Encouraging Adaptation to Flood Risk:
The Role of the National Flood Insurance Program

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Encouraging Adaptation to Flood Risk:  
The Role of the National Flood Insurance Program  

Howard Kunreuther*  

1. Introduction  
Undertaking adaptation measures to reduce the risks of future flood damage presents a major challenge for individuals and communities at risk because there is a reluctance to incur the upfront costs normally associated with these investments. One would think that the knowledge that climate change is likely to increase the chances and severity of future floods and storm surge related damage would make these investments more attractive. Not true! The uncertainty associated with future sea level rise and the nature of hurricanes often leads key decision makers to hope for the best rather than fearing the worst.¹  

Few homeowners residing in areas subject to flood-related losses from hurricanes and riverine flooding voluntarily invest in measures that reduce future losses, even when these measures are cost-effective (Kunreuther, Meyer and Michel-Kerjan, 2013). In a survey of over 500 residents in coastal counties during Hurricane Sandy in 2012, a large majority of respondents indicated doing at least one storm preparation activity, but these were mainly short-term preparation actions such as buying batteries and food and water reserves that required limited effort. Surprisingly, less than half of storm shutter owners in the New York City area who responded to the survey actually installed them to protect their windows before the hurricane (Meyer et al., 2013).  

This paper highlights the important role that insurance coupled with adaptation measures can play in reducing future flood damage. The next section highlights why individuals do not invest in these protective measures building on recent empirical studies in psychology and behavioral economics. Section 3 provides three guiding principles for insurance to play a role in encouraging individuals to invest in adaptation measures to

* My thanks to Shereen Chaudhry, Carol Heller and Carolyn Kousky for their helpful comments on an earlier draft of the paper.  
¹ The impact of risk and uncertainty on climate change policies is the theme of a framing chapter for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. See Kunreuther, Gupta et al., (2014).
protect themselves against future losses. Section 4 proposes how the National Flood Insurance Program (NFIP) can be redesigned so that it encourages adaptation. The concluding section proposes options to adapt to the flood risk for future consideration.

2. Intuitive and Deliberative Thinking

A large body of cognitive psychology and behavioral decision research over the past fifty years has revealed that individuals often make decisions under conditions of risk and uncertainty by combining intuitive thinking with deliberative thinking. In his recent thought-provoking book, Thinking, Fast and Slow, Nobel Laureate Daniel Kahneman summarized the differences between these two modes of thinking (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.

Intuitive processes work well when decision makers have copious data on the outcomes of different decisions and where recent experience is a meaningful guide for the future, as would be the case in stationary environments (Feltovich et al., 2006). These processes do not work well, however, for low-probability, high-consequence (LP-HC) events for which the decision maker has limited or no past experience (Weber, 2011). In such situations, reliance on intuitive processes for making decisions will most likely lead decision makers to maintain the status quo. Thus, intuitive decisions may be problematic in dealing with adaptation to climate change risks such as increased flooding and storm surge due to sea level rise for which there is limited or no personal experience or historical data. Intuitive processes are utilized not only by the general public, but also by technical experts such as insurers and regulators (Kunreuther, Pauly and McMorrow, 2013) and by groups and organizations (Cyert and March, 1963; Cohen, March and Olsen, 1972; Barreto and Patient, 2013).

The analytic tools associated with deliberative thinking, on the other hand, focus attention on both short- and long-term decision consequences, leading to a more
comprehensive evaluation of options. In the context of adaptation decisions for reducing flood losses, individuals will want to invest in a measure when its expected long-term benefits exceed the expected costs.

**Systematic Biases Characterizing Intuitive Thinking**

The errors that individuals exhibit in deciding whether to invest in cost-effective adaptation measures can be traced to the effects of six systematic biases that have been well-documented. These biases, summarized in Table 1, shape how we instinctively perceive and deal with risk.

**Table 1. Systematic Biases Characterizing Intuitive Thinking**

<table>
<thead>
<tr>
<th>Bias</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Myopia</td>
<td>the tendency to focus on overly short future time horizons when appraising immediate costs and the potential benefits of protective investments</td>
</tr>
<tr>
<td>2. Amnesia</td>
<td>the tendency to forget too quickly the lessons of past disasters</td>
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<tr>
<td>3. Optimism</td>
<td>the tendency to underestimate the likelihood that losses will occur from future hazards</td>
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<tr>
<td>4. Inertia</td>
<td>the tendency to maintain the status quo or adopt a default option when there is uncertainty about the potential benefits of investing in alternative protective measures</td>
</tr>
<tr>
<td>5. Simplification</td>
<td>a tendency to selectively attend to only a subset of the relevant facts to consider when making choices involving risk</td>
</tr>
<tr>
<td>6. Herding</td>
<td>the tendency to base choices on the observed actions of others</td>
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</table>

**Myopia** Economists have had a long-standing interest in measuring how preferences for short-term outcomes depart from that which would be expected if people were fully rational when discounting time. People should trade-off the prospect of receiving a reward now versus one in the future by assessing the time value of money. As an example, if your bank generously offers you a 20% annual return on savings, you should

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2 The material in this section is based on Meyer and Kunreuther (2017) where more detail on the nature of these biases can be found.

3 For a review of the historical treatment of time preferences in economics see Frederick, Loewenstein, and O’Donoghue (2002).
be indifferent between having $100 cash in your pocket today or having a check for $120 mailed to you in a year. People routinely engage in what is termed *hyperbolic discounting*, where they demand far more compensation for short-term delays of gratification than could be explained by the opportunity cost of money that is measured by interest rates.

In this respect, one of our greatest weaknesses as decision makers is that our intuitive planning horizons are typically shorter than that which is needed to see the long-run value of such investments. Controlled experiments and field surveys with respect to investment decisions reveal this behavior can be explained either by *myopic loss aversion*, which assumes that people are short-term oriented in evaluating outcomes and are more sensitive to losses than to gains. [(Gneezy and Potters, 1997); (Thaler et al., 1997)] or *narrow framing*, isolating the current decision from future opportunities to make similar decisions [(Redelmeier and Tversky, 1992) Kahneman and Lovello, 1993]]. While we might appreciate the need for a safer home, our myopia imposes a crippling handicap to our ability to adopt them. We either do not see the value of the investments or procrastinate in adopting them.

*Amnesia*  Emotions, such as worry or anxiety, are often stimulated by experiencing a disaster and may lead to investment in protective measures during the immediate post-event period (Baron et al., 2000; Schade et al., 2012) but these feelings tend to fade quickly over time. Many homeowners voluntarily purchased flood insurance after suffering damage but they then may decide not to renew their policy if they have not experienced a disaster because they feel they have wasted their premium. They would rather invest in a new TV or stereo where they will experience immediate pleasure once they connect the appliance. This same pattern has also been found in housing markets, whereby after a flood, home prices are discounted, and then rebound in just a few years (e.g., Atreya et al., 2013).

*Optimism*  People tend to believe that they are likely to be immune from threats while others are not. We perceive the likelihood of a specific event based on our own personal experiences rather than on statistical data (Slovic 2000). It is hard to imagine a storm surge from a hurricane inundating our home or having our roof detached by strong winds
until after we have experienced such a disaster. This behavior, termed the *availability bias*, has been observed and tested in a large number of controlled experiments and field studies (Tversky and Kahneman, 1973). There is thus a tendency to underweight the probability of a disaster if one has not recently experienced the event (Hertwig et al., 2004).

A more serious source of error is an interest in constructing scenarios that *we hope* will happen. Rather than imagining our living room being under water or the roof being blown off our home, we prefer to think of the ways that we will escape harm by gathering and processing information that supports our desired outcome: not experiencing damage from a disaster. To support this behaviour, Karlsson et al. (2009) have developed a model that implies that we seek out information after receiving good news but put our heads in the sand by avoiding additional information should we be given negative prior news. Using data sets of monitoring behavior by Scandinavian and American investors they show that individuals monitor their portfolios more frequently in rising markets and avoid additional information given they the market is going down.

**Inertia**  A principal reason why we do not undertake protective measures to reduce future losses is that we often prefer to stay with the status quo rather than following new paths of action. This saves us both time and energy by not having to collect information on the costs and benefits of new alternatives (Samuelson and Zeckhauser 1988). Sticking with the current state of affairs is the easy option, favored by emotional responses in situations of uncertainty (“better the devil you know than the devil you don't”) and by many proverbs or rules (“when in doubt, do nothing”).

The downside is that we have an all-too-easy escape hatch when *we should* be thinking carefully about what to do to prepare for the possibility of large losses. We don’t ask. “Should I invest money in flood proofing my house or elevating it and how expensive will these measures be?” The status quo bias is also due to loss aversion, which in this case refers to the certain costs of a protective measure in relation to the uncertain gain in reducing damage from an unlikely future disaster.

**Simplification**  With respect to extreme events there is a tendency to make choices by considering only the few factors that come readily to mind. If the perceived likelihood of
a flood or hurricane is very small, a person is likely to view the probability to be below one’s threshold level of concern. They then focus on the upfront cost associated with an adaptation measure without considering any of its potential benefits should a disaster occur. Behavior in a controlled experiment on insurance decision making with money at stake provides support for the threshold model. McClelland et al (1993) found that more than 25 percent of the subjects in this experiment bid zero dollars when asked the maximum they were willing to pay for insurance protection.

More generally, our brain tends to process only cues perceived as being large and thus meriting attention. This poses a particular problem for extreme events whose probability of occurring is, by definition, small. Furthermore, when there are a number of cues that grab our attention we typically lack the mental capacity to comprehensively process all of them, so we look for short-cuts, such as paying attention to only the most salient ones. This means that we ignore cues that carry important implications for our safety and financial stability because these potential disasters are not on our radar screen.

**Herd**ing    Individuals’ choices are often influenced by other people’s behavior, especially under conditions of uncertainty. When faced with an outside threat the adage that there is safety in numbers is often quite valid. The instinct to follow the herd goes awry when the collective crowd is no better informed than the least informed of its individual members. Decisions made by neighbors are likely to be an important input into one’s own choices. As in an information cascade, if a large number of neighbors have decided not to purchase insurance and the word spreads, then others may follow suit. (Banerjee 1992). Of course, such inferences could be mistaken if their neighbors’ decisions were also based on an underestimation of the risk and the mistaken inference that insurance was not cost-effective.

To illustrate how herding plays a role in protection against adverse events, consider the decision on whether to purchase disaster insurance. A 2013 study of the factors that caused Queenslanders to buy flood insurance found that ownership was unrelated to perceptions of the probability of floods, but highly correlated with whether residents believed there was a social norm for the insurance (Lo, 2013). In an earlier survey of homeowners in flood and earthquake-prone areas, one of the most important
factors determining whether a homeowner purchased earthquake or flood insurance was discussions with friends and neighbours rather than considering the perceived likelihood and consequences of a future disaster occurring (Kunreuther et al., 1978).

**An Illustrative Example**

The Waters family has lived in their home in Pensacola for twenty years and had forgotten that there was severe flooding in 2014 in the nearby community of Long Hollow. Their house was not situated in a Special Flood Hazard Area since the likelihood of suffering flood-related damage was estimated to be less than 1 in 100. Hence the Waters were not required to purchase flood coverage and their insurance agent never recommended that they buy a policy offered by the National Flood Insurance Program. They also had not considered investing in elevating their home because their perceived risk of a flood was below their threshold level of concern and the upfront costs of elevating their house were very high relative to the expected benefits in the next few years. None of their friends in the area had purchased an insurance policy nor had they taken steps to elevate their houses so the Waters felt no reason to be out of step with their neighbors. The family was shocked and surprised when a recent torrential rainstorm caused two feet of flooding in their house and they learned that their homeowners’ policy did not include water-related damage from hurricanes, flood or storms.

This scenario illustrates how each of the six biases discussed above:

- **Myopia**: They focused on the short-term upfront costs of flood proofing and not the long-term benefits from undertaking these measures
- **Amnesia**: They forgot that their nearby community of Long Hollow had severe flooding from a rainstorm in 2014
- **Optimism**: They felt they were safe since they were not in the Special Flood Hazard Area
- **Inertia**: They had no incentive to change from the status quo
- **Simplification**: The likelihood of flooding was below their threshold level of concern so they were not worried about flood damage
- **Herding**: None of their friends and neighbors had invested in protective measures
3. Motivating Deliberative Thinking: Role of Insurance

Insurance is designed to spread risk across all policyholders, each of whom pay a relatively small premium so insurers can cover the large losses suffered by a few. Policyholders who invest in adaptation measures should be rewarded with lower premiums because their expected claims payments are lower than they would be if they had not invested in such measures. In this sense, insurance provides economic incentives to undertake preventive measures prior to a disaster while at the same time providing financial benefits in the form of claim payments after a disaster. Many states, such as Florida, Louisiana, Alabama, Maryland, Mississippi, New York, South Carolina, Texas, and California, have laws requiring companies to offer premiums discounts for certain hazard mitigation measures, or have state insurance programs that offer such discounts (Multihazard Mitigation Council, 2015; OMB, 2016).

*Guiding Principles for Insurance*4

Insurance can encourage deliberative thinking by providing transparent information to those residing in hazard prone areas as to the risks they face and how they can reduce them. There is a need to deal with issues of fairness and affordability issues should the premiums charged by insurers cause economic hardship to some individuals. For insurance to play this role today with respect to natural hazards, three guiding principles deserve consideration

**Principle 1—Premiums Should Reflect Risk** Insurance premiums should be based on risk to provide individuals with accurate signals as to the degree of hazard they face and to encourage them to engage in cost-effective adaptation measures to reduce their vulnerability.

Catastrophe models have been developed and improved over the past 25 years to more accurately assess the likelihood and damages resulting from disasters of different magnitudes and intensities. Today, insurers and reinsurers utilize the estimates from these

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4 These guiding principles for insurance are based on concepts from behavioral economics that are discussed in more detail in Kunreuther, Pauly and McMorrow (2013).
models to determine risk-based premiums and how much coverage to offer in hazard-prone areas (Grossi and Kunreuther, 2005)

**Principle 2—Requiring Insurance in Hazard-Prone Areas**  
*Given the systematic biases that lead to intuitive thinking for LP-HC events, residents in hazard-prone areas should be required to purchase insurance as a condition for a mortgage since they are unlikely to do so voluntarily.*

Today, banks normally require homeowners to purchase homeowners insurance as a condition for a mortgage. But financial institutions do not require earthquake insurance as a condition for a mortgage, even in seismically active areas of California, and flood insurance is not required for property in areas subject to flooding that are not designated as SFHAs by the NFIP.

**Principle 3—Dealing with Fairness and Affordability Issues**  
*Any special treatment given to low-income and other individuals currently residing in hazard-prone areas deserving special treatment should come from general public funding and not through insurance premium subsidies.*

Funding could be obtained from several different sources such as general taxpayer revenue, state government or taxes on insurance policyholders. It is important to note that Principle 3 applies only to those individuals who currently reside in hazard-prone areas. Those who decide to locate in these regions in the future would be charged premiums that reflect the risk.

**Encouraging Investment in Cost-Effective Adaptation Measures**

The first two guiding principles of insurance can encourage homeowners in hazard-prone areas to invest in adaptation measures where the long-term expected benefits associated with loss reduction exceed their expected costs. To illustrate how this might work in practice, consider the Waters Family who had no interest in elevating their home or purchasing flood insurance to protect themselves against flood damage.

Suppose homeowners with a mortgage were required to purchase flood insurance with insurance premiums reflecting risk even though they were not located in an SFHA. (Principle 2) They were also told that if they elevated their coastal property from three
feet below Base Flood Elevation (BFE) to one foot above BFE to reduce storm surge damage from hurricanes, their annual risk-based premium would decrease by $3,480 from $4,000 to $520 to reflect the lower expected claims payments from flood related damage.

If the Waters family were myopic, then the expected benefits from elevating their home in the form of reduced insurance premiums for the next two to three years would not justify incurring a $25,000 cost to elevate their property. However, if the family were offered a loan, then they might have an interest in undertaking the adaptation measure.

As an example, Connecticut’s Shore Up CT program, initiated in July 2014, helps residential or 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 ¾%.

Suppose Florida had a program similar to Shore Up CT and the Waters family were offered a 15 year loan at an annual interest rate of 2 ¾%. The annual cost of the loan would only be $2,040 per year. Thus, the savings to the homeowner each year from taking the loan and investing in mitigation and hence receiving a lower insurance premium would be $1,440 (that is, $3,480 - $2,040). The rationale for such a loan is simple: it spreads the cost of the adaptation measure across a number of years, which is appropriate given that any adaptation measure provides benefits to the property over its lifetime.

**Addressing Fairness and Affordability Issues**

Congress is urged to design insurance programs that communicate to Americans their actual risk but also place the concept of fairness explicitly on the table in determining how much individuals should pay for coverage. In this case fairness means the impact that a sudden increase in premiums will have on the well being of the affected individuals. Empirical research reveals that public perceptions of fairness are likely to lead firms to take this factor into account when making pricing decisions (Kahneman et al., 1986). For the same reason, one would also expect Congress to consider whether their actions will be judged by the public as fair when they pass new legislation with respect to how insurance premiums will affect low-income residents currently residing in flood prone areas.
When the National Flood Insurance Program (NFIP) was enacted in 1968 there was a concern that high premiums would significantly reduce property values and that this could become an unfair economic strain. For this reason, the NFIP specified that homeowners living in high-risk areas at the time the law was enacted would be charged a subsidized premium. In July 2012 (three months before Hurricane Sandy), Congress passed and the President signed the Biggert-Waters Flood Insurance Reform Act of 2012, (BW12). Among other provisions BW12 required that the NFIP gradually remove insurance subsidies for certain properties and eventually charge premiums that reflect flood risk.

Soon after becoming law, BW12 faced significant challenges from many homeowners who felt that their risk-based premium increases were unjustified and unfair because they could not afford the increased cost that they would be forced to pay. Hence, in March 2014 Congress passed the Homeowner Flood Insurance Affordability Act that slowed some rate increases, halted others altogether, and also led to two reports by the National Research Council on how to deal with issues of affordability (National Research Council 2015b, 2016).

One way to maintain risk-based premiums while at the same time addressing issues of fairness and affordability is to offer means-tested vouchers that cover part of the cost of insurance. Several existing 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). A recent RAND study recommends that those whose total housing costs, including flood insurance premiums, exceed a certain percentage of their income be provided with financial assistance. This would ensure that taxpayers are not subsidizing high-income individuals (Dixon, 2017).

If the property owners were offered a multi-year loan to invest in mitigation measure(s), the voucher could cover not only a portion of the resulting risk-based insurance premium, but also the annual loan cost to make the package affordable. As a condition for the voucher, the property owner could be required to invest in cost-effective adaptation measures. An empirical study of homeowners in Ocean County, NJ reveals

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5 For more details on these programs see Kunreuther and Michel-Kerjan (2011)
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 high hazard flood area (the V Zone) and a lower hazard area (the A Zone) (Kousky and Kunreuther, 2014).

Figure 1: Cost of Program to the Federal Government and a Hypothetical Homeowner
Source: Kousky and Kunreuther (2014)

**Modifying the National Flood Insurance Program (NFIP)**

When it was formed in 1968, the NFIP was designed to encourage individuals to purchase flood insurance given the lack of private sector coverage against the risk. Following the severe Mississippi floods of 1927 and continuing through the 1960s there was a widespread belief among private insurance companies that the flood peril was uninsurable by the private sector (Overman, 1957; Gerdes, 1963; Anderson, 1974). This lack of coverage by the private sector triggered significant federal disaster relief to victims of Hurricane Betsy in 1965 and led to the creation of the National Flood Insurance Program (NFIP) in 1968. Carolyn Kousky provides a comprehensive analysis of the current status of the NFIP and the need for reforming the program so that more individuals purchase insurance and invest in cost-effective adaptation measures (Kousky, 2017).
The massive damage and disruption from hurricanes Harvey, Irma and Maria this fall has highlighted the importance of providing protection against future damage from urban flooding as well as storm surge. Few individuals had protected themselves against damage from these disasters either by investing in mitigation measures or purchasing flood insurance. More specifically, FEMA estimated that prior to Harvey, only 15 percent of Harris County residents had flood insurance and less than half of homeowners in Florida were protected against the losses they experienced from Irma. Even worse, less than 1 percent of households in Puerto Rico had flood insurance when Hurricane Maria devastated the island. This has created considerable interest by Congress and concerned stakeholders in the future of the National Flood Insurance Program (NFIP) that is set to expire on December 8, 2017. We thus have an opportunity to reexamine the nature of the program and the role that it can play in concert with the private sector to encourage the purchase of flood insurance and investment in cost-effective adaptation measures.

*The Importance of Accurate Mapping*

The need for better flood maps in the United States was noted by Congress in 2012 when it formed a second Technical Mapping Advisory Council (TMAC) to address stakeholder experience with flood maps, the mapping program’s credibility and its efficiency and present their findings to the Federal Emergency Management Agency (FEMA). In its December 2015 annual report, the TMAC recommended that “FEMA should transition from identifying the 1-percent-annual-chance floodplain and associated base flood elevation as the basis for insurance rating purposes to a structure-specific flood frequency determination” (TMAC, 2015a).

This recommendation is in line with a June 2015 report by the National Research Council on pricing negatively elevated structure in the NFIP where it concluded that

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6. [https://fema.maps.arcgis.com/home/webmapviewer.html?webmap=3d76ed9bd0642109b60ffead76fd](https://fema.maps.arcgis.com/home/webmapviewer.html?webmap=3d76ed9bd0642109b60ffead76fd)
8. Carolyn Kousky obtained this estimate was determined by comparing the number of NFIP policies in Puerto Rico ([https://bsa.nfipstat.fema.gov/reports/1011.htm](https://bsa.nfipstat.fema.gov/reports/1011.htm)) with the number of households in the commonwealth.
9. This subsection is taken from my column in the 2016 Wharton Risk Center newsletter, pp. 8-9. [http://opim.wharton.upenn.edu/riskreview/WhartonRiskCenter-newsletter_2016.pdf](http://opim.wharton.upenn.edu/riskreview/WhartonRiskCenter-newsletter_2016.pdf)
“current NFIP methods for setting risk-based rates do not accurately and precisely describe critical hazard and vulnerability conditions that affect flood risk for negatively elevated structures” (National Research Council, 2015b).

Accurate flood maps are needed, not only for the highest-risk areas, but also for areas outside those normally considered flood-prone. Such maps, coupled with elevation data on individual structures, would provide information on the likelihood of floods of different depths that could cause damage to the structure, its contents and critical systems like the air conditioning and heating units. State-of-the-art technology, such as LIDAR (Light Detection and Ranging) and advanced engineering, could determine the likely damage to the different structures from each of the potential floods. A recent analysis of three counties in North Carolina compared the current NFIP premiums for homes with risk-based premiums using LIDAR and found significant differences (Dorman et al., 2017).

With estimates of the resulting damage to the property from floods of different magnitudes, actuaries can then determine flood insurance premiums that reflect risk. Premiums based on risk, in turn, would enable FEMA, private insurers and other interested parties to communicate the flood risk to property owners, along with an explanation as to how the flood insurance premiums are determined.

Accurate knowledge of the flood risk is a first step in encouraging homeowners to invest in cost-effective loss reduction measures that would reduce their premiums. Real estate agents and mortgage institutions also should have a responsibility and interest in ensuring that purchasers and owners are aware of their flood risk, and in providing information to them on how to take steps to reduce property damage from future disasters.

The TMAC also highlighted the importance of focusing on future conditions such as changes in precipitation patterns, changes in stream flow, sea level rise and their uncertainties to estimate the nature of future flooding so as to aid communities in their land use planning decisions (TMAC, 2015b).

Cost estimates by the Association for State Flood Plain Managers for developing accurate flood maps for the entire country are in the range of $4.5 to $7.5 billion with an annual maintenance costs of $116 to $275 million (ASFPM 2013). It is important that Congress consider authorizing sufficient funds for constructing accurate flood maps in a
timely fashion as part of the reauthorization of the NFIP program in 2017. FEMA and other interested parties will then be able to communicate the nature of the flood risk to all residents whose property is subject to inundation. By continuing to move toward accurate risk-based insurance premiums, encouraging property owners to invest in cost-effective loss reduction measures we will have taken a giant step in reducing flood damage in an efficient and equitable manner.

**Using Choice Architecture to Frame the Problem**

Choice architecture, a term coined by Thaler and Sunstein (2008), indicates that people’s decisions often depend in part on how different options are framed and presented. In the context of LP-HC events, framing typically refers to the way in which likelihoods and outcomes can be characterized so as to nudge individuals to undertake protective measures prior to future adverse events.

One way to help people pay attention to the possibility of an adverse event is to stretch the time horizon for estimating the probability of the event. For example, people are more willing to wear seatbelts if they are told they have a .33 chance of a serious car accident over a fifty-year lifetime of driving rather than a .00001 chance each trip (Slovic et al., 1978). Property owners are far more likely to take flood risk seriously if they are told the chance of at least one flood during a 25 year period is 1-in-5 rather than the comparable annual probability of 1-in-100 (Weinstein et al., 1996).

A recent web-based experiment found that more than 17 percent more individuals were willing to purchase flood insurance next year when they were given the likelihood of a flood over a 25 year period than when the probability was presented for one year (Chaudhry et al., 2017). FEMA has recently taken steps to communicate the flood risk in this manner by indicating that the chances of a homeowners experiencing a flood with 100 year return period some time in the next 30 years is greater than 1 in 4.10

**Importance of Well-Enforced Standards**

In order for residents to be able to purchase a flood insurance policy from the NFIP, communities have to agree to enforce building codes to reduce future losses. Following

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Hurricane Andrew in 1992, Florida reevaluated its building code standards and enacted the Florida Building Code (FBC) in 2001, the strongest statewide building code in the United States. The FBC was based on national model codes developed by the International Code Council heavily emphasizing wind-engineering principles.

A study of the difference in realized damage from hurricanes in Florida during the 2001-2010 found that homes built to FBC standards suffered 53% less damage than homes built prior to the enactment of the FBC. A comparison of the increased costs to meet the FBC standards in relation to the expected reduction in windstorm damage across the life of the home reveals that there is two to eight dollars in expected damage reduction (benefit) for every dollar of increased construction costs. (Simmons et al 2017).

Additional support for the FBC comes from an analysis of insurance claims from Hurricane Charley that did significant damage to property in southwest Florida in August 2004. Figure 2 reveals that homes that met the new wind-resistant standards had a claim frequency that was 60 percent less than those 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 Safety, 2007). Projecting into the future, enforcing the new 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).

Homeowners who adopt cost-effective adaptation measures could also receive a seal of approval from a certified inspector that the structure meets or exceeds building code standards. Evidence from a July 1994 telephone survey of 1,241 residents in six hurricane-prone areas on the Atlantic and Gulf Coasts provides supporting evidence for some type of seal of approval. Over 90 percent of the respondents felt that local home builders should be required to adhere to building codes, and 85 percent considered it very important that local building departments conduct inspections of new residential construction (Insurance Institute for Property Loss Reduction, 1995).
Figure 2: Average claim severity by building code category from Hurricane Charley.
Source: Institute for Business & Home Safety (IBHS)

Private Flood Insurance

The Swiss Re Institute estimates that of the $15 billion in flood damages expected annually in the U.S., only $5 billion is insured today (Swiss Re Institute, 2017). A nationwide survey from roughly a decade ago found that on average, about half of properties in mapped 100-year floodplains had flood insurance, although there was substantial geographic variation, with take-up rates higher in coastal areas of the south and east. Outside of mapped 100-year floodplains, the study estimated roughly one percent were insured against flood-related damage (Dixon et al., 2006).

The private sector could complement the NFIP in providing flood coverage in flood-prone areas. The largest private provider of flood insurance, Private Market Flood, announced on its website that it now has 18,000 policies in force across 37 states. While this is more private insurance policies than were in place just a few years ago, it is only a fraction of the five million NFIP policies-in-force. The Wharton Risk Center is currently undertaking a study of the status of the private flood insurance market through a grant from Department of Homeland Security Apex program.

As the private sector expands, it will be important to consider whether it will be complementary or compete with NFIP or form some other partnership. Can the private market expand the number of people covered against flood in the U.S.? Will all insurers

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rely on NFIP mapping or undertake their own analyses of the flood risk in pricing coverage and pay a portion of the cost incurred by the public sector in producing these maps?

5. Thoughts for the Future

Modifying the NFIP is a first step to incentivize cost-effective adaptation measures. The concluding section proposes two other options for future consideration.

*Multi-year Insurance (3-5 Years)*\(^{12}\)

As a complement to property improvement loans, insurers could consider designing multi-year insurance (MYI) contracts of three to five years with a backstop from the public sector for catastrophic losses. The insurance policy could be tied to the structure rather than the property owner, and carry an annual premium reflecting risk that 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. With an MYI contract, insurers would have an 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.

Insurers should have an interest in marketing multi-year policies to reduce their marketing costs and provide homeowners with a guarantee that their policy would not be canceled should the insurer suffer losses from a severe disaster. In fact, *Private Market Flood* gives homeowners the option of selecting a one, two or three year flood insurance policy at a premium that is constant over the length of the contract. The insurer would have the option of increasing their premiums should there be an increase in the risk at the end of the contract. Combining MYI with long-term loans would encourage investments in cost-effective adaptation measures. If insurance rates are actuarially based, then the premium reduction from adopting a risk-reduction measure will be greater than the annual loan cost.

\(^{12}\) See Kunreuther (2015) for more details on multi-year insurance
Buyouts for Relocating Homes

One tool for combating the tendency to rebuild in areas prone to recurrent losses are buy-back programs that pay owners cash for destroyed properties on the condition that the lots not be rebuilt. After Hurricane Ike devastated Texas in 2008, for example, FEMA spent $103 billion on such a program, buying back 756 destroyed homes, and converting the remaining land to parkland.

The challenge of such programs is in securing compliance from homeowners. In cases where the properties are second or vacation homes this might be easy, but not so when the properties are primary residences, especially when owners would have to move away from a community of neighbors with whom they have lived for years. Residents in New York and New Jersey who had just experienced the devastation of Hurricane Sandy indicated in a 2013 survey that most believed that federal aid was best spent rebuilding homes rather than buying them. Given such resistance, decisions to accept buy-outs require community-level support, where residents have the option to relocate as a group rather than individuals.

A good example of such an effort occurred in Staten Island after Hurricane Sandy. Two weeks after the storm, Joseph Tirone, who owned a rental property in Oakwood Beach, decided to organize neighbors to agree to leave their damaged homes and relocate elsewhere. Almost all of the residents who attended the meeting he organized indicated they would be interested in selling and leaving if they could get a fair price for their house and make sure that their homes would not be given to rich people or be redeveloped into new homes. It also may take a long time for federal grant money to reach residents who are interested in receiving buyouts to sell their home and move elsewhere but they are not willing to wait in limbo for months. Hence it will be important to establish ways of providing these funds soon after a disaster or in a timely fashion to homeowners interested in relocating prior to an adverse event.

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13 This subsection is taken from Meyer and Kunreuther (2017), chapter 10
Governor Andrew Cuomo praised the community for coming together and committed to using funds for relocating homes from the FEMA Hazard Mitigation Grant Program (HMGP) that mandates that the land be returned to open space—the same program that funded reclamation projects after Hurricane Ike five years earlier. Similar programs were authorized by Governor Christie in New Jersey on even larger scale: the State’s “Blue Acres” buyout program allocated $300 million to acquire 719 severely damaged properties across several municipalities, and by 2015 more than 500 offers had been accepted by homeowners, all carrying the agreement that the lots not be rebuilt.

It would be a major challenge to convince people to move prior to a disaster when there are no funds available and few incentives to do this at a social level (leaving friends and neighbors) and at an economic level (selling their property at a price that enables them to buy a new home).

Short-term economic incentives and other initiatives to overcome myopia and the status quo are needed to encourage deliberative thinking among homeowners at risk, focusing their attention on the potential long-term benefits of adaptation. Given the impacts that climate change is likely to have on future flood related risks, it is important for residents in flood prone areas and their community leaders to take steps now to invest in these protective measures.

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16 For more details on this managed retreat in Staten Island see Rush (2015).
REFERENCES


