnerships .....</b>	<b>6</b>
<b>4. Roles of the Public and Private Sectors .....</b>	<b>10</b>
4.1. Risk Communication .....	10
4.2. Risk Reduction.....	13
4.3. Risk Transfer.....	16
<b>5. A Proposed Program .....</b>	<b>19</b>
<b>6. Conclusion and Suggestions for Future Research .....</b>	<b>21</b>
6.1. Finer-Scale Risk Communication .....	21
6.2. Higher Take-Up of Insurance .....	22
6.3. Insurance for Low-Income Households.....	22
6.4. New Policy Models.....	23
<b>References .....</b>	<b>24</b>

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Carolyn Kousky and Howard Kunreuther\*

## 1. Introduction

The cost of natural disasters has been steadily increasing around the world largely because more properties—and more valuable properties—are being built in risky locations (e.g., Benson and Clay 2004; Kousky 2014; Swiss Re Institute 2017). These rising costs have commensurately increased governments' liability for disaster losses. Since 2000, the US government has spent \$265 billion on supplemental appropriations for disaster relief (Lindsay and Murray 2014). Furthermore, climate scientists predict more intense hurricanes, heavier precipitation events, and more severe heat waves, fires, and droughts in many places across the globe and the planet warms (e.g., IPCC 2012; Sander et al. 2013).

Insurance is an essential component of household and community resilience for reducing future losses from floods, earthquakes, and other disasters because it encourages investments in cost-effective loss reduction measures while facilitating the rebuilding of damaged property and long-term recovery from disasters through claim payments (e.g., Turnham et al. 2011; Kunreuther et al. 2013). Yet the same forces that make insurance ever more critical also increase the challenges for underwriting these risks. Insuring disasters poses a challenge for insurance companies because of the potential for extreme losses. To meet regulatory and rating agency requirements, insurers must hold or purchase access to sufficient capital to remain solvent after an event; this can be costly. The high premiums associated with insuring catastrophic risks may lead consumers to take their chances by forgoing coverage. The severe loss of capital following a catastrophic disaster may also lead to “hard” insurance markets, where supply is scarce and coverage costly. These challenges have prompted various kinds of government intervention in almost all disaster insurance markets, both in the United States and around the world.

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This paper synthesizes findings from the dialogue at a workshop hosted by Resources for the Future and the Wharton Risk Management and Decision Processes Center in November 2016, as well as the six papers prepared for the workshop. The papers evaluated the following programs: the National Flood Insurance Program (NFIP), the California Earthquake Authority (CEA), wind pools in the state of Florida, the Terrorism Risk Insurance Program (TRIA), Flood Re in the UK, as well as all-hazards disaster insurance.

Here, we tease out lessons learned from these programs to suggest ways of improving public-private partnerships for disaster insurance for households and small businesses in three interrelated areas: (1) risk communication, (2) risk reduction, and (3) risk transfer. We do not consider insurance for infrastructure or large commercial entities. We first discuss the challenges of insuring disasters, and the nature of the decision processes of interested parties in dealing with low-probability, high-consequence events. With this background, we formulate guiding principles for a comprehensive insurance program and discuss the limitations of the private sector in marketing insurance without public sector involvement.

## **2. The Disaster Insurance Gap**

Insurance against disaster losses allows policyholders to finance repair and rebuilding without having to divert current income or draw down savings. Insurers that give premium discounts for hazard mitigation encourage those at risk to invest in protective measures prior to a disaster. Insurance can also reduce disaster assistance from the federal government, which may be slow to arrive, mismatched to meet immediate needs, and distortionary—that is, it may generate perverse incentives (Talbot and Barder 2016). For instance, disaster aid may lead those at risk to underinvest in risk reduction or may skew decisions toward what is funded even if that is not optimal. Insurance, on the other hand, when priced appropriately, tends to have fewer incentive problems.

Despite those benefits of insurance, a large disaster insurance gap exists worldwide and in the United States (Swiss Re Institute 2017). For example, just over 10 percent of homes in California have earthquake insurance (Marshall 2017). In 100-year floodplains of the United States, only roughly half of homes are insured against floods, and even fewer outside these areas carry flood insurance (e.g., Dixon et al. 2006; New York City 2013; Adams 2015). A number of factors may suppress consumer demand for disaster coverage, impede insurers from supplying coverage, and/or present regulatory challenges for insurance commissioners.

Empirical studies guided by research in cognitive psychology and behavioral decisionmaking over the past 50 years have revealed that individuals and organizations often make suboptimal decisions about low-probability, high-consequence risks. Decisions about these risks are often governed by combining intuitive with deliberative thinking. In his thought-provoking book *Thinking, Fast and Slow*, Nobel Laureate Daniel Kahneman (2011) summarized the differences between these two modes of thinking.

*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 acquired by personal experience. *Deliberative thinking* (System 2) allocates attention to effortful and intentional mental activities in which individuals evaluate trade-offs, recognize relevant interdependencies, and consider the need for coordination. Most people make choices by combining these two modes of thinking.

Intuitive processes work well when people have copious data on the outcomes of different decisions, and when recent experience is a meaningful guide for future actions. These processes in general do not work well for low-probability, high-consequence events, however, because by definition, such events are rare and people have limited or no past experience with them. For extreme events, individuals exhibit systematic biases, such as being unduly influenced by a recent disaster, underestimating the future likelihood of a severe loss, or dismissing a risk by treating it below their threshold level of concern.

### **2.1. Consumer Behavior**

Low-probability, high-consequence events are subject to the *availability bias*, where the judged likelihood of an event depends on its salience (Tversky and Kahneman 1973). This is a principal reason why individuals might purchase insurance only after a disaster but cancel their policies several years later: if they have not suffered a loss, they now perceive the likelihood of a disaster as low. An analysis of NFIP policies revealed that the median tenure of flood insurance was between two and four years, whereas the average length of time in a residence was seven years (Michel-Kerjan et al. 2012). This behavior can be observed even when homeowners are required to purchase flood insurance as a condition for obtaining a federally insured mortgage if banks and financial institutions fail to enforce the requirement over the life of the loan.

Individuals are also myopic, in that they focus on the returns that they are likely to receive in the next few years rather than over a longer time horizon. When determining whether to invest in protection to reduce losses to a home or business, people often view the upfront costs

as much higher than the expected benefits over the next two or three years, and hence they decide not to undertake these actions. If they focused on the full life of the property, they might realize that the expected benefits from the mitigation measure exceed the upfront costs; from a financial perspective, then, the investment would be justified.

Other factors can cause households to be uninsured against disasters. In the United States, standard homeowners policies exclude losses from floods and earthquakes. Homeowners may not realize that they have to purchase separate coverage for these risks, or they may know but decline coverage. Disaster policies may not automatically renew each year and may not be escrowed as part of mortgage payments, leading some people to drop coverage.

Workshop participants expressed concern that federal disaster aid may create a moral hazard problem, whereby homeowners and business owners assume the government will provide them with assistance following damage to their property and so fail to insure. Empirical evidence on this moral hazard is scant, however. The few papers that have tried to correlate actual disaster spending with insurance purchases find either a positive relationship (Browne and Hoyt 2000) or a very small effect (Kousky et al. 2014). This can be explained by the limited disaster money given to US disaster victims and the requirement that recipients of disaster assistance maintain insurance policies to be eligible for such aid in the future (Kousky 2016). More research is needed on the extent to which perceptions of generous postdisaster relief may lead to lower predisaster insurance purchases.

## **2.2. Insurer Behavior**

Disaster losses can be very severe in some years, that is, losses are “fat tailed” (e.g., Malamud and Turcotte 2006; Holmes et al. 2008). In an extreme event, a large number of an insurance company’s insured portfolio will suffer damage at the same time. To protect against the possibility of insolvency, insurance companies are required to hold large amounts of capital and/or secure access to capital through reinsurance or other risk transfer mechanisms; this can be costly and increase the price of insurance significantly (Kunreuther and Michel-Kerjan 2011). When disaster insurance is expensive, however, the premiums can be more than property owners are willing or able to pay (Kousky and Cooke 2012).

It is somewhat surprising that sometimes insurance managers also sometimes exhibit systematic biases or use simplified decision rules when faced with uncertainty or ambiguous information regarding low-probability risks. Limited data and limited past experience with

extreme events may cause insurers to engage in intuitive thinking when determining what coverage to offer and how much to charge (Cabantous et al. 2011).

Behavior by insurers may follow a “safety-first” model, originally proposed by Roy (1952) and applied to insurance by James Stone, the insurance commissioner of Massachusetts. Stone (1973a, 1973b) suggested that an underwriter who wanted to determine the conditions for a specific risk to be insurable would focus on keeping the probability of insolvency below some threshold level of concern rather than trying to maximize expected profits. Such an approach, Stone said, would lead insurers (1) to not charge anything for coverage against a specific risk if its likelihood were perceived to be very low, and (2) to charge much higher premiums or view the risk as uninsurable when the likelihood of a disaster and the resulting damage were highly ambiguous (Hogarth and Kunreuther 1985; Kunreuther and Hogarth 1992). Discussions with underwriters indicate that this safety-first model still characterizes insurers’ decisionmaking process.

September 11, 2001, provides an illustration of the behavior. Before the terrorist attacks, actuaries and underwriters had not determined a price for protection against terrorism coverage or excluded this coverage from their standard commercial policies. They were essentially covering this risk for the very modest add-on for unspecified events included in typical property insurance premiums. Their failure to examine the financial risks associated with terrorism was surprising, given the attempted bombing of the World Trade Center in 1993, the Oklahoma City bombing in 1995, and other terrorist attacks throughout the world prior to 2001. Presumably insurers perceived the likelihood of larger attacks on US soil to be negligible. Following 9/11, most insurance companies changed course and refused to offer any coverage against terrorism, considering it an uninsurable risk despite increased buyer demand. The few that did provide insurance charged extremely high premiums (Michel-Kerjan and Kunreuther 2017).<sup>1</sup>

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<sup>1</sup> A few examples stand out. First, Golden Gate Park in San Francisco was unable to obtain terrorism coverage at any price (Smetters 2004). Second, prior to 9/11, Chicago’s O’Hare Airport had \$750 million of terrorism insurance coverage at an annual premium of \$125,000. After 9/11, insurers offered the airport only \$150 million of coverage at an annual premium of \$6.9 million (Jaffee and Russell 2003). And third, in early 2002 one insurance broker negotiated a contract between an industrial firm that was willing to pay \$900,000 for \$9 million in coverage should a terrorist attack damage or destroy one of its facilities in the coming year; that is, the insurer considered the likelihood of damage from a terrorist attack in the next year to be greater than 1 in 10 (Kunreuther et al. 2013).



### **2.3. Regulator Behavior**

State insurance commissioners and state legislatures authorize the sale of insurance against different risks, oversee and approve their premiums, and regulate many other aspects of the private insurance market. Insurance companies have voiced concerns that state regulators limit their ability to charge prices that reflect the risks they face. It has been observed that US insurance commissioners tend to weight the affordability and availability of insurance policies more heavily than solvency considerations (Klein and Wang 2007). Controlling rates to appease homeowners, however, can make it difficult for firms to operate profitably. For instance, a 2008 examination of cumulative insurer profits by year in Florida revealed that insurance companies had been in the red since 1992 (Klein 2008). Although the companies made profits in quiet years, the losses from 1992, 2004, and 2005 more than wiped out all those profits. This led many insurance companies to scale back operations in Florida and along the Gulf Coast.

After an extreme event, state insurance commissioners often prevent steep price increases in an attempt to protect consumers. Following Hurricane Andrew (1992), insurance regulators in Florida prohibited dramatic rate increases and let companies increase prices only gradually over a decade; the state legislature passed a moratorium on policy cancellations. The Florida legislature also instituted a three-year moratorium that limited how quickly firms could reduce their market share in the state (McChristian 2012). Following Hurricane Katrina (2005), Florida allowed an initial wave of price increases, which were generally highest in coastal areas, but then began disapproving them in 2006. Other states have taken similar measures. After Katrina, the Louisiana Department of Insurance prohibited cancellation or nonrenewal of residential dwelling and commercial property insurance for structures damaged by Hurricane Katrina or Rita (2005) until 60 days after all repair and reconstruction had been completed (Klein 2008).

Workshop participants commented that companies may feel that the current regulatory environment makes it challenging for them to develop and test new products designed to appeal to consumers. It appears that insurance commissioners and insurance companies need to have a more effective dialogue on how to allow for the pricing of catastrophic risk while protecting consumers from unfair pricing practices.

### **3. The Emergence of Public Private Disaster Insurance Partnerships**

Private insurers' concerns about coverage against potentially catastrophic losses has led to government interventions in these markets around the world. The creation of public sector

programs has often been spurred by a disaster that exposed the insurance gap or created other challenges for the private market.

Flood insurance, for example, was offered by the US private sector beginning in 1896. Following the 1927 Mississippi floods, however, when insurers suffered serious losses, all insurance companies withdrew coverage of property in highly flood-prone areas because of their concern with future catastrophic losses as well as challenges with adverse selection (Kunreuther et al. 1978). It took another disaster, flooding from Hurricane Betsy in 1965, to demonstrate how few homes were insured against flood, prompting liberal federal disaster relief and widespread congressional support for creating the NFIP (Knowles and Kunreuther 2014).

Similarly, Hurricane Andrew in 1992 led to the establishment of the Florida Residential Property and Casualty Joint Underwriting Association (later Florida Citizens), the Northridge earthquake of 1994 led to the creation of the California Earthquake Authority (CEA), the terrorist attacks on 9/11 led to the creation of the Terrorism Risk Insurance Program, and flooding in the United Kingdom, particularly in 1953, led to establishment of the first UK partnership with the private sector for flood insurance, Flood Re. These quasi- to fully governmental disaster insurance programs vary substantially in their design, spanning the range of public-private partnership types. Some provide insurance directly to property owners, while others offer reinsurance; some offer coverage for a single peril only, while others provide more comprehensive policies. Take-up rates vary: some have mandatory purchase or offer requirements, while others do not. Financing arrangements and the public-private shares for payment of claims vary as well. The programs also differ in the nature and extent of incentives or regulations for risk reduction and how they make coverage affordable. Table 1 compares the programs evaluated in this project.<sup>2</sup>

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<sup>2</sup> Several other papers and reports have compared countries' disaster insurance programs (CCS 2008; Medders et al. 2011; Paudel 2012; Atreya et al. 2015; McAneney et al. 2016) but do not draw out specific lessons for the United States, as we do in this work. We also look beyond just the structure of risk transfer to consider public and private responsibilities for risk reduction and risk communication as well.

Table 1. Insurance Program Design Comparison

	<i>Coverage provided</i>	<i>Take-up rates and mandates</i>	<i>Financing</i>	<i>Claims paying ability (up to the given event)<sup>a</sup></i>	<i>Incentives or mandates for risk reduction</i>	<i>Affordability addressed?</i>
National Flood Insurance Program (NFIP)	Flood only	~50% in 100-year floodplains, much lower outside them; mandatory for those with loans in 100-year floodplain	Premiums, debt from Treasury, recent reinsurance purchase	NFIP has borrowing authority from the Treasury; without borrowing it can pay claims up to a 1/16.7 year all flood perils occurrence exceedance probability (as of 2014) <sup>b</sup>	Lower premiums for elevation and some community measures; regulations on development in 100-year floodplains	Historically lower rates for older homes (being phased out); continued discounts for certain properties that face increased risk
California Earthquake Authority (CEA)	Residential earthquake only	~10%; mandatory offer, no mandatory purchase	Premiums, reinsurance, insurer contributions and assessments, debt, accumulated capital	1/250 year all perils occurrence exceedance probability (as of 2014) <sup>b</sup>	Premium discounts for seismic retrofits on older homes and for mobile homes reinforced by earthquake-resistant bracing system	No
Florida Citizens Property Insurance Corporation	Homeowners policies or wind-only policies	Wind coverage required by lenders	Premiums, reinsurance, catastrophe bonds, state Hurricane Catastrophe Fund, postloss assessments on Citizens and non-Citizens policyholders	1/100 year all perils occurrence exceedance probability (as of 2013) <sup>b</sup> ; as of 2016, no postevent assessments for 1/100 year event	Premium discounts for verified wind-resistant features (e.g., strengthening roof-to-wall connections, protecting window openings and doors)	No

Florida Hurricane Catastrophe Fund	Mandatory reinsurance to companies writing policies in Florida	Mandatory participation for authorized property insurers	Premiums, reinsurance, investment income, revenue bonds	N/A <sup>d</sup>	None	No
Terrorism Risk Insurance Act (TRIA)	Reinsurance for terrorism losses in United States	~60%; mandatory offer; no mandatory purchase	Federal funds, surcharges on commercially insured policyholders	Claims payments guaranteed by US government for industry losses up to \$100 billion	None	No, but evidence rates are a small percentage of total premiums
Flood Re	Reinsurance for flood losses in United Kingdom	~95% take-up for primary coverage; flood coverage required for mortgage and included in standard homeowners policies	Premiums, levy on insurers, ad hoc payments from insurers	1/200 year event <sup>c</sup>	None	Temporary premium subsidies for high-risk properties (shifting to risk-based pricing over 20–25 years)
All hazards Insurance	All natural hazards including flood, earthquake, fire, wind, and hail	Generally mandatory, varies by country	Varies by country but may include premiums, policy surcharges, reinsurance, government funds, etc.	Varies by insurer and country	Varies and depends on whether pricing is risk-based	Varies; uniform rates or flat fees in some countries (e.g., Spain, France, New Zealand)

<sup>a</sup> This column gives the maximum event, expressed by return interval, for which the program could pay claims.

<sup>b</sup> These estimates are taken from NFIP (2015).

<sup>c</sup> Taken from Surminski (2017).

<sup>d</sup> The FHCF has a statutory limit of up to \$17 billion, but this will provide different claims-paying capacity to the 150-plus participating insurers. Without detailed data from each insurance company, it is difficult to determine when FHCF would exhaust its \$17 billion. See Medders and Nicholason (2017) for more discussion.

Table 1 contains useful lessons. Well-functioning disaster insurance markets for extreme events—earthquakes, floods, hurricanes, terrorism—require some type of government intervention. These public sector policies and programs are diverse, often driven in part by a country’s culture and historical experience. While there does not appear to be one best fits-all design, some approaches have proven less effective or have more perverse or unintended consequences than others, as discussed in the following sections. Take-up of disaster insurance is generally low absent a mandate from either the government or lenders. Very few insurance

programs charge premiums that fully reflect the risk at a property level because the likelihood and consequences of future losses are difficult to estimate, the premiums are averaged over large areas, and/or the premiums are cross-subsidized or discounted for various reasons, such as affordability concerns or regulatory restrictions on premiums for high-risk properties. Some actively engage in risk communication and hazard mitigation, while others do less of these activities. There is large variation in claims paying ability and the financing used by these programs. At one extreme is the CEA, which has access to capital to pay claims up to a 1-in-250-year event. At the other extreme is the NFIP, which is already in debt and so has very little capital to pay claims, although it would presumably have borrowing authority from the Treasury (it must be increased by Congress).

#### **4. Roles of the Public and Private Sectors**

Workshop participants and the authors of the papers in this Special Issue have identified challenges to insuring against extreme events and offered concrete recommendations for dealing with them in three related areas: (1) risk communication, (2) risk reduction, and (3) risk transfer. We consider the comparative advantages of the public and private sectors and how they can work together effectively in each of these areas.

##### **4.1. Risk Communication**

As discussed above, decisionmakers often poorly evaluate low-probability risks, exhibiting systematic biases. It is thus not surprising that a major challenge is communicating risk so that those who are exposed to the risk are aware and understand the potential consequences. Workshop participants agreed that promoting risk understanding and acceptance of technical risk information was essential and had to be undertaken by both private and public sectors.

Insurance can play an important role in communicating risk if premiums are transparent and if the pricing reflects the risk. A premium with a hidden or unexplained cross-subsidy or discount, however, may lead people to believe they are safer than they actually are. There was a consensus that property-level risk based pricing would be an improvement over current practices.

Many insurance programs, particularly those where the public sector plays a key role, have risk communication beyond pricing as an explicit objective. For instance, the website of the

CEA details earthquake risk for different counties in California and provides information on what structures may be suited for retrofits.<sup>3</sup> The NFIP provides flood risk information through mailings and online. It also provides flood hazard maps to all participating communities. Since the maps were created to implement the program and not simply as the best risk communication tool for local governments, however, they might actually mislead residents in flood-prone areas. Specifically, the maps define a high risk area as one where the chance of flooding has an annual probability greater than 1 in 100. This line may lead property owners to believe that if they live outside this zone they are safe and all areas within it are equally risky (Kousky 2017).

Beyond the insurance programs, there is also a role for public sector information provision. In the U.S., the federal government already has risk communication efforts, such as Flood Smart and the Federal Alliance for Safe Homes (FLASH). Flood Smart is the NFIP's primary platform for communicating flood risk and insurance information to the public. The campaign runs messages on radio, television, and in print, but its primary outreach tool is FloodSmart.gov, a website with detailed information about flood hazards, maps, and insurance coverage. FLASH, a collaborative disaster safety education organization comprising more than 100 state and federal emergency management agencies, (re)insurers, business, nonprofits, and others, creates disaster education programs, publishes home safety and insurance guidebooks, and offers a wide range of resources, including videos, peril maps, and toolkits for homeowners to make safety improvements on their own. There are also myriad communication activities at the state and local level. For example, New York City has created the website <http://www.floodhelpny.org> to give residents information on flood risk and mitigation options.

Workshop participants agreed that a critical time for information provision is during the early stage in the home purchase decision. Mandatory hazard disclosure laws at the time property is sold could ensure that all property owners are informed about disaster risks. Nationally, potential purchasers of property in 100-year floodplains are required to be informed by the lender at the time of sale that the property is in a mapped high risk area. Some states have more expansive disclosure requirements. California, for instance, requires sellers to disclose whether a property is in a designated flood, wildfire, or seismic area. A study of California's 1998 flood hazard disclosure law found that it did have an effect: floodplain properties sold for 4-plus percent less after the law than before it (Troy and Romm 2004). For such policies to be effective,

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<sup>3</sup> See <https://www.earthquakeauthority.com/earthquake-risk-preparedness>.

disclosure should be made early in the sale process—information disclosed just before the sale is finalized is unlikely to be heeded, given the buyer’s psychological commitment to the property (Palm 1981)—and the requirement should be strongly enforced (Godschalk et al. 2000).

Currently, it is rare for property owners to receive any information on how the risk may change over the coming years or decades. This is most relevant for coastal flood risks, where sea-level rise and changing storm patterns are likely increasing. The Technical Mapping Advisory Council, which reviews flood hazard maps for the Federal Emergency Management Agency (FEMA), has published “Future Conditions,” a report that highlights the importance of considering how climate change may alter flood risk in the coming years (Technical Mapping Advisory Council 2015). The New York City website mentioned earlier is also actively communicating information about changing risk.

The private sector—both for-profit companies and not-for-profit groups focused on risk management—can complement public sector efforts to improve risk communication. For example, Temblor is a website (<http://temblor.net>) and mobile app that provides property-specific seismic risk data in easy-to-understand formats while also providing information on risk reduction activities and earthquake insurance (directing users to an agent for a property-specific insurance quote). As another example, the mission of the Institute for Building and Home Safety, a nonprofit supported by the insurance and reinsurance industry, is “to conduct objective, scientific research to identify and promote effective actions that strengthen homes, businesses, and communities against natural disasters and other causes of loss.”<sup>4</sup>

## Recommendations

- Make available to property owners and communities understandable, structure-specific risk information, perhaps presented as a risk score or metric for each hazard. Disseminate the information via multiple platforms, including websites, phone-based apps, and print mailings. Production of such tools will likely require collaboration between the public and private sectors.
- Give homes in risk-prone areas seals of approval or scores based on their susceptibility to different hazards. This would let potential buyers see how well the structure is protected against future disasters. Property inspections should be conducted by independent,

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<sup>4</sup> <https://disastersafety.org/about/>

certified individuals and supported by real estate agents, financial institutions, and communities.

- Develop community maps delineating current *and* future flood risk.
- Coordinate the various government risk communication efforts across agencies and scales of government, to promote synergies and avoid duplication of effort.

#### **4.2. Risk Reduction**

In the United States it appears that cost-effective mitigation measures are not undertaken by many property owners and renters in hazard-prone areas. For instance, only an estimated 10 percent of earthquake- and flood-prone households have implemented mitigation measures. Reasons for the lack of mitigation may be that property owners underestimate both the risk of a future disaster and the potential benefits of mitigation, and others may not have access to capital to cover the up-front costs (Kunreuther et al. 2013).

Misaligned incentives for risk reduction may suppress mitigation investments. Many workshop participants observed that local governments reap the benefits of economic development through increased tax revenue but bear none of the costs when a disaster occurs. Hence they lack economic incentives to adopt strong building codes or limit development in the highest-risk areas. Similarly, there was concern that federal assistance under the Stafford Act may make local governments less interested in mitigation: federal disaster relief covers at least 75 percent of the cost to replace or repair damaged public buildings and infrastructure. Empirical research on any incentive effects from federal assistance to local governments is, however, lacking.

Insurance and mitigation may be viewed as substitutes if the mitigation measures reduce risks enough that property owners can comfortably self-insure. But for most cases, mitigation can be more appropriately viewed as a complement to insurance if premiums reflect risk since it lowers potential losses and hence insurance claims. This effect could motivate partnerships involving private insurers, public or quasi-public insurers, and the government in encouraging risk reduction.

Charging risk-based prices for insurance and providing long-term home improvement loans for cost-effective hazard risk reduction could overcome consumers' tendency to be myopic and not look beyond a short time horizon. If the upfront cost of the mitigation measure is spread over a long period, such as the term of the mortgage, and the annual insurance premium is reduced, investing in mitigation could be advantageous to the property owner (Kunreuther 2008).



The Small Business Administration already offers loans for disaster victims to include hazard mitigation in their rebuilding, although very few households take advantage of this program. FEMA has produced outreach materials to inform homeowners that if a rebuilding loan includes the cost of elevation, it can often be cheaper to elevate several feet above the minimum due to the much lower flood insurance premium they receive for such elevation (FEMA 2013). Xian et al. (2017) has determined the optimal elevation based on estimates of the NFIP risk-based insurance premium coupled with a long-term loan at different interest rates and payback periods.

Several insurance programs and companies offer premium reductions for certain mitigation measures. For example, the NFIP offers substantially lower rates when homes are elevated above the base flood elevation (see Kousky et al. 2016). The CEA now offers premium discounts up to 20 percent for new, safer construction (Marshall 2017). In addition, some states—including Alabama, California, Florida, Louisiana, Maryland, Mississippi, New York, South Carolina, and Texas—require companies to offer premium discounts for certain hazard mitigation measures, or they have state insurance programs that offer such discounts (Multihazard Mitigation Council 2015; OMB 2016). It is unclear, however, whether these programs have encouraged homeowners to invest in new hazard mitigation measures or simply rewarded homeowners who have already done so.

Florida provides a cautionary tale on the potential problems with state-mandated premium discounts. In 2003, it required insurance companies to provide discounts for certain mitigation options. Unfortunately, the way the state enacted this requirement was such that it forced companies to provide premium discounts that were unjustified and not matched to claims payments (for more detail, see Medders and Nicholson 2017). Moreover, accountability and oversight were insufficient. In the end, more than half of inspected homes obtained premium credits without undertaking any mitigation (Medders et al. 2014), and these financially unsound credits may have prompted insurers to leave the state or damaged firms' financial positions (Florida Commission on Hurricane Loss Methodology 2010).

Governmental disaster insurance programs can have unique opportunities to promote or fund hazard mitigation. Risk reduction is an explicit goal of the NFIP, with FEMA offering grants to encourage homeowners to mitigate properties that flood repeatedly. Reducing losses through cost-effective mitigation is critical to reducing future claims, since unlike a private insurer, the program cannot refuse coverage to any property in a participating community. The CEA has two grant programs for mitigating properties at greatest risk of earthquake damage. One is for risky properties that have held a CEA policy for three or more years. A qualifying

homeowner who braces and bolts the insured structure receives a \$3,000 grant to offset the costs, as well as a 20 percent reduction on CEA premiums.<sup>5</sup>

The federal government has small amounts of grant dollars available for supporting risk reduction projects during the pre-disaster period. One example is FEMA's Pre-Disaster Mitigation grant program; the Corps of Engineers also invests in risk reduction prior to disaster events. For flooding, a recent analysis of federal risk reduction spending—which includes programs in FEMA, the Corps, and the Department of Housing and Urban Development, among a few others—finds that more than 90 percent of the funding is tied to a presidential disaster declaration post-disaster and limited to the affected community; very little funding is available pre-disaster (Kousky and Shabman 2017).

Local governments can reduce risk through well-enforced building codes and land-use regulations. The NFIP has a unique lever to influence these decisions, since flood insurance is available to a community only if the local government adopts floodplain regulations, including that all new construction in the 100-year floodplain to be built at or above the base flood elevation. Beyond this minimum requirement, the NFIP tries to encourage voluntary risk reduction by local governments through the Community Rating System. If a community takes steps to lower its flood risk, all property owners receive discounted flood insurance premiums. Flood Re, the flood insurance program in the United Kingdom, has not yet taken steps to encourage investment in risk reduction measures, a potentially missed opportunity (Surminsky 2017).

## Recommendations

- Expand federal and state funding for predisaster hazard mitigation, particularly for the riskiest properties, such as those that experience repetitive flooding.
- Examine how insurance premium reductions could create incentives for new mitigation investments, perhaps in combination with low-interest loans.
- Promote funding and financing that are underutilized, such as postdisaster Small Business Administration loans for hazard mitigation.
- Convene an expert group to investigate better ways of incorporating the full costs of insuring a structure over its life into initial decisions of where and how to build.

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<sup>5</sup> For more information, see the program website: <https://www.ceabracebolt.com/>.

### **4.3. Risk Transfer**

Risk transfer for disasters can be costly, for the reasons discussed in Section 2. We begin with the proposition that the private market should insure and reinsure disaster risks to the extent it can, recognizing that the public sector will need to play three complementary roles to facilitate equitable and efficient transfer of risk: (1) making disaster insurance affordable for low-income households, (2) providing public reinsurance against catastrophic losses that are beyond the capabilities of reinsurers and other risk transfer instruments, and (3) mandating insurance coverage, if widespread take-up rates is a policy objective.<sup>6</sup>

The cost of disaster insurance is often high, and the cost burden of flood insurance premiums on low-income households has emerged as a policy concern (National Research Council 2015). If disaster coverage is deemed critical for such households, help should come through an explicit federal assistance program rather than through a cross-subsidy that distorts risk signals and is viewed as inequitable by those who are charged higher premiums to cover the cross-subsidy.

Such pricing distortions have been used in several of the programs evaluated, including the NFIP and Florida Citizens. In the NFIP, lower premiums were provided, not based on household income or wealth, but on the age of the structure: older homes were given discounted rates, which rendered the program unable to finance catastrophic losses (Kousky 2017). Due to legislation in 2012 and 2014, these are now being phased out. Beginning in 2005, Florida Citizens Property Insurance Corporation, a nonprofit, tax-exempt government entity, effectively froze premiums that were highly subsidized; the private sector could not compete, and Citizens became the largest insurance provider in the state. Private insurers' surplus plummeted, and many left the state (Medders and Nicholason 2017). The CEA, on the other hand, has not discounted premiums in any manner that would threaten the financial standing of the program, but as a result, take-up rates are very low, hovering around 10 percent (Marshall 2017). To the extent higher premiums deter the purchase of insurance, risk based pricing may discourage some property owners from purchasing coverage voluntarily.

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<sup>6</sup> The public sector must also, of course, continue to play a role in consumer protection regulations. In the United States, state-level regulators protect the consumer by requiring that insurers have sufficient capital and surplus to pay claims following a severe disaster. These capital requirements are designed to minimize insolvency risk. Regulators also approve insurance pricing to protect the consumer from unfair premiums.

For disaster risks with a very long tail of the loss distribution and risks that are difficult to model, states and the federal government can cover extreme losses above a large threshold. This is the case today with terrorism coverage. After 9/11, as discussed above, insurers refused to offer terrorism coverage or did so at exorbitant prices, and in response Congress passed the Terrorism Risk Insurance Act (TRIA), which requires primary insurance companies to offer terrorism coverage in exchange for the federal government's covering a portion of catastrophic losses. This is not a complete federal backstop of losses above some threshold, since the federal government can recoup its payments ex post through commercial policyholder assessments. The arrangement has made terrorism coverage widely available and affordable for commercial properties (Michel-Kerjan and Kunreuther 2017). In contrast, a federal backstop was never explicitly guaranteed for the NFIP, and now the program carries a debt that it will never be able to repay.

The Florida Hurricane Catastrophe Fund (FHCF), an example of US state reinsurance, was created in 1993 to provide more capacity for private insurers to offer coverage in the state. Florida Citizens and private insurers are required to purchase protection from the FHCF. Surplus in the FHCF can accumulate tax-free. In the event of a large disaster, it can issue bonds to pay claims and then repay this debt through assessments on policyholders in most lines of property casualty insurance. Although FHCF pricing is required to be actuarial, it is still below the costs of private sector reinsurance, since it is tax-exempt and does not need to include the risk and profit loads or marketing costs and expenses that private reinsurers incorporate in their pricing (Medders and Nicholason 2017).

In other countries, the government covers losses above a high threshold, either as a backstop or as reinsurance. For example, in Spain, where "extraordinary risk" insurance is a mandatory component of property, life, and personal accident policies, the state-run Consorcio de Compensación de Seguros is responsible for insuring against natural hazards and social-political perils and operates with an unlimited government guarantee. In France, insurers are required to provide natural catastrophe coverage as part of "physical damage" contracts and may transfer those risks to the state-owned reinsurer, Caisse Centrale de Réassurance, at a subsidized cost. It is secured by a government backstop, but payouts are contingent on an official declaration of a natural catastrophe. In New Zealand, the government's Earthquake Commission provides natural disaster protection automatically to homeowners who insure against fire. The program administers and pays claims from the state's natural disaster fund, which is backed by an unlimited government guarantee.

Another approach to helping the private sector manage catastrophic losses is to set up a separate program for the riskiest properties, as Flood Re has done in the United Kingdom (Surminski 2017). Insurers can cede the riskiest properties to the Flood Re pool at a discounted price, paid for by a levy on all insurers according to their home insurance market share. Because the private insurance company's liability for these properties is reduced, it can write coverage for the remaining properties in flood-prone areas of the country. In this model, as with the Florida programs, the cost is distributed over a wider base of policyholders, not just those who have suffered a loss.

Similarly, residual market mechanisms in the United States were designed to provide coverage for those unable to find a policy in the voluntary market. The Insurance Information Institute has found that exposure in beach and wind pools has been growing, suggesting these are not markets of last resort but often primary markets for wind coverage in hurricane-prone areas (Hartwig and Wilkinson 2014). In Florida, Citizens explicitly chose to offer lower-cost policies and became the largest insurer in the state (Medders and Nicholason 2017). More recently, it has been shedding policies to better manage exposure.

The benefits of widespread take-up of disaster coverage include reduced rebuilding time, faster resumption of normal economic activity, the decreased need for federal relief, and enhanced resilience. If increasing take-up is a policy goal, it may be necessary to require homeowners to purchase disaster insurance. Substantial evidence indicates that households do not voluntarily insure against earthquakes and floods, and lenders in the United States do not require insurance against earthquake risk and only require flood when mandated by law. As pointed out in Section 2, many homeowners in flood-prone areas who are required by the NFIP to have coverage are uninsured today. Bundling flood and earthquake insurance into the homeowners coverage that banks require as a condition for a mortgage would dramatically increase take-up rates (Kunreuther 2017). Flood coverage is much more widespread in the United Kingdom, where it is a part of homeowners insurance and required by lenders (Surminski 2017).

## **Recommendations**

- Develop a federal assistance program for low-income households so that they can afford disaster coverage. This should be paid for by general tax dollars and not through cross-subsidies in insurance pricing.
- Determine whether government backstops or reinsurance against catastrophic losses not covered by private reinsurance or other risk transfer mechanisms, such as catastrophe

bonds, could strengthen and improve the functioning of the primary insurance market. The study should identify the level at which government support is made available and define the structure and process for receiving that support.

- Analyze when and how risky properties could be ceded to a government residual market and how those risks would be financed.
- Promote better relationships between state regulators and insurance companies on disaster lines and innovation in product offerings for disaster lines.

## 5. A Proposed Program

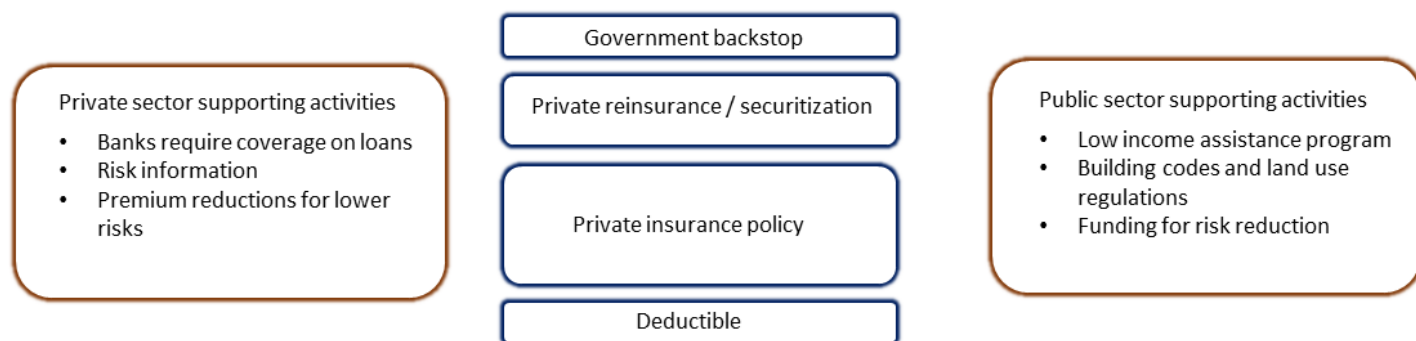
We conclude with a proposal for a comprehensive program that capitalizes on the strengths of the public and private sectors while requiring property owners to absorb some of the risk associated with disasters so that they have incentive to undertake mitigation measures. We base this proposal on several guiding principles:

- Premiums should reflect risk, with information on the hazards clearly communicated to prospective policyholders.
- Cost-effective mitigation measures should be encouraged through insurance premium reductions and long-term loans that spread the upfront costs over time.
- Affordability of insurance for low-income residents should be addressed through public sector assistance, not subsidized insurance premiums.
- Catastrophic losses that cannot be covered by private reinsurance or other risk transfer instruments should be backstopped by the public sector.
- The public sector should provide incentives, information, and some funding for investments in risk reduction.
- All natural disasters should be covered in a single private insurance policy to reduce the variance in losses and satisfy homeowners' desire to be covered against all hazards.

We propose a system of layering of disaster losses as shown in Figure 1. The blue boxes show schematically how the layers would function; the size is not necessarily proportional to the amount of coverage in each layer. This layering idea is not new, and it has many appealing features, such as providing more appropriate economic incentives, enhancing the involvement of the private sector, and better meeting the financial needs of those at risk from future disasters

(e.g., Litan 2006). We note, however, that the layers of risk transfer need to be supported by public and private sector activity centered on risk communication and risk reduction.

**Figure 1. Layering Disaster Losses**



The property owner would be responsible for the first layer of losses through a deductible, which creates an incentive to reduce future losses by undertaking mitigation measures while reducing moral hazard. Property owners could choose higher deductibles that would lower their insurance premiums if they were able to self-insure a higher portion of losses. Higher deductibles might be supported by tax-exempt disaster savings accounts, which property owners could tap to cover losses.

The second layer of losses would be transferred to an insurer through a homeowners policy that included all natural perils, with premiums reflecting risk. Banks and financial institutions would require this coverage as a condition for a mortgage.<sup>7</sup> An all-hazards policy has numerous benefits for the property owner. As the National Association of Insurance Commissioners has observed, having to purchase multiple policies is inefficient and confusing, and it delays claims settlements because the cause of the losses from hurricanes—wind or water—must first be determined (NAIC 2009). Following Hurricane Katrina, insurers spent considerable time and money fighting lawsuits from policyholders who contended that damage to their homes was due to wind, in which case the standard homeowners policy would cover the losses, rather than inundation. An all-hazards policy would avoid this problem (Kunreuther

<sup>7</sup> The NAIC has suggested an insurance mandate in highest-risk zones for property owners with federally backed mortgages. This is similar to the current flood insurance requirement by the NFIP but includes all natural disasters (NAIC 2009).

2017). Financial assistance for low-income homeowners would be provided by the government in form of tax credits or vouchers based on specified criteria for household income or house value. The tax credit or voucher could also cover the cost of a loan to enable the property owner to invest in cost-effective mitigation measures (Kousky and Kunreuther 2014).

The next layer of losses would be covered through private reinsurance or other forms of risk transfer, such as catastrophe bonds purchased by the insurance company. The highest layer of losses would be covered by the public sector. Although neither has been tested yet with a catastrophic loss event, the experience of both Flood Re and TRIA suggests that if the government can cover the riskiest properties, or cover catastrophic losses, the private market could profitably offer disaster insurance for the remaining losses above the deductible. Coverage at the state or federal level could entail *ex ante* premiums or *ex post* assessments to recoup some or all of the public sector expenditures. The attachment point for state or federal payments would need to be carefully determined. It should not be too low, since the private market should be encouraged to bear as much risk as possible, but it also needs to make private firms feel comfortable about bearing the remaining risk. This would require a detailed market evaluation.

As shown in Figure 1, both the public and private sectors would need to also engage in supporting activities, such as risk communication, adoption and enforcement of building codes, and limitations on future development through restrictive zoning and other land-use regulations.

## **6. Conclusion and Suggestions for Future Research**

Disasters are challenging to insure, and the price of coverage is often high. In response, policymakers around the world have devised a variety of quasi-public and fully public disaster insurance schemes. In this paper, we have teased out some guidelines for how the public and private sector can work together to move toward a system in which comprehensive and affordable coverage is provided for those at risk. That said, it is clear that more detailed research and investigation are needed to inform reform efforts of the current systems. In addition, new policies may be required. We highlight several in this concluding section.

### **6.1. *Finer-Scale Risk Communication***

Participants in the workshop agreed that better information on the specific risks at a given property could encourage investments in risk reduction and promote the purchase and retention of disaster insurance. Because prices send a power signal about risk, fine-grained insurance pricing could also improve risk understanding. Communication efforts presuppose better



mapping and modeling. For flood, this means investment in more data and application of advanced modeling techniques. Where data are not available or cost-effective, lower-cost options, need to be explored. All approaches require funding, however, and thus Congress should appropriate funds for continued improvements in hazard mapping. Once better maps are available, researchers in risk communication should investigate the most effective ways of communicating the results to residents.

### ***6.2. Higher Take-Up of Insurance***

Various factors can explain why so many people at risk have no disaster insurance and fail to invest in hazard mitigation: homeowners may lack information on the risk, dismiss it as negligible, be myopic, lack the necessary capital, regard the transaction costs as too high, or respond to perverse incentives. Field research is needed to untangle which contributing factors are most important and whether policy changes could help counter the tendency to underinvest in insurance and mitigation.

One of the biggest challenges is to convince homeowners that not incurring losses from a disaster does not make the purchase of insurance a waste of money or justify canceling the policy. It is extremely difficult to get the message across that people should celebrate not having collected on their insurance policy this year, and that a disaster could still occur next year. Future empirical and experimental research could determine the effectiveness of rebates for those who have not suffered a loss coupled with messages such as “the best return on an insurance policy is no return at all.”

### ***6.3. Insurance for Low-Income Households***

One part of closing the disaster insurance gap is making sure that all those living in risky areas can afford disaster insurance. Workshop participants suggested that instead of using cross-subsidies in pricing, Congress create an explicit program to provide assistance to households in need, coupled with a mitigation program. This approach would reduce both the losses incurred by low-income residents and the costs of risk transfer. There remain several unanswered questions, however: how much assistance would be needed, what the scope of the program would be, and what types of mitigation could be offered, among others. A good example of the type of studies needed was recently completed by RAND (Dixon et al. 2017).

#### **6.4. *New Policy Models***

This paper has proposed several roles for the public sector in improving insurance of disasters, and an even broader array of policies have been proposed in scholarly work on this topic. More research is needed on comparing and evaluating these alternatives. For example, would a residual pool model or a federal reinsurance model be preferable—and on what grounds—to the current federal program of direct writing of flood coverage? Such work first requires developing a consensus on the public policy goals that should guide program development.

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