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Financing Flood Losses

*A Discussion of the
National Flood Insurance Program*

Carolyn Kousky



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Abstract

The National Flood Insurance Program (NFIP), housed in the Federal Emergency Management Agency (FEMA), has been providing flood insurance to households and businesses for almost 50 years. To inform the policy discussion leading up to reauthorization, this paper analyzes five aspects of the NFIP: (1) risk modeling and risk communication; (2) the roles of the public and private sector; (3) take-up rates; (4) incentives for risk reduction; and (5) rate setting and the financing of catastrophic flood events. Suggestions for reform are discussed.

Key Words: flood, insurance, disaster, premiums, NFIP

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Financing Flood Losses: A Discussion of the National Flood Insurance Program

Carolyn Kousky *

1. Introduction

The global average annual direct cost of natural disasters between 2000 and 2012 was approximately \$100 billion (Kousky 2014). Of all natural disasters, floods are the costliest (Miller et al. 2008) and have affected the most people (Stromberg 2007). This is true worldwide, as well as in the United States, where of all natural hazards, floods accounted for the most lives lost and the highest amount of property damage over the 20th century (Perry 2000). Further, climate change is projected to increase losses from flooding and coastal storms over the coming decades (IPCC 2012).

The National Flood Insurance Program (NFIP), housed in the Federal Emergency Management Agency (FEMA), has been providing flood insurance to households and businesses for almost 50 years. It was created in 1968 as a voluntary partnership with local communities. Communities that join the NFIP adopt minimum development regulations governing the 1 percent annual chance floodplain. Their residents then become eligible to purchase flood insurance policies through the program. Single-family and two- to four-dwelling residences can purchase up to \$250,000 of building coverage and \$100,000 of contents coverage. Nonresidential policyholders can insure both structure and contents up to \$500,000 each. As of November 2016, more than 5 million policies were in force nationwide, representing close to \$1.25 trillion in coverage.

The NFIP has always been broader than just an insurance program. Three program goals are usually articulated: identifying and mapping risk, encouraging floodplain management, and providing flood insurance. Some NFIP documents also state a program objective to reduce the need for and reliance on federal disaster assistance (Hayes and Neal 2011). Beyond providing insurance, the program maps flood hazards and has a series of regulations, grants, and incentive

* Kousky is a fellow at Resources for the Future, kousky@rff.org.

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programs for household- and community-level investments in flood risk reduction. These multiple goals inform all aspects of the program, including pricing.

The past half-century has seen many changes in data availability, modeling, and the private market, as well as studies and evaluations of multiple aspects of the NFIP. Over the years, the program has been modified as the need for minor changes or improvements became evident, but it still needs much modernization. Most recently, changes were enacted in the Biggert Waters Flood Insurance Reform Act of 2012 and then the Homeowners Flood Insurance Affordability Act of 2014. The program is up for reauthorization in 2017, providing an opportunity to update many aspects of the program and address some well-recognized shortfalls in risk modeling, risk communication, and pricing. Reauthorization also presents an opportunity to adopt policies aimed at closing the flood insurance gap.

To inform the policy discussion leading up to reauthorization, this paper analyzes five aspects of the NFIP: (1) risk modeling and risk communication; (2) the roles of the public and private sector; (3) take-up rates; (4) incentives for risk reduction; and (5) rate setting and the financing of catastrophic flood events. The last section of the paper explores a menu of possible reform options for congressional consideration.

2. Risk Modeling and Risk Communication

FEMA maps the flood hazard in participating communities on flood insurance rate maps (FIRMs).¹ These form the basis of the NFIP's risk modeling and risk communication efforts. A focus of mapping is identifying 1 percent annual chance floodplains (100-year floodplains), referred to as Special Flood Hazard Areas (SFHAs). SFHAs are the basis of many NFIP regulations and requirements: property owners in an SFHA with a loan from a federally backed or regulated lender are required to purchase flood insurance; participating communities must adopt minimum floodplain regulations in the SFHA (see Section 5); and pricing is different inside and outside the SFHA (see Section 6). The SFHA boundary is thus central to much of the NFIP as currently structured, and a considerable amount of time and effort goes into its determination.

FIRMs also designate different flood risk zones. These include two zones in the SFHA: the V zone, which is subject to breaking waves of at least 3 feet, and the A zone, which is not.

¹ FIRMs are accompanied by a flood insurance study.

Outside the SFHA is the X zone. FIRMs generally show both the 500-year floodplain (shaded X) and the area beyond it (unshaded X). For certain zones, the FIRM may also show base flood elevations (BFEs), the estimated height of water in a 1 percent annual chance flood. The zones and BFEs from the flood maps are an input into rate setting. (Pricing models and rate setting are discussed in Section 6.)

FEMA established the Cooperating Technical Partners (CTP) program in 1999 as a way for local governments and organizations to aid in FIRM production. The objective is to stretch limited mapping funds and let local communities have direct input into mapping, particularly when they have better data or information. FIRMs were originally produced on paper but have now almost all been digitized, largely through FEMA's Map Modernization program. FEMA also maintains the National Flood Hazard Layer (NFHL), a publicly available geospatial database with flood hazard data, FIRMs, and official map revisions. The NFHL also lists the NFIP communities, cross-section and hydraulic structure information, and base map information, such as roads, streams, and public survey land data. As of June 2013, the NFHL data covered about 92 percent of the US population (FEMA 2013b).

The Biggert-Waters Flood Insurance Reform Act of 2012 (BW12) established an ongoing effort to update flood maps. The law requires that maps for populated areas show the 100-year and 500-year floodplains, as well as areas of residual risk, the level of protection provided by flood control structures, and information on coastal erosion, changing lake levels, and subsidence. The law authorized \$400 million for updating maps for fiscal years 2013–2017, but appropriated funding was \$90.3 million in 2013 and \$90.2 million in 2014. It also created an advisory group, the Technical Mapping Advisory Council (TMAC), to review and make recommendations related to FEMA's mapping efforts. TMAC includes representatives from federal, state, and local governments, as well as the private sector. It was tasked with examining the quality and distribution of FIRMs, performance metrics for mapping, mapping and data standards, ways to maintain and update FIRMs, relationships with local partners, approaches for improving interagency coordination, and ways to incorporate the best available climate data into mapping.

Many FEMA maps have been criticized for being out-of-date, using poor-quality data or methods, or not taking account of changed conditions. FEMA attempts to evaluate all maps once every five years. FIRMs produced after 2005 use current flood models and engineering procedures, but earlier studies likely understate flood risk; even recent FIRMs may use old surge models, as was the case for the New York City 2007 FIRM, which was based on models and analysis from the 1980s (FEMA 2013a). A National Academy of Sciences report noted that

elevation data are critical to determining flood map accuracy, and outdated FIRMs do not use LiDAR data, which can be 10 times more accurate (National Research Council 2009; GAO 2010b). In 2013, the Association of State Floodplain Managers estimated the cost of providing flood maps that meet the BW12 criteria for all communities nationwide; it found the upfront cost to be \$4.5 billion to \$7.5 billion, with annual maintenance costs of \$116 million to \$275 million (ASFPM 2013). Although the report did not estimate the benefits, it cites earlier work indicating that the benefits of updated maps exceed the costs.

FIRMs are one of the NFIP's primary risk communication tools. The National Flood Insurance Reform Act of 1974 requires that lenders inform borrowers if their property is located in a mapped SFHA. This does appear to have affected the housing market: many studies have found that homes in the 1 percent annual chance floodplain are discounted relative to homes outside it (e.g., Bin and Polasky 2004; Bin et al. 2008; Kousky 2010; Atreya et al. 2013).

The SFHA boundary, however, may create a false belief that flood risk changes abruptly at the line and that properties outside the SFHA are safe (ASFPM Foundation 2004). Flood risk, of course, varies both inside and outside the SFHA. Flood events larger than the 1 percent annual chance flood do occur. For instance, Hurricanes Katrina, Ike, and Sandy all caused flooding beyond the SFHA and at depths that exceeded the BFE by several feet (FEMA 2013a). A comparison of AIR-modeled storm surge risk along the Atlantic and Gulf coasts shows that large areas not mapped as SFHAs are exposed to surge; AIR estimated roughly 40 percent of properties (NFIP 2015). It is unclear how well residents understand or appreciate flood risk outside SFHAs. The TMAC (2015a) has suggested that FEMA transition away from identifying the 1 percent annual chance floodplain and use a property-specific flood risk assessment instead.

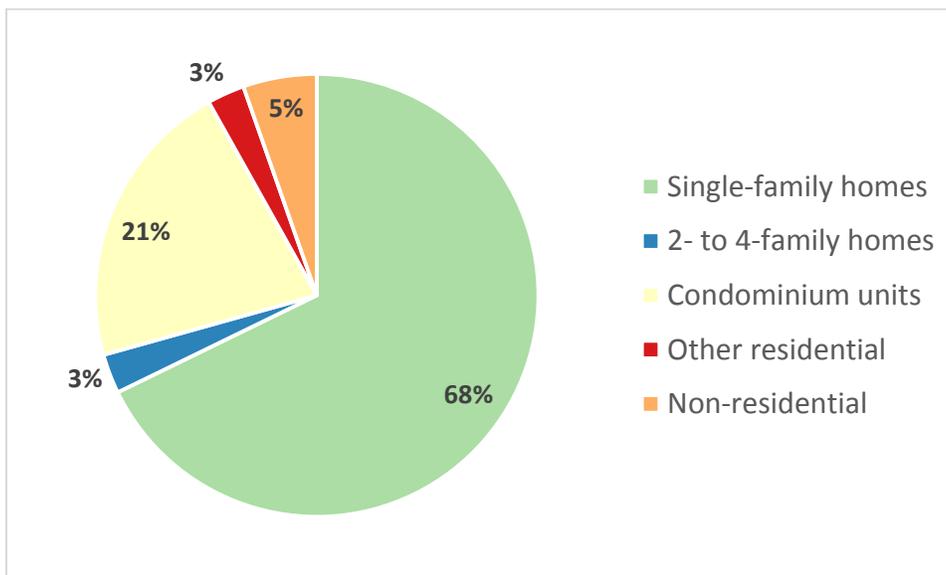
FIRMs are a snapshot of today's flood hazards in a community. They are not an indication of flood risk decades into the future and thus may not be appropriate for guiding development and land-use decisions and the siting of infrastructure. A study conducted for FEMA evaluated how population growth and climate change might alter flood risk in the United States through 2100 (AECOM 2013). It estimated a median increase in the area of the 100-year floodplain in riverine environments of 45 percent nationwide and 55 percent in coastal areas, but with large regional variation. On average, roughly 30 percent of this increase is attributable to population growth and 70 percent to climate change. Given that one of the NFIP's goals is not just providing insurance but mapping flood hazards, many stakeholders have asked whether FEMA should start providing estimates of future conditions. Since 2001, communities have been able to request that FEMA show how a fully developed watershed would alter the SFHA, but FEMA has not prepared maps showing how erosion, sea-level rise, or changing precipitation

patterns would alter flood risk. Responding to a congressional request in BW12, TMAC (2015b) issued a report on ensuring that FIRMs reflect the best available climate science, sea-level rise, and future development projections. This report included multiple suggestions for how FEMA could provide nonregulatory information on future flood risk. Current FIRMs would continue to be used for rate setting of one-year policies.

Even when information on future risk may be available, no policy mechanism currently exists to alert residents about how flood risk may change over the time they own a property or over the life of a mortgage. In coastal communities subject to increasing risks from erosion, sea-level rise, development, and changing storm patterns, properties that today are just outside the SFHA are unlikely to remain outside over the next several decades. Residents may not be getting an adequate picture of the true costs and risks of living in a location many years into the future.

Beyond simply providing maps, over the past decade the NFIP has undertaken a few outreach and marketing campaigns to educate communities and residents about flood risk. Much of the focus has been on residential homeowners, who account for the majority of NFIP policies (see Figure 1). The largest ongoing marketing campaign, called FloodSmart, seeks to educate residents about their flood risk and the role of flood insurance. The main outreach tool of the campaign is FloodSmart.gov, but the program has also run advertisements on TV, radio, and in print and has partner stakeholders that help push the campaign's messages. The FloodSmart website directs residents to agents that sell flood insurance, provides information on flood hazards, explains flood maps, and describes coverage options. The NFIP also sometimes engages in localized outreach campaigns. For instance, in advance of El Niño, a campaign in California encouraged residents to purchase flood insurance in case the rain was severe that year. As far as this author is aware, no publicly available study has evaluated these campaigns.

Figure 1. NFIP Policies by Occupancy Type, August 2016



3. Roles of the Public and Private Sectors

Today 77 private firms write policies and process claims on behalf of the NFIP but bear none of the risk and are not involved in rate setting. These “write-your-own” (WYO) companies write policies and process claims (many use a vendor) in exchange for a fee. The Government Accountability Office (GAO 2009) has found that the NFIP has historically paid one-third to two-thirds of annual premium revenue to WYO companies but does not collect any data to compare these payments with actual expenses of the companies. The WYO allowance, as a percentage of written premiums, is roughly 15 percent agent commissions, 2.3 percent voluntary payment of state premium taxes, and 12.5 percent to 13.5 percent company expenses. The company expense percentage is based on a five-year industry average of the expense ratio for multiple property insurance lines, with an additional 1 percent for other costs of a federal program. Companies also receive compensation for processing claims; the amount varies with the size of the claim. In 2008, FEMA used actual expense data to modify the way it handles payments for claims processing because of very large payments to WYO companies in 2004 and 2005 (GAO 2009). WYO companies also get a bonus for expanding the policy base of the NFIP (of up to 2 percent of written premiums).

In addition to the WYO companies, there is a Direct Servicing Agent (DSA). The DSA is a private contractor that works on behalf of FEMA to sell, service, and adjust claims on flood insurance policies obtained directly from the federal government rather than through a WYO company. The DSA handles the policies of insurers that withdraw from the program or go out of

business and also writes policies for severe repetitive loss properties.² The percentage of policies handled by the DSA has varied from 50 percent in 1986 to 3 percent in 2008 and is now 14 percent (Brown 2016). Whereas WYO companies are paid on a percentage basis to incentivize them to issue more policies, the DSA is not, since it does not market for the NFIP and only services the particular group of policies specified in its contract with FEMA. The contract is competitively awarded to the DSA at a fixed cost per policy (GAO 2007).

The private flood insurance market has been very small. It generally provides coverage above the NFIP cap or in the lender-placed market, whereby lenders can force-place flood insurance on properties that are out of compliance with the mandatory purchase requirement (Dixon et al. 2007). Recent years have seen a bit more private sector activity, most of it in the surplus lines market, but the number of private policies is dwarfed by the 5 million NFIP policies. Most private flood insurance focuses on high-value homes; these structures have higher premiums, are more likely to combine flood and homeowners coverage in the same carrier, and might be better protected (NFIP 2015). As discussed in Section 6, the NFIP's coarse rating structure has allowed some flood insurance companies that are pricing at a finer scale to identify areas where the NFIP is overcharging and offer lower-cost policies to those homeowners.

Some legislators have been concerned that certain regulations may be limiting further development of a private market. The first potential limitation is that policyholders may believe they would lose their pre-FIRM or grandfathered rates if they switched to a private policy and then wanted to return to the NFIP. Legislation passed by the House in the spring of 2016 would direct FEMA to consider private policies as meeting continuous coverage requirements, such that policyholders who switched to a private sector firm and then came back to the NFIP would still be eligible for any previous premium discount. The second concern is that lending institutions may not be confident that private policies meet the mandatory purchase requirement. BW12 required lending institutions to accept certain private policies; federal regulators proposed new rules on this at the end of October 2016. The House has also addressed this issue in legislation, proposing broader requirements for acceptability of private policies. The Consumer Mortgage Coalition has come out in opposition to any rules or legislation that allow for policies that do not adequately protect the collateral property or that could allow insurers to pay the homeowner

² A severe repetitive loss property is defined as a structure with four or more claims of at least \$5,000 each (building or contents), or at least two separate claims (building only) whose cumulative amount exceeds the value of the property. Both definitions specify at least two claims within a 10-year period and more than 10 days apart.

instead of the lender, potentially raising the possibility that flood victims could take the insurance payout and leave the lender with the flood-damaged home.

It is unclear how much appetite the private sector has to take on more flood risk. Some observers have suggested that supply might increase as insurance companies become more comfortable with flood models and flood policies. For some insurers, though, flood risk in areas with the greatest concentration of NFIP policies (see Section 4)—namely, along the Gulf coast—is highly correlated with their wind exposure, and there may be little interest in offering flood coverage. It is unclear whether broader diversification, perhaps through an expanded flood insurance purchase mandate, could encourage more private firms to write policies or whether an agreement with the government to backstop losses in the tail of the claims distribution would allow the private sector to develop a robust flood insurance market.

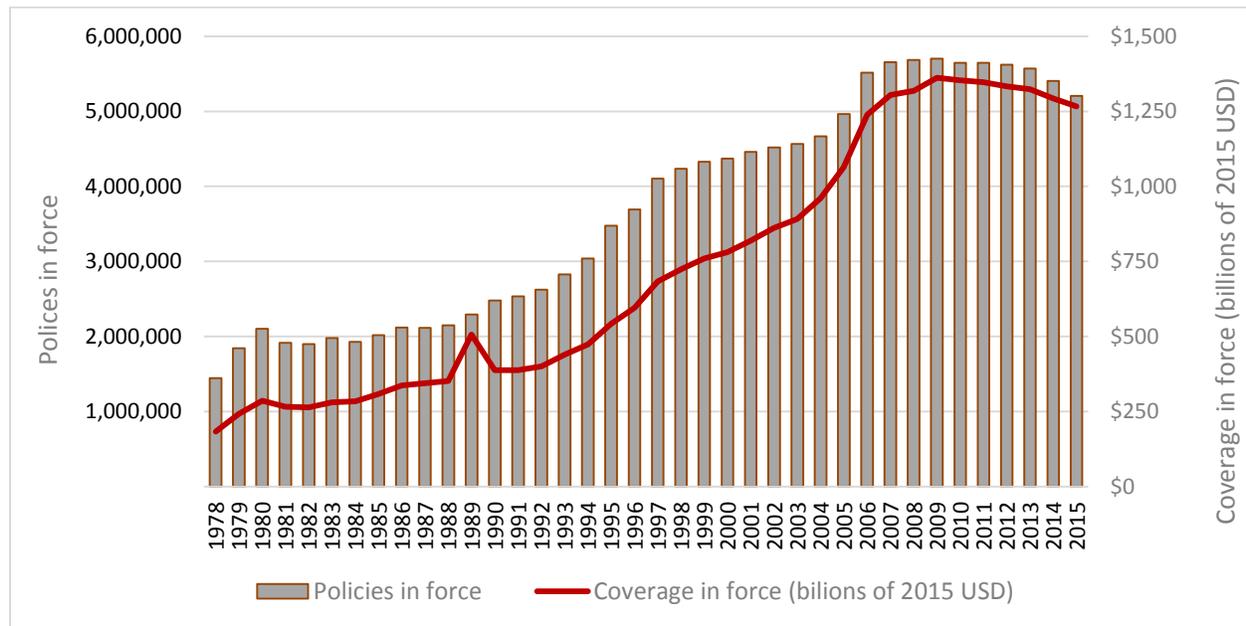
4. Take-Up Rates

In the early years of the NFIP, very few households chose to purchase flood insurance. This prompted Congress, in the Flood Disaster Protection Act of 1973, to make flood insurance mandatory for property owners in an SFHA with a loan from federally regulated lender. The law also requires that communities participate in the NFIP in order to qualify for federal disaster aid. Since that time, the number of policies has grown steadily, reaching a high point in 2009. Over the past several years, however, the number of policies in force has been declining slowly, as seen in Figure 2. The reasons for this decline are not fully understood. The pricing changes in 2012 and 2014 may play a role, but the decline predates those increases.

NFIP policies are not distributed evenly around the country. Roughly 35 percent of all policies are in Florida and another 12 percent are in Texas. Louisiana comes in third (with almost 9 percent of all policies), California fourth (6 percent), and New Jersey fifth (just over 4.5 percent). These five states account for 66.5 percent of all the policies in the program. Overall take-up rates also vary substantially around the country. They are much higher in coastal areas than inland. An analysis by RAND Corporation a decade ago found that take-up rates in SFHAs in the South and West were around 60 percent and were lowest in the Midwest, at 20 to 30 percent (Dixon et al. 2006). Although no national database of structures in SFHAs can be matched with policies for a precise measurement of take-up rates, other estimates based on surveys or county averages have indicated that the take-up rate in SFHAs is around 50 percent (Kriesel and Landry 2004; Kousky and Michel-Kerjan 2012). New York City (2013) estimates that fewer than 20 percent of those inundated by Hurricane Sandy had flood insurance, reflecting in part the fact that Sandy's storm surge pushed beyond SFHAs. An analysis by RAND found

that about 55 percent of properties in SFHAs in New York City at the time of Sandy were insured, in line with earlier estimates of SFHA take-up rates (Dixon et al. 2013).

Figure 2. Policies and Coverage in Force, by Year



Several studies have sought to identify the determinants of flood insurance demand. Unsurprisingly, they generally find take-up rates are higher in areas where the hazard is greater (Kousky 2011; Landry and Jahan-Parvar 2011). These researchers also find that as education of homeowners and home values increase, so too does coverage or the likelihood of insuring (Kousky 2011; Landry and Jahan-Parvar 2011; Atreya et al. 2015; Brody et al. 2016). Petrolia et al. (2013) surveyed coastal homeowners and found that those who anticipated higher damage from a flood were more likely to insure.

Several studies have found that after a flood event or a year with high flood damages, take-up rates for flood insurance increase, but the effect dies out in a few years (Browne and Hoyt 2000; Gallagher 2014; Atreya et al. 2015). Much of this increase, however, could be driven by a requirement that recipients of federal disaster aid purchase flood insurance policies. An examination of take-up rates for flood insurance after hurricanes found that this requirement increased take-up rates by about 5 percent, with only an additional 1.5 percent increase in take-up rates not due to this requirement (Kousky 2016). These policies may not be maintained, however: the bump in policies is gone three years after the disaster.

There has long been concern that some policyholders may not maintain their flood insurance over time. A study of NFIP policies between 2001 and 2009 found that the median tenure was only two to four years (Michel-Kerjan et al. 2012), although some drop in policies can be explained by people's moving. That said, some policyholders keep their flood insurance for considerable time. In 2012, roughly 20 percent of all NFIP policies had been in place for 3 to 5 years, another 18 percent had been in place for 6 to 10 years, and 12 percent had been in place longer than 10 years (Kousky 2015). Those policies that had been held for longer were more likely to be for properties in an SFHA. BW12 required that flood insurance be escrowed for many types of loans beginning in January 2016. It remains to be seen whether this will prove effective in encouraging homeowners to maintain their flood insurance. To the extent people stick with the status quo, as found in behavioral economics research, or don't make the time to renew, escrowing may ensure that policies are held longer.

Critics have speculated that federal disaster aid may discourage households from insuring if people treat federal aid as a substitute for insurance. In reality, however, disaster aid is insufficient to restore properties to predisaster conditions (Kousky and Shabman 2012). Under FEMA's Individual and Households Program, grants to disaster victims are capped at just over \$30,000, and most grants are far less. Between 2005 and 2014, the average individual assistance (IA) grant for housing repairs associated with flood-related disasters was only \$5,508 (2015 USD).³

IA is only available when authorized by a presidential disaster declaration, and homeowners are first directed to the Small Business Administration for low-interest loans to finance their rebuilding. Furthermore, the majority of disaster aid is for items that are not covered in a standard NFIP policy, such as for debris cleanup, infrastructure, public buildings, or other needs assistance. Additionally, for a homeowner located in an SFHA, purchasing and maintaining a flood insurance policy is a requirement of receiving disaster aid; if this requirement is not met, the household is not eligible for future assistance (National Flood Insurance Reform Act of 1994, 42 U.S.C. § 582). Other forms of disaster aid may be granted after large events, but any reimbursement for repairs and rebuilding is highly uncertain, depending on decisions by Congress and local governments (Kousky and Shabman 2013).

³ Calculated using IA data available from OpenFEMA.

People's perceptions, however, may be different, and their perceptions will guide decisions about whether to insure.

Laboratory experiments and surveys have asked individuals whether they consider disaster aid when making insurance decisions. These studies have the benefit of assessing how perceptions before a disaster can influence the purchase decision, but answers to surveys may not always reflect real-world behavior. Results vary. Usually, if individuals are told about assistance, this information will indeed lower their willingness-to-pay for insurance, but without such a prompt, they may not consider disaster aid at all when making insurance decisions (Kunreuther 1978; van Asseldonk et al. 2002; Botzen and van den Bergh 2012; Petrolia et al. 2013; Raschky et al. 2013). One empirical examination of insurance purchases after receipt of federal disaster aid for flood events in Florida found that receipt of individual assistance had a small crowding-out effect on flood coverage levels and no effect on take-up rates (Kousky et al. 2014).

Several studies have attempted to estimate the price elasticity of demand for flood insurance—or how consumers respond to a change in price. This work has found that consumers are relatively price inelastic (Kriesel and Landry 2004; Landry and Jahan-Parvar 2011; Atreya et al. 2015). Such estimates, however, face many challenges. The first is the mandatory purchase requirement: homeowners subject to this regulation may appear price inelastic, but this may not reflect their true preferences if they could have voluntarily chosen to insure. At least one study found that residents were more price sensitive (although the elasticity was still small) if they were unlikely to have a mortgage (and thus subject to this requirement) (Dixon et al. 2006). Two methodological challenges also complicate estimating price elasticity for flood insurance. First, NFIP premiums can be highly correlated with flood risk—or homeowners' perception of risk—making it difficult to tease out the effect of price from the effect of risk without an exogenous change in price, which these studies do not have to use in identification. Second, premiums are observed only for policies actually bought, and so researchers cannot examine the behavior of those who choose not to insure. The recent price increases from the legislation passed in 2012 and 2014 may be influencing insurance demand, and may plausibly be useful for identification, but this has not been studied. (Concerns about the affordability of NFIP policies are discussed further in Section 6.)

Little to no research has addressed how demand for NFIP policies is related to specific features of the insurance product. For example, the NFIP policy excludes alternative living expenses and business interruption and has only limited basement coverage. Contents can be insured only for actual cash value, not for replacement cost. The NFIP policy also does not cover

landslides. FEMA is exploring alternative coverage options that may be more appealing to certain potential policyholders.

5. Incentives for Risk Reduction

The NFIP has several carrots and sticks for encouraging policyholders and communities to invest in flood mitigation. At the household level, the program offers premium discounts for certain mitigation measures. The largest premium discounts are given for elevating a property above the BFE (Kousky et al. 2016). Elevating homes is very expensive, however, and homeowners may need grants or loans to make it financially feasible. It also may not be cost-effective to mitigate a home until it is damaged by a flood and the elevation can be done as part of the rebuilding. And for some properties, such as row houses, elevation will just not be possible. Many stakeholders in the NFIP have requested that the program offer premium credit for a broader array of mitigation measures, but to price accurately, FEMA actuaries need verified information on how potential measures would reduce claims and this is not always available.

FEMA also offers policyholders in SFHAs up to \$30,000 to bring a home into compliance with current building codes through “increased cost of compliance” (ICC) coverage. This is available for structures substantially damaged (more than 50 percent of the home’s value) by a flood and for repetitive loss properties.⁴ ICC covers elevation above BFE, relocation, demolition, and flood-proofing (for nonresidential structures).

In addition to ICC payments, FEMA offers grant funds for mitigation. The Flood Mitigation Assistance (FMA) program was created in 1994 to assist homeowners in undertaking mitigation measures to reduce future losses and future NFIP claims. The grants are available only to NFIP policyholders. Eligible mitigation projects include elevation, flood-proofing utilities, and relocation. In FY2015, \$150 million was available in this program. Prior to 2012, other FEMA grant programs targeted repetitive loss properties and severe repetitive loss properties, but the 2012 law combined these with the FMA program. FEMA has other hazard mitigation grant programs that fund projects for multiple perils, including floods. These include the Pre-Disaster Mitigation Grant Program and the Hazard Mitigation Grant Program.

⁴ A repetitive loss property is defined as a structure with two or more claims of more than \$1,000 in any rolling 10-year period.

At a community level, FEMA has minimum floodplain regulations that all participating communities must adopt. These vary by flood zone but include the following: (1) the community must require that all new development in SFHAs obtain a permit; (2) new development in floodways (the central portion of a floodplain that carries deep and/or high-velocity flows) must not be permitted if it increases flood heights; and (3) all new construction, or substantially improved or damaged properties in SFHAs, must be elevated such that the lowest floor is at or above the BFE, which is the estimated height of floodwaters in a 100-year flood (nonresidential structures can also be dry flood-proofed). In V zones, additional building requirements apply to address the force of waves. The community also must base all regulations on the most up-to-date map. Some communities may elect to have codes that exceed these minimum requirements.

The NFIP could potentially improve the required floodplain regulations. For instance, new maps of coastal communities are designating coastal AE zones (behind V zones), defined as 1 percent annual floodplains where BFEs have been designated and are subject to breaking waves of 1 to 3 feet. These coastal AE zones currently have the same NFIP minimum building regulations and the same NFIP rates as inland AE zones subject to no waves at all. Some communities have voluntarily imposed stricter building codes in these areas to account for the force of waves. FEMA has encouraged such voluntary efforts but not altered the minimum floodplain regulations. It may be beneficial to designate coastal AE zones for special building codes and pricing.

The NFIP also creates incentives for communities to take additional actions through the Community Rating System (CRS). This voluntary program, established in 1990, rewards communities for voluntarily reducing their flood risk. All communities are initially rated as Class 10. As they undertake actions that reduce risk, they accrue points. The actions are grouped into four categories: (1) public information; (2) mapping and regulation; (3) flood damage reduction; and (4) flood preparedness. At certain point thresholds, communities move down the classes to the highest level is Class 1. At each new level, residents in the SFHA of the community get an additional 5 percent reduction on their NFIP premiums. Thus, SFHA residents in Class 9 communities get a 5 percent reduction, and residents in Class 1 communities get a 45 percent reduction. Outside the SFHA, a 5 percent reduction in premiums is given for residents of Class 7–9 communities, and a 10 percent reduction applies for Class 1–6 communities. As of 2014, only 5 percent of NFIP communities participated in the CRS, but they accounted for 67 percent of all policies in force (FEMA 2014). Only five communities nationwide have attained Class 1 or 2: Roseville, California; Tulsa, Oklahoma; King County and Pierce County, Washington; and Fort Collins, Colorado.

Several studies have examined how the CRS affects claims or flood damages. These generally find that claims are lower in communities that participate in the CRS, but unsurprisingly, certain activities are more likely to influence claims or damages than others (e.g., Brody et al. 2008; Highfield and Brody 2013; Kousky and Michel-Kerjan 2015). Research suggests that in Florida, most communities earn very few of the total possible points; they focus on public information and mapping activities but score low on damage reduction and flood preparedness activities (Brody et al. 2009).

6. Rate Setting and the Distribution of the Costs of Catastrophes

6.1. Premiums

This section describes current pricing in the NFIP, drawing on Kousky et al. (2016). In 2016, the median premium across all single-family policies was \$512 and the mean was \$871. The 99th percentile premium was \$4,540.⁵ These summary statistics, however, mask variations in premiums across different rate classes and flood zones that will be discussed in this section. It is important to note at the outset, however, that the NFIP is considering rate reforms.⁶ Ultimately, the changes could be substantial, possibly overhauling current practices in favor of more parcel-specific, risk-based rates. Full reform would take many years and resources; in the interim, more modest changes will likely be made.

Currently, just over 80 percent of policies in the program are charged what FEMA refers to as full-risk rates. The NFIP full-risk rating method for SFHAs is based on a hydrologic model developed by the US Army Corps of Engineers and coupled to damage curves (for more information, see National Research Council 2015b). The probabilities of various-magnitude floods are modeled, and curves that relate these probabilities to damages based on the value of the property and characteristics of the structure (such as elevation) are used to develop an estimate of expected damage. The damage curves are checked against claim experience. The same rate is applied to properties that have similar characteristics.

The factors that influence NFIP full-risk premiums vary by flood zone and are summarized in Table 1. Rates across all zones vary by occupancy type—for example, a single-

⁵ Thanks to Mitchell Waldner for providing these statistics.

⁶ See http://www.floods.org/Files/Conf2016_ppts/E3_NealCecilStearrett.pdf.

family home or a commercial building (see Figure 1 for distribution of policies by occupancy type). The presence and/or type of basements or obstructions also play a role across zones. Apart from that, the factors influencing rating differ by zone. In 2008, GAO raised concerns that some of the data used in FEMA modeling were outdated or inaccurate. FEMA has been updating FIRMs and making other improvements, but certain items, such as probability estimates of floods, have not been updated in some time (GAO 2008).

Table 1. Factors of NFIP Full-Risk Rates, by Zone

<i>A zone</i>	<i>V zone</i>	<i>Outside SFHA</i>
Type of property	Type of property	Type of property
Number of floors	Year of construction	Basement type
Basement presence	Obstructions	Loss history (for PRP qualification)
Elevation relative to BFE	Replacement cost ratio	
	Elevation relative to BFE	
	Number of floors	
	Basement presence	

Note: BFE = base flood elevation; PRP = preferred risk policy

Source: Kousky and Kunreuther (2016).

Premiums are then adjusted by several factors. First is a loss adjustment factor, which covers the costs of loss adjusters and special claims investigations. Second is a deductible offset. Third is an underinsurance factor, which accounts for the fact that many policyholders do not insure to value (and rates are calculated based on full values), making lower claims more likely. Finally, an expected loss ratio adjustment loads rates for agents’ commissions and other expenses, and a contingency loading of 10 percent of premiums is applied in A zones and 20 percent in V zones (loading is higher if the structure is below the BFE). The Homeowners Flood Insurance Affordability Act of 2014 imposed a \$25 fee on all residential policies and a \$250 fee on nonresidential policies to help offset the costs of reinstating other classes of lower rates, discussed below. It also required an assessment to help build a reserve fund (currently set at 15 percent). There is no cost of capital in NFIP rates. NFIP rates are not set based on a modeling of the aggregate risk of the entire portfolio and are not set to meet a solvency target.

The NFIP classifies the first \$60,000 of building coverage for single-family homes (\$175,000 for businesses) as the “basic limit” and charges higher rates for coverage under this amount, since losses are more likely to occur in this range. The basic limit threshold, however, is a fixed dollar value, not a percentage of the structure value. This makes insurance more

expensive for lower-valued homes and is a perverse cross-subsidy from low-valued to high-valued structures. The subsidy could be corrected by making the threshold a percentage of the value of the structure (or replacement cost)—a change for which there is precedent, in that V-zone rates are based on the insurance purchased as a percentage of the replacement cost.

Within SFHAs, premiums vary substantially by zone and elevation. In 2016, for all policies in the A zone, the median premium was \$890 and the mean was \$1,432. In the V zone, the median premium was \$4,307 and the mean was \$4,759. Only roughly 1% of all policies in force nationwide are in a V zone—just a narrow strip on the coast subject to waves of at least 3 feet. V-zone rates are the most expensive, however, because of the potential damage. For structures below BFE, annual premiums for either zone quickly jump into the thousands or tens of thousands of dollars. For more details, see Kousky et al. (2016).

Outside SFHAs, there are two rate classes. The first is the X-zone rate, which is the same for properties in the 500-year floodplain or beyond it. The second type is a Preferred Risk Policy (PRP), which accounts for the majority of policies in force outside SFHAs. Neither rate is based on the elevation of the property relative to BFE. PRP rates are lower premiums for homes with a minimal loss history—specifically, properties that have not had any of the following: two claims of more than \$1,000 each, three or more claims of any amount, two federal disaster aid payments of more than \$1,000 each, three federal disaster aid payments for separate occurrences for any amount, or one insurance claim and two federal aid payments of more than \$1,000 each. The annual premium for a PRP policy with the maximum allowable building and contents coverage is \$499.

The largest group of properties with discounted premiums are pre-FIRM structures, those built before FEMA had mapped flood risk in a community. As of fall 2015, this was roughly 17 percent of policies (Brown 2016). The discounted rate structure was put in place to avoid penalizing homeowners who had built while unaware of the risk or before the NFIP floodplain regulations had been adopted by their communities. Many of these are high-risk properties that would have seen high premiums. Pre-FIRM properties sustain more damage and have higher claims than post-FIRM properties (GAO 2010a; Kousky and Michel-Kerjan 2015). FEMA does not recoup the lost revenue by raising premiums on other policyholders, nor does it receive taxpayer funds to offset these lower rates. Even with the discount, most pre-FIRM policyholders are still paying more than would be paid under full-risk rating for buildings that had been constructed in compliance with building codes (Hayes and Neal 2011).

Under the 2012 and 2014 legislation, pre-FIRM rates are being phased out for all policyholders. For single-family residences, the premium increase must be a minimum of 5 percent but cannot exceed 18 percent per year. Rates for nonprimary residences, businesses, severe repetitive loss properties, and properties substantially damaged or improved (at a cost exceeding 50 percent of the structure's value) will increase at 25 percent a year until they reach full-risk premiums. Full-risk rates, however, are based on elevation. FEMA will thus keep increasing rates until a property owner submits an elevation certificate to allow for post-FIRM pricing. Homeowners may not realize that they can get an elevation certificate but continue using pre-FIRM rates until they are no longer less expensive. Note that for properties at or above BFE, post-FIRM rates, which are based on elevation, should be lower than pre-FIRM rates. For properties below BFE, however, pre-FIRM discounts can save homeowners thousands of dollars annually. A recent National Academies report examined rating for properties below BFE, which is the case for most pre-FIRM properties, and suggested improvements, such as better accounting of more frequent floods (National Research Council 2015b).

A second group paying discounted premiums are grandfathered properties, those that were built in compliance with the hazard map in effect at the time of construction or that have maintained continuous coverage beginning before the map change. These properties can keep the rate of the original map if a new map indicates they are now at higher risk. Zone grandfathering is the most common form of rate grandfathering; it occurs when a property previously classified as outside an SFHA is included in the SFHA in a revised map or when a property moves from an A zone to a V zone. Policyholders newly mapped into the SFHA are given a PRP rate (with a reserve fund assessment and federal policy fee), which increases every year until it reaches the X-zone premium level. Elevation grandfathering occurs when a new map raises the BFE without changing the zone itself. For instance, if a property was 2 feet above BFE on the old map but is now 1 foot below, the rate associated with being 2 feet above BFE could still be used.

Currently, a few other small groups of properties are eligible for lower premiums: (1) post-FIRM properties in V zones constructed between 1975 and 1981, for which premiums do not account for wave action; (2) A99 properties, those that will be protected by structural flood control currently under construction, which receive rates as if it is finished; and (3) AR properties, those protected by a levee that has been decertified but will be restored, which are charged the rate for outside the SFHA.

The NFIP does not receive any taxpayer funds to offset the price discounts in the program; most are cross-subsidies (Kousky et al. 2016). The discounts for grandfathered properties are offset by higher rates on other policyholders in the zone. CRS discounts are

likewise accounted for by adjusting all premiums upward so that aggregate revenue is enough to cover expected losses plus the CRS discounts. The expected discount for the April 1, 2014, rate changes was 11.8 percent, translating into a 13.4 percent load. Other cross-subsidies that may merit attention include the implicit subsidy to higher-value homes due to the \$60,000 threshold, cross-subsidies between high- and low-risk properties outside SFHAs, and cross-subsidies from coastal AE zones to inland AE zones.

The 2012 and 2014 reform legislation sparked concern about the affordability of flood insurance policies. BW12 eliminated both pre-FIRM and grandfathered rates, among many other changes, generating particular outcry from homeowners facing higher risk from new FIRMs. This led Congress to reinstate grandfathering in 2014 and slow the phaseout of pre-FIRM rates. The 2012 and 2014 laws both also called for studies of affordability and for FEMA to develop an affordability framework. In fulfillment of these requirements, the National Research Council (2015a, 2016) released two reports on this topic, and FEMA is drafting an affordability framework to deliver to Congress in 2017.

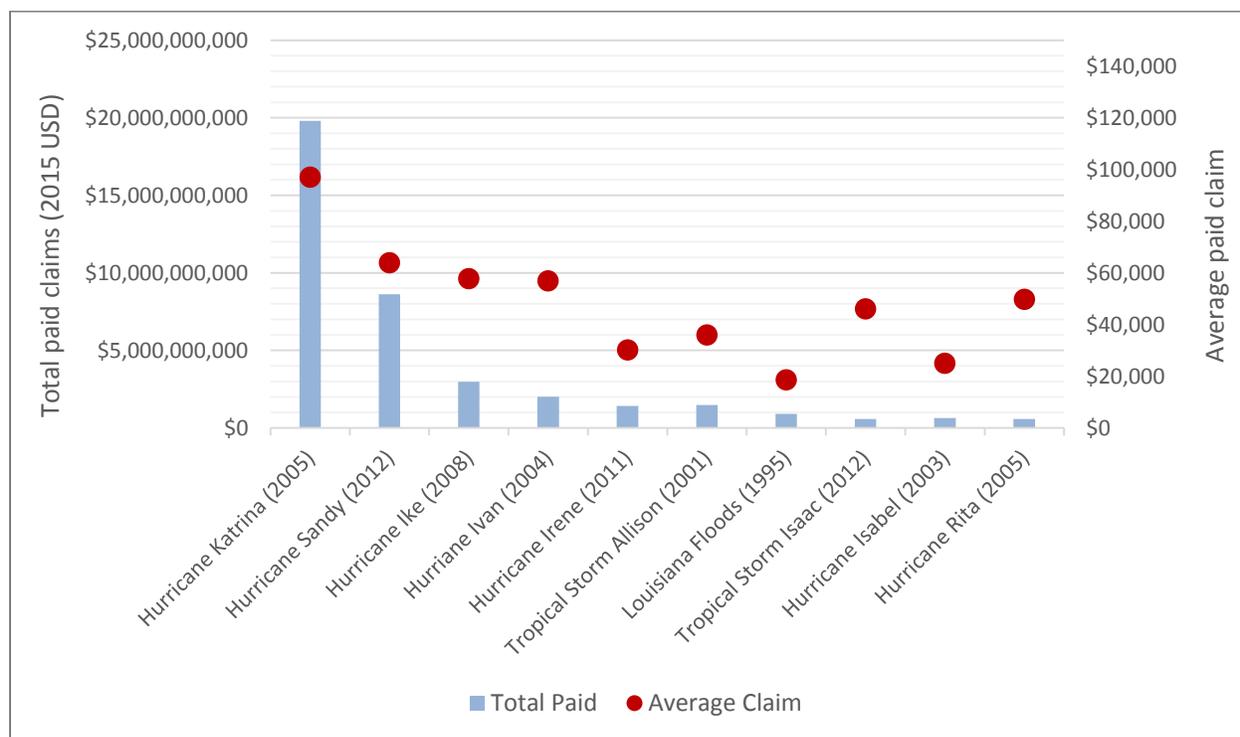
The first National Research Council (2015a) report discussed the multiple ways that one could identify who needs financial assistance with premiums. After that determination, a range of policy questions must be answered: Who will receive assistance? What assistance will be provided? How will assistance be provided? How much assistance will be provided? Who will pay for assistance? And how will assistance be administered? FEMA is considering answers to these questions in its affordability framework. The myriad policy choices range from tax credits to vouchers to assistance with mitigation measures that lower premiums.

Work is thus well under way on how to design a program to provide targeted assistance to low-income residents for whom flood insurance is a financial burden. In addition, however, the NFIP struggles with the question, “Is it worth it?” Homeowners often say that flood coverage is too expensive for what they get. In part, the complaint raises questions of whether people understand their flood risk and understand the role and functioning of insurance; some research suggests otherwise on both accounts. It also has to do with the design of the product, and whether it provides the type and extent of coverage desired. These issues—fundamentally different from asking how to help needy residents obtain financial protection—are important questions for the NFIP.

6.2. Covering Catastrophic Losses

The NFIP has amassed a huge debt, currently \$23 billion, with no way to repay this debt in the foreseeable future. The NFIP has never had a financial architecture to be able to cover claims from high loss years. The program was never capitalized by Congress. The program has always had borrowing authority from the US Treasury, but there was no consideration of how this would be repaid following a catastrophic year. Figure 3 shows the 10 highest-cost flood events for the NFIP. Because of Katrina, 2005 was an outlier, with both more claims and higher-value claims than other years (see Kousky and Michel-Kerjan 2015). Sandy, in 2012, was second in terms of total paid claims.

Figure 3. Top 10 Highest-Cost Flood Events



Before the 2012 and 2014 legislation, the NFIP had only two sources of funds for paying claims: premiums and debt. The reform legislation took some steps to create a financial structure for covering high loss years, but this was not done systematically or comprehensively. That is, there was little thought to how various financing mechanisms would work together. First, in BW12, Congress authorized the creation of a reserve fund and legislated that FEMA maintain an amount in the reserve equal to 1 percent of total exposure. As of April 2016, FEMA is charging NFIP policies a reserve fund assessment of 15 percent of the premium to build up this fund (this applies to PRP policies as well). By the end of fiscal year 2016, FEMA projected to have almost

\$1.75 billion in the reserve fund and estimated it could take decades to build up the fund to the required ratio (Brown 2016).

Second, Congress authorized the purchase of reinsurance. In 2016, FEMA purchased a very small amount of reinsurance as a pilot, transferring \$1 million in risk to Transatlantic Re, Swiss Re, and Munich Re (Guy Carpenter provided brokerage assistance). The NFIP made a larger, over \$1 billion placement in January, 2017 with 25 different reinsurers. This purchase will cover 26% of losses between \$4 billion and \$8 billion. A Guy Carpenter analysis conducted for FEMA concluded that the current reinsurance market could provide \$7.5 billion to \$10 billion or more of indemnity coverage, if developed over time as comfort with the NFIP's business and exposure grows and as the supportive modeling develops (NFIP 2015).

Using reinsurance to fully protect the program, however, would be quite costly, and it is not clear where the funding would come from because further premium hikes seem politically unpalatable. FEMA contracted with Guy Carpenter and AIR Worldwide to conduct a holistic loss modeling analysis of NFIP's portfolio in 2014 (NFIP 2015). One reinsurance scenario analyzed would pay out \$17 billion after NFIP has paid \$8 billion in claims in a year. This would cost \$2.2 billion annually, but the current premium revenue of the program is only roughly \$3.7 billion (NFIP 2015).⁷ This scenario would effectively protect the NFIP from having to borrow any more for 99 percent of possible annual outcomes—but that comes at a cost. The report discusses many factors that would influence the types and amount of reinsurance purchased, including the observation that the market is likely more comfortable with occurrence protection.

7. Conclusion: Considerations for Reform and Reauthorization

Over the past 50 years, our ability to model, communicate, and transfer disaster risk has undergone many changes, and our technology and data have greatly improved. The NFIP now has a 48-year history that can inform approaches to upgrading and reforming the program. This long history, though, has also created path dependency, and the NFIP now needs to be modernized in light of the transformations and improvements we have seen, particularly when it

⁷ The analysis of the NFIP aggregate portfolio found that a 1-in-100-year all-flood loss (coastal and inland) was \$24.5 billion for an annual aggregate loss and \$18.2 billion for a single occurrence. The single occurrence modeled loss for a 1-in-100-year event is driven by flooding from hurricanes and tropical storms; inland flood losses have a limited impact above a certain threshold. That said, the possibility of more than one inland flood in a year increases the consequences of inland flooding when annual aggregate losses are modeled. The analysis finds, for comparison, that Katrina was a 1-in-392-year event and Sandy was a 1-in-17-year event.

comes to technology, modeling, and data. As the program looks to reauthorization in 2017, FEMA is evaluating many options that are within its authorities, but other changes would require congressional action. In considering possible changes, it is important to remember that reform depends fundamentally on program objectives—of which there are currently several—and that there may be trade-offs among them. This section briefly reviews some potential changes that Congress may wish to consider, setting aside the laudable progress FEMA is making on its own.

The first and most basic reform is to appropriate funds to upgrade the NFIP data systems and update maps around the country. In addition, if FEMA is to be the institution that produces nonregulatory maps for projecting future flood risk, as called for in BW12, then the process for doing so needs to be designed and funded, following recommendations from the TMAC. Investments in improved technology, data, and resources could provide the foundation to help the program move toward property-specific flood risk information and pricing.

Property-level risk information would help the program tackle two ongoing challenges: how to communicate to residents that flood risk is not binary but instead varies across the landscape and extends beyond SFHAs, and how to communicate flood risk over the life of a mortgage or building or even the time someone will occupy a home. This is critical in coastal areas, where models suggest flood risk is increasing over time. Property owners need to be aware that their current flood zone and BFE may change over the coming decades. For such information to be fully internalized by the housing market, a simple marketing campaign will not suffice. Instead, new policy tools are needed to link housing and development decisions with information on hazard risks and their projected changes.

As flood risk changes and maps are updated over time, grandfathering will become increasingly unsustainable. The number of property owners paying rates not commensurate with the risk—both those who are underpaying because they are grandfathered and those who are overpaying to offset the grandfathering—will grow. A path for slow phaseout of grandfathered rates is needed and could be contemplated for the 2017 reauthorization.

Cross-subsidization in the program from grandfathering and other sources also creates the opportunity for the private sector to write policies where the NFIP is currently overcharging. Property-specific rating would go a long way to ameliorating this problem. In addition, as the push toward greater private sector involvement continues, the ultimate goals of privatization and its implications for the NFIP need to be examined. For example, if private insurers primarily write policies only for the NFIP's "good" and "overpriced" properties, the practicality of making the NFIP a national-level residual market needs to be carefully considered. It is unlikely that the

NFIP as a residual market could be financially self-sustaining without explicit transfers from taxpayers to make up the difference between premiums for discounted properties and their risk-based rate and/or a guarantee from the Treasury to cover losses above some threshold.

That raises the final issue that could usefully be addressed in reauthorization: developing a clear financing program for covering catastrophic loss years. To support the design of the financial architecture of the program, a systematic analysis should address the costs and benefits of using of the reserve fund, borrowing authority, reinsurance, other forms of risk transfer, and perhaps, with congressional approval, a Treasury backstop at some catastrophic loss level. Questions include how various financing structures influence the cost of policies and how that will in turn affect demand, unless a more comprehensive mandatory purchase requirement is adopted. Once a clear financial structure is in place, the NFIP debt should be forgiven so the program can start anew with better financing and upgraded rates.

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