

# Policy Tenure Under the U.S. National Flood Insurance Program (NFIP)

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In the United States, insurance against flood hazard (inland flooding or storm surge from hurricanes) has been provided mainly through the National Flood Insurance Program (NFIP) since 1968. The NFIP covers \$1.23 trillion of assets today. This article provides the first analysis of flood insurance tenure ever undertaken: that is, *the number of years* that people keep their flood insurance policy before letting it lapse. Our analysis of the entire portfolio of the NFIP over the period 2001–2009 reveals that the median tenure of new policies during that time is between two and four years; it is also relatively stable over time and levels of flood hazard. Prior flood experience can affect tenure: people who have experienced small flood claims tend to hold onto their insurance longer; people who have experienced large flood claims tend to let their insurance lapse sooner. To overcome the policy and governance challenges posed by homeowners' inadequate insurance coverage, we discuss policy recommendations that include for banks and government-sponsored enterprises (GSEs) strengthening their requirements and the introduction of multiyear flood insurance contracts attached to the property, both of which are likely to provide more coverage stability and encourage investments in risk-reduction measures.

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**KEY WORDS:** Catastrophes; flood insurance; individual decision making; multiyear insurance; NFIP

## 1. INTRODUCTION

The economic and insured losses from great natural catastrophes such as hurricanes, earthquakes, and floods worldwide have increased significantly in recent years. According to reinsurance giant Munich Re, economic losses over the period 2000–2009 were \$670 billion, principally as a result of the 2004, 2005, and 2008 hurricane seasons.<sup>(1)</sup> There has also been a significant increase in insured losses during the past 20 years, largely due to the occurrence of severe catastrophes.

Table I reveals that of the 25 most costly insured catastrophes from 1970 to 2009 (in 2009 dollars), 14 have occurred since 2001, 12 of them in the United States.<sup>3</sup> With the exception of the terrorist attacks on September 11, 2001, all 25 of the most costly catastrophes were natural disasters. More than 85% of these were weather-related events—floods, hurricanes, typhoons, storms—with nearly three-quarters of the claims in the United States.<sup>(2)</sup>

It is difficult to recall that until Hurricane Hugo hit the South Carolina coast in 1989, no disaster in the United States had cost insurers more than \$1 billion

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<sup>3</sup>Several large-scale disasters have also occurred in regions where the insurance penetration is very low, so they do not appear in Table I. That is the case, for instance, of the December 2004 tsunami in Southeast Asia and the 2010 earthquake in Haiti that killed hundreds of thousands of people.

**Table I.** The 25 Most Costly Catastrophe Insurance Losses, 1970–2009

Event	Victims (Dead or Missing)	Year	Area of Primary Damage	\$ Billion Paid by Private Insurance	\$ Billion Paid by the U.S. NFIP
Hurricane Katrina	1,836	2005	USA, Gulf of Mexico, <i>et al.</i>	47.9	17.5
9/11 attacks	3,025	2001	USA	36.7	–
Hurricane Andrew	43	1992	USA, Bahamas	24.5	0.3
Northridge Earthquake	61	1994	USA	20.3	–
Hurricane Ike	348	2008	USA, Caribbean, <i>et al.</i>	15.9	2.6
Hurricane Ivan	124	2004	USA, Caribbean, <i>et al.</i>	14.6	1.8
Hurricane Wilma	35	2005	USA, Gulf of Mexico, <i>et al.</i>	13.7	0.4
Hurricane Rita	34	2005	USA, Gulf of Mexico, <i>et al.</i>	11.1	0.6
Hurricane Charley	24	2004	USA, Caribbean, <i>et al.</i>	9.1	0.06
Typhoon Mireille	51	1991	Japan	8.9	–
Hurricane Hugo	71	1989	Puerto Rico, USA, <i>et al.</i>	7.9	0.64
Winterstorm Daria	95	1990	France, UK, <i>et al.</i>	7.7	–
Winterstorm Lothar	110	1999	France, Switzerland, <i>et al.</i>	7.4	–
Winterstorm Kyrill	54	2007	Germany, UK, NL, France	6.3	–
Storms and floods	22	1987	France, UK, <i>et al.</i>	5.9	–
Hurricane Frances	38	2004	USA, Bahamas	5.8	0.2
Winterstorm Vivian	64	1990	Western/Central Europe	5.2	–
Typhoon Bart	26	1999	Japan	5.2	–
Hurricane Gustav		2008	USA, Caribbean, <i>et al.</i>	5.2	0.1
Hurricane Georges	600	1998	USA, Caribbean	4.6	0.3
Tropical Storm Allison	41	2001	USA	4.3	1.34
Hurricane Jeanne	3,034	2004	USA, Caribbean, <i>et al.</i>	4.3	0.2
Typhoon Songda	45	2004	Japan, South Korea	4.0	–
Thunderstorms	45	2003	USA	3.6	–
Hurricane Floyd	70	1999	USA, Bahamas, Columbia	3.5	0.6

Data from Swiss Re, Insurance Information Institute and U.S. Department of Homeland Security.

Note: Dollar amounts are indexed to 2009 using inflation rates published by the U.S. Bureau of Labor Statistics.

in claims payments. But times have changed: there have been repeated large-scale events in the United States and other parts of the world in recent years where insured losses have far exceeded \$1 billion. This change is primarily due to an increase in the value at risk and insurance density in hazard-prone areas. The possible change in climate patterns leading to more intense hurricanes may have played a role as well.<sup>4</sup>

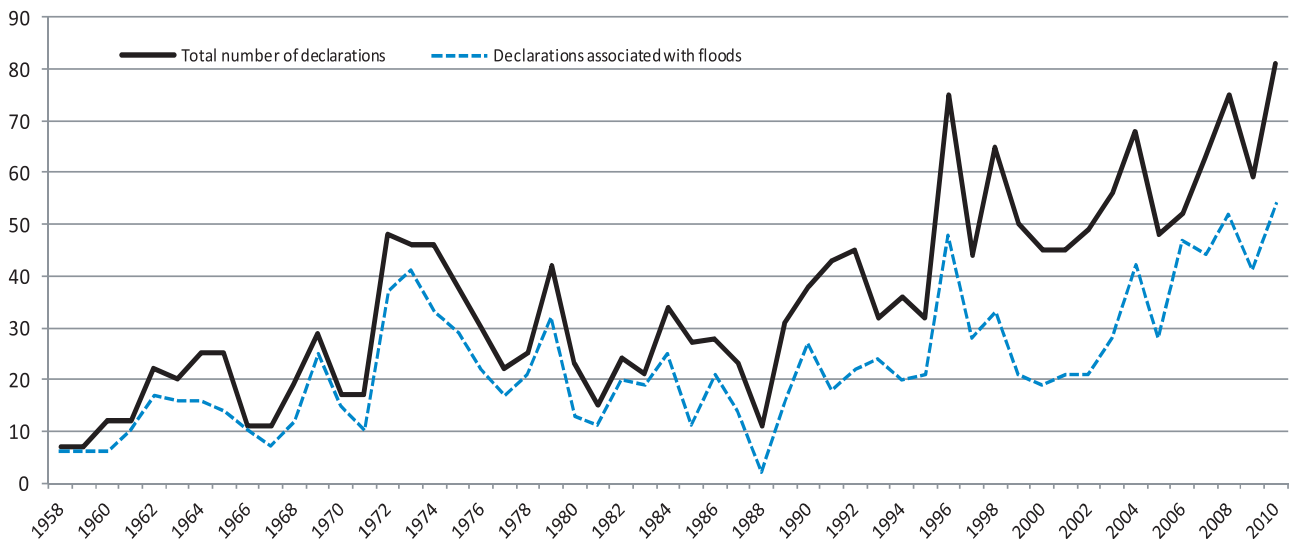
There was a radical increase in insured losses in the early 1990s due primarily to Hurricane Andrew in Florida (\$24.5 billion in 2009 dollars) and the Northridge earthquake in California (\$20.3 billion in 2009 dollars). The four hurricanes in Florida in 2004 (Charley, Frances, Ivan, and Jeanne) collectively totaled almost \$35 billion in insured losses. The last two columns of Table I indicate the insured losses paid by private insurers and the federally managed National Flood Insurance Program (NFIP) in the United States, when this distinction applies. All the hurricanes and storms that made landfall triggered

flood insurance payments from storm surge and high levels of precipitation associated with them. Hurricane Katrina alone cost private insurers and reinsurers an estimated \$47.9 billion, and cost the NFIP an additional \$17.5 billion.

This article focuses on homeowners' behavior with respect to flood insurance in the United States. An important policy challenge lies in the evidence that many residents in flooded areas did not have flood coverage when they experienced a loss. Consider the flood in August 1998 that damaged property in northern Vermont. Of the 1,549 victims of this disaster, FEMA found that 84% of the homeowners in flood-prone areas did not have insurance, even though 45% of these individuals were required to purchase this coverage.<sup>(4)</sup> In the Louisiana parishes affected by Katrina, the percentage of homeowners with flood insurance ranged from 57.7% in St. Bernard Parish to 7.3% in Tangipahoa when the hurricane hit. Only 40% of the residents in Orleans Parish had flood insurance.<sup>(5)</sup>

Uninsured homeowners create a welfare cost to themselves and to all taxpayers if the government

<sup>4</sup> See Refs. 2 and 3 for a discussion on the question of attribution.



**Fig. 1.** Number of U.S. presidential disaster declarations, 1958–2010.

Source: Authors' calculations with data from the U.S. Department of Homeland Security.

provides them with disaster assistance. Under the current U.S. system, the governor of the state(s) can request that the president declare a “major disaster” and offer special assistance if the damage is severe enough. As depicted in Fig. 1, the number of presidential disaster declarations has dramatically increased over the past 50 years, from 162 over the period 1955–1965 to 545 during 1996–2005. Fig. 1 also depicts the number of those presidential declarations that were triggered by flooding events (inland flood and storm surge from hurricanes). These flood-related declarations account for nearly two-thirds of all declarations over the period 1958–2009, demonstrating the significance of floods among all U.S. disasters.

In response to Hurricane Katrina in 2005, two emergency supplemental appropriations bills (P.L. 109–61 and P.L. 109–62) were enacted by Congress that provided \$67.9 billion for emergency response and recovery needs (in 2009 prices). The following year, another \$20.5 billion was appropriated in supplemental legislation (P.L. 109–234; in 2009 prices) for recovery assistance. Taken together, this \$88.4 billion federal relief is more than the combined total amount of insurance claims paid by private insurers for wind damage and by the NFIP for flood damage caused by Katrina.<sup>(6)</sup>

The article is organized as follows. Section 2 aims to familiarize the reader on the subject of flood hazard and flood insurance in the United States. It provides a general overview of flood losses in the past

decade and of the operation of the NFIP. We also present county-level statistics on insurance penetration and the distribution of flood insurance nationwide, based on our analysis of the entire portfolio of the NFIP from January 2001 to December 2009 that was provided to the Wharton Risk Management Center for research purposes, combined with data from SHELDUS<sup>(7)</sup> and the U.S. Bureau of the Census.

Section 3 provides the key contribution of this article. That is an analysis of the insurance tenure of new policies entering the NFIP in 2001 for all consecutive years until 2009. By “tenure” we mean the number of years that people keep their flood insurance policy before it lapses. The first series of analyses is performed at a national level. We then replicate it at a state level for California, Florida, Louisiana, and Texas, which together represent nearly two-thirds of the entire NFIP portfolio, and for several states in the Northeast, another exposed region (Connecticut, Delaware, New Jersey, New York, and Pennsylvania).

Our main finding is that the median flood insurance tenure is between two and four years only. This finding is quite stable over time across the country for properties located in Special Flood Hazard Areas (SFHAs; high-risk areas) and in non-SFHAs (low-risk areas) alike. We also look at those policyholders who suffered a claim the very first year they entered the program. Such a claim experience can impact their tenure, but only if the claim is small

(which increases the tenure) or very high (which decreases it).

Section 4 discusses some reasons why this tenure is so short. Aside from migration, behavioral biases have a negative influence on the length of time that people hold onto their insurance policies. People typically have difficulty understanding the probability of loss. They underestimate their exposure, misjudge the economic and social impact from suffering flood damage, and have short memories regarding past catastrophes. There might also be rational economic explanations, for instance, that flood insurance competes with the family's other expenses.

In Section 5, we discuss policy recommendations, among them our recommendation that Congress and the Federal Emergency Management Agency (FEMA) work more closely with banks and government-sponsored enterprises (GSEs; e.g., Fannie Mae and Freddie Mac) to ensure a much higher compliance rate with the mandatory flood insurance purchase requirement. We also propose the creation of multiyear flood insurance contracts (e.g., 3, 5, or 10 years) attached to the property, not the individual, which would be added to the menu of contracts offered by the NFIP.

## 2. OVERVIEW: FLOOD LOSSES AND FLOOD INSURANCE IN THE UNITED STATES

### 2.1. Distribution of Flood Losses by County

Flooding arises from different types of events: coastal surges linked to hurricanes, heavy rains, and large river flows. The distribution of floods in the United States is linked to climatic, topographic, and basin size characteristics.<sup>(8)</sup> To examine flood damage nationwide, we constructed two measures of flood experience by using information from the SHELDUS database:<sup>(7)</sup> the number of floods that occurred between January 1, 2000 and December 31, 2008 in a given county (Fig. 2a) and the property losses associated with these floods in that same county (Fig. 2b). In both measures, we consider only flood events that inflict more than \$100,000 in damage (in 2008 prices).

The data from Fig. 2a reveal that while floods are often described as low-probability, high-consequence events, these events occur relatively frequently in some parts of the country, notably southern California, counties in the Great Plains states, counties in the Northeast, and those along the coasts of the Gulf of Mexico and Florida. Many of these coun-

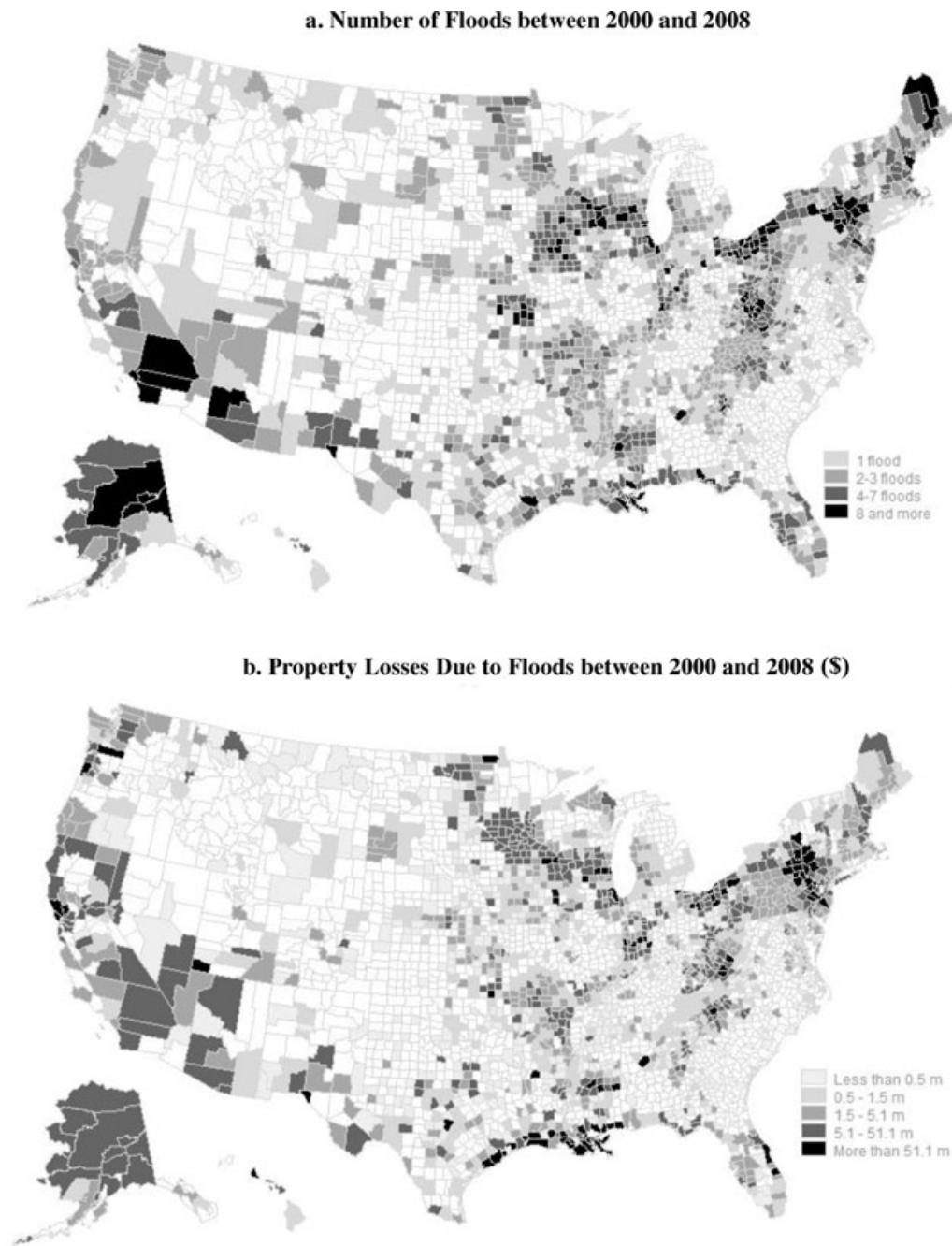
ties have experienced at least four floods inflicting more than \$100,000 in property costs between 2000 and 2008, and a not trivial number of them experienced eight floods or more during this period.

As shown in Fig. 2b, the counties with high property damages correspond to localities with high flood frequencies, notably in the Northeast. Several counties along the Gulf Coast and Florida are in the 95th percentile of the damage distribution (represented in black in Fig. 2b), primarily because they experienced severe storm surges from all the major hurricanes that made landfall between 2004 and 2008. This dual characteristic of the flood hazard—frequent but smaller floods, and less frequent but truly devastating ones with a very high degree of loss concentration—explain why insurers have historically refused to cover flood hazard<sup>(9)</sup> and the creation of the federally run NFIP, to which we now turn.

### 2.2. The Rationale for the NFIP

The National Flood Insurance Program (NFIP) was ultimately developed due to a widespread belief among private insurance companies that flood peril was uninsurable by the private insurers alone. This lack of coverage by the private sector led the federal government to provide significant relief to victims of Hurricane Betsy in 1965. Discussion took place about the role that the federal government could play in developing some form of public insurance coverage, which led to the creation of the NFIP in 1968.<sup>(10)</sup> It was thought that a government program could potentially be successful because it would have funds to initiate the program, pool risks more broadly, subsidize existing homeowners while charging actuarial rates to new construction and tie insurance to land-use changes that might lower risks. The program would also have the capacity to spread losses over time by borrowing money from the federal government to compensate for a deficit, something private insurers cannot do (see Ref. 11 for an analysis of the first 42 years of operation of the program between 1968 and 2009).

In communities where local governments enact flood management regulations that follow FEMA requirements, property owners are eligible to buy flood insurance from the NFIP. The cost of flood insurance is determined by the federal government, which manages the program. The length of the contract is also determined by the government; it is one year. The majority of NFIP policies are written through the Write-Your-Own (WYO) Program, which allows



**Fig. 2.** (a) Number of floods between 2000 and 2008. (b) Property losses due to floods between 2000 and 2008.

*Note:* County-level analysis. Included here are only those floods that inflicted more than \$100,000 in property costs in a given county (2008 prices). When considering the distribution of all counties that experienced losses, \$0.5 million corresponds to the first quartile, \$1.5 million to the median damage, \$5.1 million to the third quartile, and \$51.1 million to the 95th percentile of the damage distribution (Fig. 2b).

*Source:* Authors' calculation—data from SHELUDS.

participating property/casualty insurance companies to write and service NFIP's standard one-year flood insurance policy.<sup>(12)</sup> The insurance companies bear no risk and are compensated for writing policies and settling claims; FEMA, which runs the program today under the U.S. Department of Homeland Security, benefits from the private industry's marketing channels and the presence of private insurers in participating communities. Nearly all flood policies issued today by the NFIP are written by 90 companies that write flood insurance policies through the WYO Program. (Note that some additional coverage is offered by private insurers above the current \$250,000 maximum building-coverage limit covered by the NFIP for residential property owners and under special commercial insurance policies, but this is not the focus of this article.)

### 2.3. Data Set and Key Statistics

More than 40 years after its inception, the NFIP has grown significantly. As of December 2010, there were 5.65 million NFIP policies in force nationwide, which generated \$3.35 billion in premiums (average annual premium per policy of \$593 nationwide), for a total insured value of over \$1.23 trillion.

The data set we accessed comprises the entire portfolio of the NFIP nationwide for nine consecutive years (2001–2009). The data set does not provide identifying information of the homeowner, preventing us from doing a household-level analysis, but it has the ZIP code, city, and county in which the policyholder's residence is located. It contains a variety of variables relating to the policy such as the date the policy was purchased and when it lapsed. The data set also has the flood zone, notably if the property is located in a Special Flood Hazard Area (SFHA) defined by FEMA as "the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year." After we eliminated some policies for which we do not have complete information over time, our data set contained 34.4 million policies in force, ranging from 4 million policies in force in 2001 to 5.3 million in 2009.

It is interesting to see whether the counties that suffered a large number of floods in past years and/or high level of damage (Figs. 2a and 2b) are also those where the demand for flood insurance is high. In Fig. 3 we construct a measure of insurance penetration at a county level for the year 2008 that is defined as the ratio of number of flood policies in force over number of housing units in that county (as estimated

by the U.S. Census; 2008 is the latest data available). We see that insurance penetration rates are very heterogeneous throughout the country. More than half of the counties have a penetration rate lower than 1%. While this is expected for regions of the country that are not prone to flood hazard, this is surprising for counties that have suffered eight floods or more over the period 2000–2008; that is the case for some counties in Ohio, Minnesota, and Iowa.

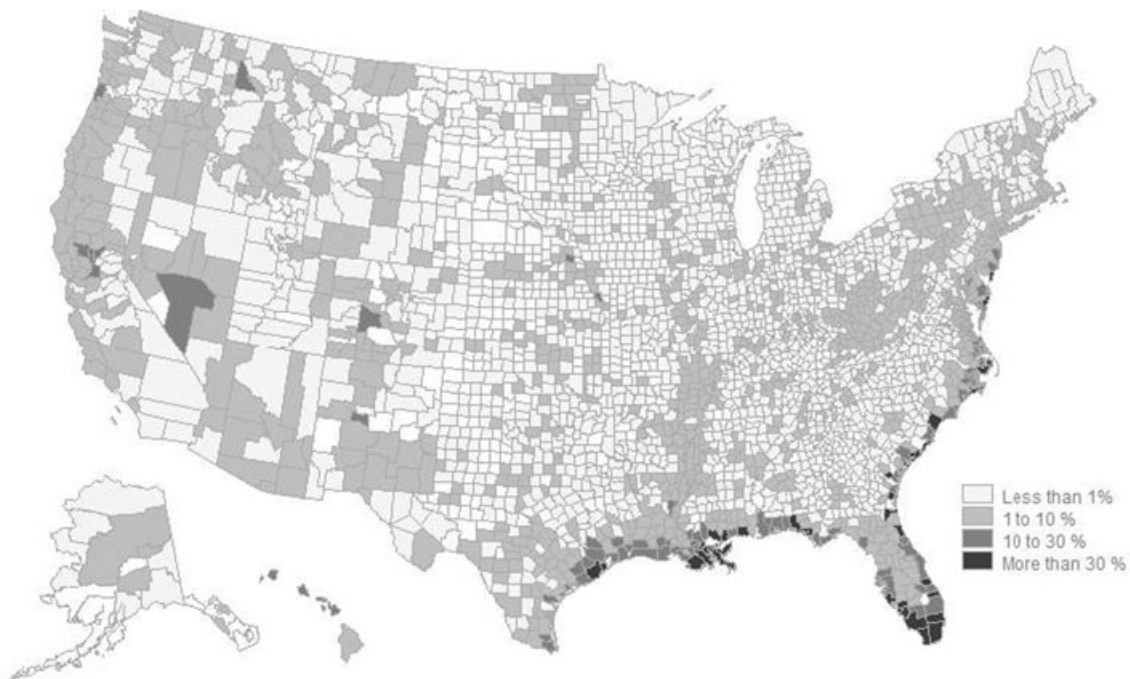
The highest penetration rates are seen in coastal counties where flood damage due to storm surge has been severe in recent years (see Fig. 2b), particularly in Florida, Louisiana, and Texas (86.4% of the NFIP policies were situated in coastal counties along the Atlantic and the Pacific coasts in 2009). As expected, high penetration rates also correspond to more exposed counties along large rivers (e.g., the Mississippi River) or those subject to high precipitation. Finally, it is worth mentioning that 61.1% of the NFIP policies in force in 2009 were situated in an SFHA. In other words, nearly 40% of the people who had flood insurance coverage that year were living in an area not considered high risk by FEMA.<sup>5</sup>

The data we accessed from the NFIP allow us to address questions concerning insurance demand by calculating a proxy of insurance penetration, as we just demonstrated. Through more advanced econometric analyses it is also possible to determine the impact on insurance demand of loss experience, federal relief, period since the last loss, and news coverage, as well as the effect of risk reduction measures on flood losses;<sup>6</sup> these analyses are undertaken in several companion papers currently in progress.

Here, we concentrate our analysis on the dynamic of insurance purchase and the following questions: How long do individuals who have purchased flood insurance keep their policy? Does this insurance tenure depend on the level of flood risk the individuals are subject to? Does this tenure vary over time and across locations? How is it affected by claim experience?

<sup>5</sup> A study of the flood insurance penetration rates that could be associated at a much more granular level with local exposure to flood hazard would be highly valuable, but this would require a precise estimate of the number of housing units situated in all floodplains across the United States. To our knowledge, this has not been done at a national level yet, even though more NFIP zone maps have now been digitalized. A 2006 RAND report,<sup>(13)</sup> based on a random sample study of 100 NFIP communities (out of 20,000), estimates that 49% of single-family homes in SFHAs purchased insurance, with an important heterogeneity among communities.

<sup>6</sup> See, for instance, Ref. 14.



**Fig. 3.** Flood insurance penetration by county in 2008.

*Note:* County-level analysis. Insurance penetration at a county level that is defined as the ratio number of flood policies over number of housing units in that county.

*Source:* Authors' calculation—data from NFIP, U.S. Census.

### 3. ANALYSIS OF FLOOD INSURANCE TENURE

#### 3.1. Evolution of Inflows and Outflows NFIP Policies: The Katrina Effect

To better appreciate the national dynamic of flood insurance purchases over time, Fig. 4 depicts the number of housing units in our sample covered by NFIP policies (solid line; total number of policies in force). From this entire portfolio, it is also possible to analyze the inflows of *new* policies into the program over the period 2000–2009 (dashed line; new policies issued) and outflows, that is, the number of policies that lapse each year (dotted line; cancelled policies). Several housing units may be covered under the same NFIP contract, as is the case for condominium associations. For notational simplicity, a “policy” is defined as one housing unit covered by an NFIP contract. In general, the total number of policies in force grew at a relatively stable rate between 2001 and 2009—between 0% and 4% annually (except for the year 2006, which we discuss below). Over this 2001–2009 period, we calculated that the number of new policies issued by the NFIP each year represented, on average, 21.3% of the number of policies in force.

In 2006, mostly as a result of historical flood claims due to Hurricanes Katrina, Rita, and Wilma and related storm surge that had occurred the year before, the number of policies in force increased by 14.3%; that is *three to four* times the growth rates observed in previous years. This may be interpreted as a “*Katrina Effect*”: many more people wanted to be covered right after the disaster. However, this does not imply that they still felt this way several years later. A more detailed investigation of the tenure of new flood insurance contracts is required to better understand this dynamic, to which we now turn.

#### 3.2. Measure of Flood Insurance Tenure

To measure the NFIP insurance tenure, we extract from the entire portfolio all new policies in force issued in a given year over the period covered by our sample. By using the unique identification number associated with each new policy and tracking this number over time, it is possible to determine how many times each annual policy was renewed before

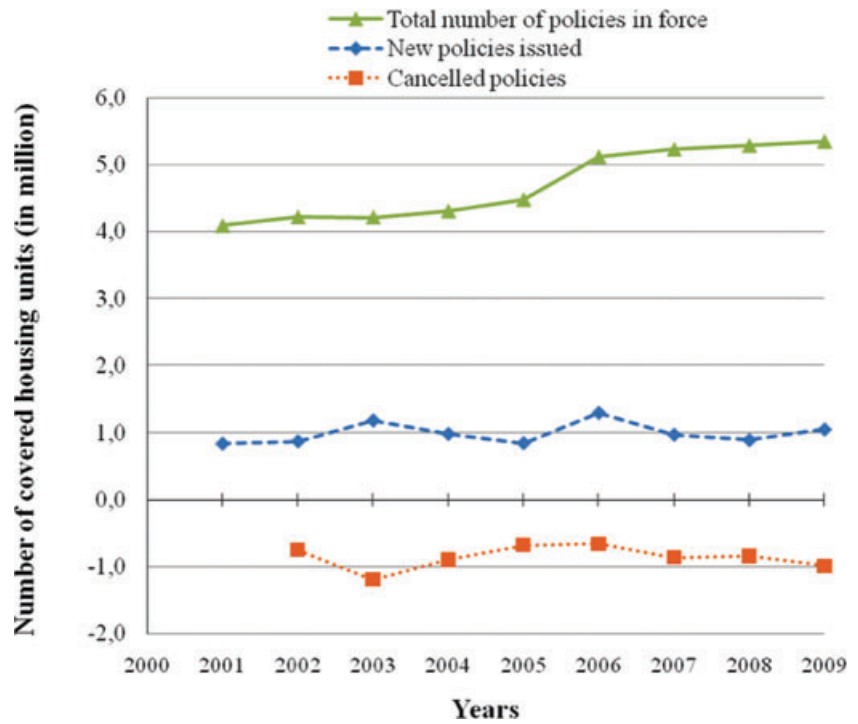


Fig. 4. Number of NFIP policies in force, 2001–2009.

Source: Authors’ calculation—data from the NFIP.

it lapsed.<sup>7</sup> Table II presents the results of our analysis. For each year, we look at the number of new policies issued by the NFIP and their respective durations through 2009 (bold numbers). (We do not look at policies that were already in the program before 2001 and remained in it after that year.)

Given our interest in analyzing what influence living in a high-risk area could have on insurance tenure, we also distinguish in Table II between policies in SFHAs and in non-SFHAs (results are numbers in *italics*).

Table II can be interpreted as follows: of the 841,000 new policies entering the NFIP in 2001, only 73.2% (rounded to 73% in the table) were still in force one year later. After two years, only 49.5% of the original 2001 policies were still in place. By 2009 (eight years after 2001), only 19.6% of them were still in place. In 2004, there were 986,000 new flood insurance policies issued by the NFIP. And we see a similar trend: only 77.7% of them (rounded to 78%) were still in place one year later. Five years later, in 2009, only 38.3% of them were still in force.

The tenure of all these flood insurance policies follows a similar pattern. The most important drop is

observed after just one year (ranging from 20.7% in 2008 to 32.7% in 2002). After the first year, the cancellation rate is lower but still quite significant. We find that the median tenure from policies issued between 2001 and 2006 is between two and four years. This is an important result of this study.

The evolution of that median tenure over time can be partially attributed to steps taken by FEMA to encourage individuals to purchase flood insurance. Prior to 2003, tenure was two years on average. For new policies issued between 2003 and 2006, it is longer (three to four years); then it declines again to less than three years in 2007. This temporary increase in the length of the tenure is likely due to an extensive advertising campaign undertaken by FEMA, the Floodsmart public awareness campaign ([www.floodsmart.gov](http://www.floodsmart.gov)), which was launched in 2004.<sup>(15)</sup>

### 3.2.1. Comparison Between SFHA and non-SFHA

Do residents in an SFHA keep their flood insurance policy longer than people living outside a high-risk flood-prone area? Since non-SFHA policies represented 38% of the NFIP in 2009, this comparison is of some interest in understanding factors that could influence individuals to cancel their policy.

<sup>7</sup> We do not know from our data set whether the policy lapsed because the policyholder terminated it, or moved elsewhere, or changed to a different WYO insurer.



**Table II.** Tenure Results: Duration of New NFIP Policies by Year After First Purchase, 2001–2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
New flood policies in force (000s)									
All	<b>841</b>	<b>876</b>	<b>1,186</b>	<b>986</b>	<b>849</b>	<b>1,299</b>	<b>974</b>	<b>894</b>	<b>1,051</b>
SFHA/non-SFHA	542 299	613 264	880 306	696 291	529 320	635 664	542 432	487 407	595 456
Tenure longer than:									
1 year	<b>73%</b>	<b>67%</b>	<b>77%</b>	<b>78%</b>	<b>76%</b>	<b>73%</b>	<b>74%</b>	<b>73%</b>	
SFHA/non-SFHA	74% 71%	67% 67%	78% 76%	77% 80%	75% 78%	74% 72%	74% 74%	75% 70%	
2 years	<b>49%</b>	<b>52%</b>	<b>65%</b>	<b>65%</b>	<b>63%</b>	<b>59%</b>	<b>58%</b>		
SFHA/non-SFHA	48% 52%	52% 50%	66% 64%	64% 67%	62% 64%	59% 60%	58% 59%		
3 years	<b>39%</b>	<b>44%</b>	<b>57%</b>	<b>55%</b>	<b>53%</b>	<b>48%</b>			
SFHA/non-SFHA	37% 41%	44% 43%	57% 56%	54% 57%	53% 54%	47% 49%			
4 years	<b>33%</b>	<b>38%</b>	<b>50%</b>	<b>48%</b>	<b>44%</b>				
SFHA/non-SFHA	32% 36%	39% 38%	50% 48%	47% 49%	43% 44%				
5 years	<b>29%</b>	<b>33%</b>	<b>44%</b>	<b>38%</b>					
SFHA/non-SFHA	28% 31%	34% 33%	44% 42%	38% 38%					
6 years	<b>25%</b>	<b>30%</b>	<b>33%</b>						
SFHA/non-SFHA	24% 28%	30% 29%	34% 32%						
7 years	<b>22%</b>	<b>26%</b>							
SFHA/non-SFHA	21% 25%	26% 25%							
8 years	<b>20%</b>								
SFHA/non-SFHA	18% 22%								

Source: Authors' calculation—data from the NFIP.

On the one hand, homeowners with a federally backed mortgage living in SFHAs are required to buy flood insurance. However, some banks and government-sponsored enterprises (GSEs) such as Fannie Mae and Freddie Mac might fail to enforce this requirement. Furthermore, mortgages are often transferred to other banks (and then to the secondary market) in non-flood-prone regions of the country, where there is less awareness of either the flood risk or the requirement that homeowners may be required to have this coverage. In other words, banks require proof of flood insurance coverage at the time the original mortgage is issued, but may not check to see that insurance policies are renewed.<sup>8</sup> This may account for the large drop after just one year.<sup>8</sup>

<sup>8</sup>No precise analysis at a national level has been able to measure the real degree of (non)compliance with the flood insurance mandatory requirement. This issue has been the subject of debate for many years, but has not been fully resolved. The situation was best described in a 2002 GAO report: "Property-specific data on mortgages, flood zone determinations, and flood insurance policies"—compiled at loan origination and at various points during the life of the loan—would be needed to fully mea-

On the other hand, one might argue that those residents in non-SFHAs who decided to purchase flood insurance even though they were not required to do so, might simply be more risk averse and thus keep their insurance longer for that reason.

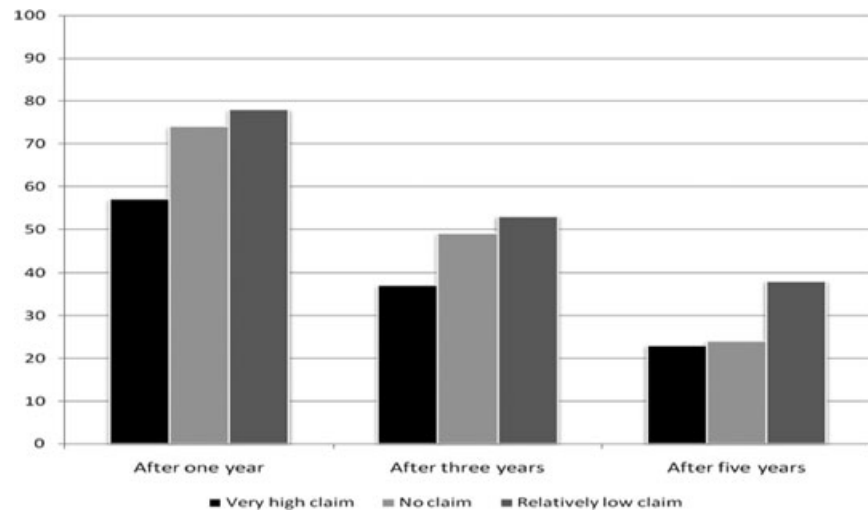
Table II presents the tenure pattern for SFHA (left column) and non-SFHA residents (right col-

sure compliance. These data are needed to ensure that homeowners purchase, maintain, and do not terminate flood insurance when it is required. Comparing these data would allow the computation of compliance rates nationally, regionally, or locally and would—with an additional set of data, the mortgage lender identification numbers—identify specific noncomplying lenders. However, there are a number of challenges to obtaining and analyzing these data. These challenges include establishing reporting requirements on lenders to provide relevant mortgage data, determining an appropriate authority to receive and compare these data, and determining the costs and benefits of obtaining these data. The regulators, and GSEs, on the one hand, and FEMA, on the other, have differing viewpoints of the viability of and the need for obtaining these data.<sup>17</sup> More recently, Dixon *et al.*<sup>13</sup> find a 20 to 25% noncompliance rate across the nation under a set of specific assumptions, but also indicate that the data they were able to collect did not allow for determination of a precise estimate.

**Fig. 5.** Impact of claims on policy tenure.

Note: This figure shows what percentage of NFIP policies were still in the program 1, 3, and 5 years after they were first introduced, depending on the level of claim the policy sustain in its first year (average percentage over the period 2000–2009). *Very high claim* refers to a claim higher than 75% of the flood policy limit; *relatively low claim* refers to a claim that was lower than 10% of the policy limit.

Source: Authors' calculation—data from NFIP.



umn). Somewhat surprisingly, these results do not show any statistically significant difference between the tenure behavior of SFHA residents and non-SFHA residents. This suggests that the tenure of flood insurance under the NFIP is independent of the level of exposure to the hazard; we find that this result is robust over the period 2001–2009.

We also analyzed the tenure for policies located specifically in flood zone A (areas associated with a risk of 100-year return flood) and flood zone V (associated with coastal areas) (both SFHAs) and those located in zones B, C, and X (non-SFHAs). The findings on SFHAs (not reported here) indicate that a slightly higher percentage of policies remain in effect after a given period of time (one to three years, etc.) for those in V zones than those in A zones. The difference is, on average, 1 to 3 percentage points. Interestingly, for non-SFHAs where insurance is not required, the median tenure is longer for those insured living in X zones (4–8 percentage points higher). X zones are areas determined to be outside the 500-year flood and those protected from a 100-year flood by levees. As a result, FEMA considers the risk to be moderate; therefore, flood insurance is cheaper, which might induce policyholders to keep their coverage. The presence of the levee might make some residents more sensitive to flood risk (even though, as we discuss later, the levee can also provide a false sense of security to many others, who would then not purchase insurance at all).

### 3.2.2. Impact of Flood Experience

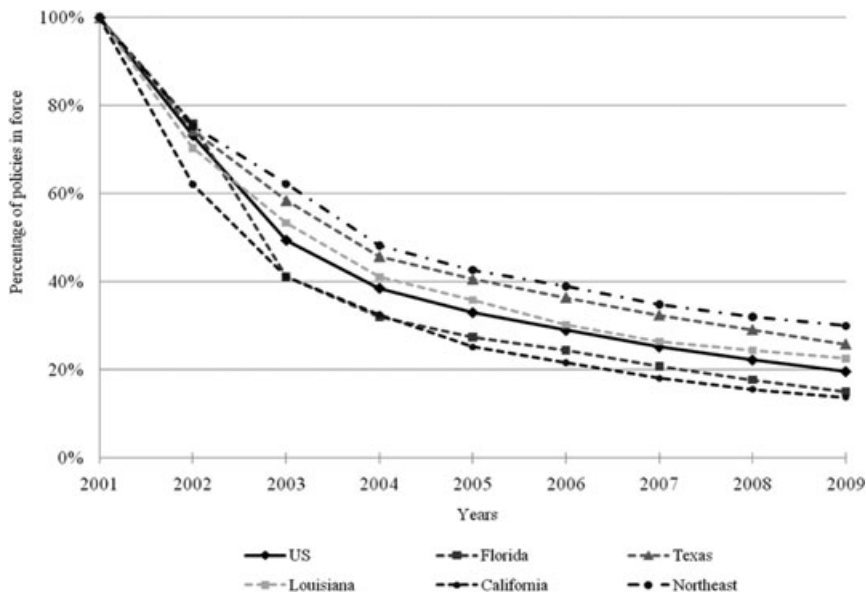
We also looked at whether the policy tenure was different for policyholders who filed a claim. Here,

we restrict our descriptive analysis to homeowners who experienced a claim the very first year they entered the program so we have the longest time horizon to look at in our data set. We find that, on average, the tenure was not different than for those without claims.<sup>9</sup>

However, looking more precisely at different sizes of claims, we find that the tenure is affected by the level of claims. Fig. 5 compares three categories of policyholders: those with no claim the first year, those who filed a relatively small claim (below 10% of their coverage limit), and those who filed a very large claim (higher than 75% of their coverage limit). We analyze what percentage of these policyholders kept their policy for one, three, and five years.

The pattern is the same: a small claim the first year leads to longer policy tenure. One possible explanation is that those policyholders realize the benefit of flood insurance very soon and see it as a good investment because they can collect rapidly on their insurance (see our discussion on that point in Section 4). But as claims increase, we find that this impact on tenure changes. In fact, policies that had a claim the first year higher than 75% of the insurance limit showed a much *lower* tenure than those with no claim. One possible explanation is that those residents relocated elsewhere, either because the damage from the flood made the house unlivable or because the disaster experience was so traumatizing. In

<sup>9</sup>We do this so there is no selection bias; for instance, looking at those who experienced a claim in year 5 artificially increases the policy tenure of those in our sample. In a companion paper we provide an advanced econometric analysis not only to test the effect of claim experience, but also how to determine whether the magnitude of claims impacts insurance demand over time.<sup>(18)</sup>



**Fig. 6.** Tenure of policies purchased in 2001 (different regions).

Source: Authors' calculation—data from the NFIP.

both cases, the residents would terminate their policy. Another explanation relates to the gamblers' fallacy;<sup>(19)</sup> some insureds might think that since they just experienced a major flood, they will not be flooded again for many years; they feel they don't need coverage anymore and let their policy lapse.

In summary, it appears that flood experience has a positive impact on flood insurance tenure, but only for relatively small claims. These results need to be viewed with caution, though, since we look only at policies with a claim the first year; claims experience will be analyzed in more detail in companion papers.

### 3.2.3. Comparison Across Locations

We were also interested in testing whether calculating tenure at the national level would hide important differences across regions, and to some extent it does. In Fig. 6 we focus on new policies issued in 2001 and compare the tenure for the entire data set (the United States), with the tenure of new policies issued that same year in California, Florida, Louisiana, and Texas. We also calculated the tenure for a group of states in the Northeast (Connecticut, Delaware, New Jersey, New York, and Pennsylvania).

While there are some important differences between states (for instance, residents in the Northeast region keep their flood policies longer than those in California), all the tenure curves in Fig. 6 show a similar decrease over time, with the most important drop always being after the first year.

### 3.2.4. Accounting for Migration

In considering why individuals let their insurance lapse, it is important to integrate migration into the analysis. When a family with flood insurance changes residence, their policy is terminated. So an important question is how much of the lapse we observe in Table II can be attributed to people moving from their home. How long do people stay in their home, on average, nationwide? The American Community Survey undertaken every year provides some insights into this question for each year between 2001 and 2008. When asked "Were you in a different residence one year ago?", fewer than one-sixth of the respondents said they were. This result remains stable over the period 2001–2009 (the average over this time period was 15.6% and was slightly higher in Florida than it was in the Northeast). This is an upper-bound of the ratio of people whose duration of residence is one year or less in the same house: that can explain part of the lapse after one year in NFIP policies.

While there are no data that replicate this survey for migration rates two, three, or four years after a person has lived in a specific residence, the ACS provides another insightful data point: the median length of residence in one place. Over the period covered by our flood insurance data set, the median length of residence at a national level was between five and six years. These median durations are higher than the median tenure of flood insurance we discussed in Table II (two to four years). So while migration patterns

explain some of the drop in flood insurance policies, a large part remains unexplained.

Why do so many people let their flood policy lapse so quickly if they are still living in their residence? Is it rational to buy a flood policy just to cancel it two or three years later given that the exposure from the flood hazard probably remains the same?

#### 4. EXPLAINING SHORT FLOOD INSURANCE TENURE: BEHAVIORAL ASPECTS

There might of course be economic reasons as to why many residents cancel their flood policy. A proportion of the population lives on a fixed income, and many depend on some form of government assistance each month. Many people live from paycheck to paycheck and often find themselves short of cash for necessities (or what they perceive as such). Given constrained resources, some residents may be forced in some cases to choose between alternative protective behaviors, such as buying healthier food, or replacing bald tires, or purchasing health insurance or fire insurance. Finances can also be volatile, with lean times requiring hard choices among competing protective actions.<sup>10</sup>

Behavioral aspects might provide another set of reasons as to why many people (those who do *not* move) do not keep their coverage for very long after they first bought it and why many others do not purchase flood insurance at all.

Decisions about protection are rarely based on formal beliefs about probabilities. Magat, Viscusi, and Huber<sup>(20)</sup> and Camerer and Kunreuther,<sup>(21)</sup> for example, provide considerable empirical evidence that individuals do *not* seek out information on probabilities in making their decisions.<sup>11</sup> Huber, Wider, and Huber<sup>(23)</sup> showed that only 22% of subjects sought out probability information when evaluating risk managerial decisions. In another study, when consumers were asked to justify their decisions on purchasing warranties for products that may need repair, they rarely used probability as a rationale for purchasing this protection.<sup>(24)</sup> The fact that there was no statistical difference in our analysis in tenure behavior between residences in SFHA and those in non-SFHA provides additional support for this finding.

Since people are not good at using probability data, the way information about flood risk is typically presented to individuals, such as “*you are in a 100-year return period floodplain*” (i.e., the aforementioned SFHA), is not very helpful for making decisions as to whether or not to undertake protective measures. And if one is told “*you are **not** in a 100-year return period floodplain*” this may imply to a person that he or she is not at risk, because s/he is not required to purchase insurance under FEMA’s rules. But of course, being outside of a SFHA does not make one immune to flooding.

Unless the risk is communicated effectively, levees and other flood control projects are also likely to give residents a false sense of security with respect to suffering damage from floods or hurricanes. In fact, Gilbert White pointed out many years ago that when these projects are constructed, there is increased development in these “protected” areas. Should a catastrophic disaster occur so that residents of the area are flooded, the damage is likely to be considerably greater than before the flood-control project was initiated. This behavior and its resulting consequences have been termed the *levee effect*. Evidence along these lines has been offered by Burby,<sup>(25)</sup> who argues that actions taken by the federal government, such as building levees, make residents feel safe when, in fact, they are still at risk for catastrophes should the levee be breached or overtopped. However, other people might view the levee as a daily reminder of the risk they face and hence keep their insurance coverage longer.

There is also evidence that people tend to ignore risks whose subjective odds are seen as falling below a certain level. In a laboratory experiment on purchasing insurance, many individuals bid zero for coverage, apparently viewing the probability of a loss as sufficiently small that they were not interested in protecting themselves against it.<sup>(26)</sup> Prior to a disaster, many individuals perceive its likelihood as sufficiently low that they contend “*it will not happen to me*” (probability neglect). Moreover, a 1 percent chance of being flooded this year (because the house is in a SFHA) seems like a very low probability, certainly below many people’s threshold level of concern. As a result, they do not feel the need to invest in protective measures, such as making their house more resilient against floods, or maintaining flood insurance coverage.

After the disaster occurs, however, these same individuals express regret that they didn’t undertake protective measures. After Hurricane Katrina,

<sup>10</sup>We thank one of the referees for suggesting this point to us.

<sup>11</sup>This section is partially based on Kunreuther, Meyer, and Michel-Kerjan.<sup>(22)</sup>

a common theme heard from survivors who had *not* bought insurance to protect their house was: “Had I known it would be this bad, I would have purchased it.” The reality, of course, was that they were told many times in the preceding years that it could be that bad.<sup>(27,28)</sup> This may be a reason why we observe many more new policies entering the NFIP as a result of the 2005 hurricane seasons, which triggered historical flood losses, than in previous years (see Fig. 4). It is also likely that there might be some form of “availability bias” (personal flood experience of relatively small claims as we showed in Section 3). Knowing someone who has suffered a loss or extensive media coverage of flood events can change one’s risk perception even though statistically there may not be a change in the probabilities of future flooding.<sup>(19)</sup> The sharp increase in purchase of flood insurance policies in 2006 after historical flooding in Louisiana and Mississippi illustrates this phenomenon. Quantifying all these possible effects requires a more advanced econometric treatment, which as noted above is currently being undertaken in companion papers.

Even for those who have suffered from flooding, the impact of the disaster quickly fades over time. Table II illustrates this lack of concern. While many more people purchased flood insurance right after the 2005 hurricane season, they did not keep their coverage longer than those who purchased a policy prior to 2005.

## 5. OVERCOMING SHORT INSURANCE TENURE BY DEVELOPING MULTIYEAR CONTRACTS

To overcome these behavioral biases that lead to cancellation or lapses in flood insurance policies after just a few years, several actions could be taken. First, Congress and FEMA should work more closely with banks and GSEs to ensure a much higher compliance rate with the mandatory purchase requirement, and fine those who do not meet this requirement.

Based on our discussion of behavioral biases toward catastrophes, another option would be to introduce a different type of flood insurance contract to the current menu sold by the NFIP and WYO insurers: multiyear flood insurance contracts of 3, 5, or even 10 years tied to the property, not the individual; that is, multiyear flood insurance, as introduced in recent published papers.<sup>(16,29–32)</sup>

With multiyear insurance, if the homeowner sold his or her property before the end of the policy period, then the insurance policy would automatically

be transferred to the new owner at the same (fixed or indexed) rate. This would certainly help ensure more properties are covered given the migration effect we discussed in Section 3. If the risk changed after this fixed time period, then the increased risk would be reflected in a new premium when the multiyear policy is up for renewal. Private insurers currently participating in the Write-Your-Own Program would add a menu of multiyear contracts to the menu of one-year contracts they currently offer on behalf of the federal government. Our analysis of the flood insurance tenure (Table II) shows that even a 5-year contract would have tremendous benefits in keeping hundreds of thousands of properties covered.

The NFIP could also work more closely with financial institutions that could provide home improvement loans to make insured properties more resilient to future floods. Such loans could be made available to spread the cost of the adaptation measure over time. For example, a homeowner with a 10-year mortgage and a 10-year flood insurance policy could obtain a 10-year home improvement loan. The financial arrangement could be such that the annual home improvement loan payments are less than the rebate the property owner obtains from the NFIP in the form of an annual premium reduction because the house is less exposed to flood damage. These risk reduction measures would likely have the added benefit of increasing property values.<sup>12</sup>

The combination of multiyear flood insurance and multiyear loans for reducing future flood losses promises to improve both individual and social welfare from the perspective of all the relevant stakeholders—homeowners, FEMA, banks and other financial institutions, and the taxpayer. Indeed, homeowners would be protected much longer and pay less by investing in risk reduction measures; the NFIP is thus less exposed to damage; the bank has safer mortgages; and the general taxpayer will pay less for postdisaster relief. Everybody is better off with this proposal.

Finally, there is another important reason why such multiyear flood insurance policies attached to the property would be a great improvement over annual policies. It would ensure the spread of risk within the program and over time. This effect would

<sup>12</sup>Note here that the annual cost of such a long-term contract might be higher than a one-year contract, since the NFIP would have to factor in the uncertainty that exists today about future risks that could change as a result of new building development or changes in current climate patterns.

be even stronger if all properties in flood-prone areas were required to have multiyear coverage and this requirement were well enforced. One way to enforce this would be to link it to real estate taxes. This would provide much-needed financial revenue for the program over time because it would create a much larger and stable policy base than is currently available.<sup>(11)</sup>

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