

MANAGING FLOOD RISK: A DISCUSSION OF THE NATIONAL FLOOD
INSURANCE PROGRAM AND ALTERNATIVES

Mark J. Browne
and
Martin Halek

January 2009

Preliminary; please do not quote without permission.

Managing Flood Risk: A Discussion of the National Flood Insurance Program and Alternatives

Mark J. Browne and Martin Halek

January 2009

JEL Classification:

Abstract

In this paper, we review the history of the federal flood insurance program, we discuss the motivations behind the government's adoption of the program, and we present proposals for changing the program to more closely align the risks of building and living in areas exposed to the flood peril. We also discuss alternatives to managing the catastrophic risk of flood that do not involve the National Flood Insurance Program or a traditional insurance mechanism.

Mark Browne

Wisconsin School of Business

Department of Actuarial Science, Risk Management and Insurance

University of Wisconsin-Madison

975 University Avenue, Grainger Hall

Madison, WI 53706

mbrowne@bus.wisc.edu

Martin Halek

Wisconsin School of Business

Department of Actuarial Science, Risk Management and Insurance

University of Wisconsin-Madison

975 University Avenue, Grainger Hall

Madison, WI 53706

mhalek@bus.wisc.edu

1. Introduction

Since its origin in 1968, the National Flood Insurance Program (NFIP) has made available flood insurance to U.S. homeowners, renters and business property owners. The NFIP has evolved since its inception in order to address the challenges inherent in insuring against catastrophic risk. Critics of the NFIP remain, including some who support some aspects of the NFIP and others who oppose government provided flood insurance altogether. Recent hurricanes have severely tested the NFIP, which in some regards has proven to be less than a perfect program for insuring flood risk. In general, there has been limited analysis and discussion of the benefits and drawbacks of the NFIP and alternative means of managing flood risk. The current paper provides an evaluation of the NFIP and offers proposals for improving the financing of losses due to flooding.

An evaluation of a government program of insurance should take into consideration:

1. **Administrative Efficiency:** Lower administrative costs consume fewer resources and increase the likelihood that individuals purchase insurance through the program.
2. **The Amount of Risk Transferred:** The greater the amount of risk that is transferred the greater the likelihood that the overriding goals of the program are achieved.
3. **Control of Moral Hazard:** Reduced concern with the occurrence of losses as a consequence of having insurance can result in a greater likelihood of losses. Insurance programs should be structured to minimize the costs of moral hazard.
4. **The Party Best Able to Control the Risk Should Typically Bear the Risk:** In the case of flood, the occurrence is not controllable by property owners or the government; however, through adoption of loss prevention and loss reduction measures, the cost of damage can be minimized. If the party that controls the degree of loss bears the risk of the loss, that party will have an incentive to minimize the potential loss. Significantly, in the case of flood insurance, the decision on where to live is a loss control decision borne by the property owner.
5. **Minimization of Negative Externalities:** Unrelated parties to a property owner - in this case other taxpayers, family members, charitable organizations, and others of good will – should not suffer any more than necessary.
6. **Consideration of All Parties:** All of the parties affected by the loss, both directly and indirectly, should be considered in an analysis of the best means for handling the loss. Many parties are affected by a flood loss. In addition to the property owner, the neighbors may suffer. Government is affected to the degree that tax revenues decrease if people choose to move. The community and local economies are impacted by an individual's house being destroyed by a flood. This suggests that some level of societal risk management may be appropriate to address the flood peril.

7. **Participation Decision:** Ideally, property owners should not be forced to participate in a flood insurance program. There may be reasons that require compulsory participation such as the need to reduce adverse selection or the need to minimize negative externalities. Nonetheless, compulsory participation is a negative, *ceteris paribus*.
8. **Premium Determination:** The premiums charged by a flood insurance program should be strictly risk-based. Insurance premiums that are based only on the risk send a clear signal to potential purchasers of the property and others about the risk. This allows for informed decision making. Subsidized insurance premiums encourage development, as well as a reduced level of loss control, by masking the true cost of flood risk. Accurate, cost-based insurance premiums can provide a highly effective means for individuals to compare across alternative development opportunities as they are explicit estimates of the cost of risk (see Kunreuther and Pauly (2006)). Premiums based on the true cost of the risk not only inform decision makers as they evaluate development decisions, they also inform decision makers as they evaluate different means for mitigating the risk and financing the risk. For instance, a homeowner in an area exposed to the flood risk would benefit from knowing the true cost of the risk when considering the cost effectiveness of various loss control strategies. Risk based premiums would reflect the mitigation strategies put in place, providing an additional financial incentive for investment in loss control.

The NFIP falls woefully short of an ideal program for risk transfer as evidenced by Hurricane Katrina. Although the NFIP was never designed to handle a storm the magnitude of Hurricane Katrina, the aftermath of Katrina provided an accurate snapshot of the program's shortcomings. First, participation in the NFIP by those suffering losses inflicted by Katrina was low, leaving these financial losses either uncompensated or borne by third-parties, including taxpayers, via governmental agencies, and charities. Victims of Hurricane Katrina received an estimated \$15B dollars in government aid (outside of the \$25B in NFIP claims), much of which was used to rebuild damaged property or to relocate households (e.g. purchase another property) (New York Times, 2006). Property owners apparently felt, and in retrospect correctly, that prior procurement of flood insurance was not necessary to receive compensation from the federal government for flood related losses. This instance of the classic Samaritan's Dilemma has been noted in prior research on flood insurance. Browne and Hoyt (2000) refer to the failure to fund ones exposure to risk because of a reliance on the expectation of charity from others, in this case the federal government, as a 'charity hazard,' which is a close cousin to moral hazard. Many property owners in high risk flood areas feel

little incentive to purchase flood insurance (or any property insurance), if they believe the government will ultimately provide them with federal assistance ex-post.¹

In addition to exposing that many did not have insurance, Katrina's resulting damage amounts demonstrated that flood coverage limits on existing flood insurance policies were in many cases insufficient. The average paid NFIP flood loss was \$96,016 which was significantly below the maximum amount of coverage available for residential or business properties (Insurance Information Institute, 2008). Moreover, Hurricane Katrina demonstrated that the NFIP was not an administratively efficient program. The legal claims battles that followed Hurricane Katrina showed both the public's lack of knowledge regarding property insurance coverage (e.g. a standard homeowners' policy does not cover flood damage) and the difficulties associated in sorting out wind damage from flood damage.

In this paper, we discuss the challenges of providing catastrophic insurance and provide suggestions to address these challenges. Our suggestions are broad based in that most of them do not involve amending the NFIP, but rather replacing it. However, in order to better comprehend many of these issues and the evolution of the NFIP, we need to understand the history and motivation in creating the NFIP itself. The remainder of the paper is organized as follows. First, we provide a discussion of why the government has taken a role in insuring flood risk, when many other risks to property are insured through private markets or are not insured at all. Second, we review the history of how the U.S. has managed flood risk leading to the creation of the NFIP and its evolution over the past 40 years. We also discuss what possible changes may lay ahead. We then discuss the challenges of providing insurance for a catastrophic risk; specifically if the federal

¹ While it is estimated that about half the (property) victims of Katrina had some flood insurance, this number includes damaged properties that were located outside of pre-determined flood zones. The percentage of insured households that were located in actual flood insurance zones in New Orleans proper was about 65%. Thus, property owners in known high risk flood areas either chose not to purchase flood insurance or failed to purchase required flood insurance.

government is to be the primary insurer. Finally, we offer several alternatives to managing flood risk.

2. The Rationale for the Government Insuring the Flood Peril

In the United States and most other countries, causes of property loss, hereafter referred to as perils, are either commonly transferred to an insurer through a private market transaction, to the government through a federal insurance plan, or are not transferred. Examples of perils that are commonly insured in private insurance markets include fire, windstorm, and theft. Perils that are primarily not insured include war and earthquake. Perhaps the most destructive peril to property insured by the government is flood. Examples of other perils insured by government agencies include terrorism and, in some states, windstorm. Government, of course, through a variety of different programs insures causes of loss that are not destructive to property. The federal government provides insurance against causes of personal financial loss including unemployment, superannuation, and deterioration in health for some.

Relative to the government providing coverage or a cause of loss going uninsured, the private market for risk transfer has several distinct advantages. Arguably the most important is that private insurance markets are characterized in most cases by significant competition between insurers. This results in innovation in policy forms, service, and pricing. Another important advantage is that competitive private markets internalize the cost of risk. That is, those that choose to expose themselves to risk by owning property bear the fair cost of that risk; the cost is not shifted to third parties.² In contrast, programs providing for risk transfer to the government are monopolistic and prone to political machinations resulting in costs of risk being placed upon those

² Regulation of some insurance markets results in the costs of risk transfer not fully reflecting the true cost of the risk.

not in a position to accrue the benefits of the risk. Generally, it is better for the party that benefits from the risk to bear the costs of the risk, rather than the benefits of the risk accruing to one party and the costs to another. A coupling of the potential benefits and potential costs of the risk reduces moral hazard.

Given the advantages to private market insurance, the transfer of flood risk to an insurer through a private market transaction is superior to it being transferred to the government under the National Flood Insurance Program. Unfortunately, the flood peril lacks many of the characteristics of risks that are commonly insured by private insurers. Traits of insurable risks include the following:

1. **Numerous and Homogenous:** The risk should be such that there are many risks that are largely similar. For instance, automobiles are commonly insured against the collision peril and homes are commonly insured against fire.
2. **Determinable Losses:** When the risk results in a loss, the loss should be determinable and quantifiable. An investigation of the loss should be able to determine that the loss actually occurred, when it occurred, and why it occurred. The degree of loss also needs to be determinable.
3. **Calculable:** The likelihood of a loss and the amount of loss that is likely to occur, should there be a loss, need to be able to be calculated; otherwise, the risk can not be priced.
4. **Accidental:** The occurrence of a loss should be fortuitous and not be under the control of the insured.
5. **Information Symmetry:** The assessments by the insurer and the potential insured of the likelihood of loss and likely amount of loss need to be reasonably close; otherwise, an agreement to transfer the risk can not be reached.
6. **Independence:** Each loss occurrence should be independent. The event that triggers the loss should not cause losses to other similar exposures.
7. **Unpredictability:** Losses that are highly predictable are generally not able to be transferred in private markets. The reason for this is because there is very little risk to transfer when the occurrence of an event is close to a certainty. In these cases, the transactions costs that are created in transferring the risk are greater than the value that would be derived by the potential insured from the transfer.

Several of these criteria of insurability do not apply to the flood peril.

Calculable: The likelihood of a flood loss in many instances is very difficult to calculate.

Some flood losses are expected to occur once every 100 years, others once every 500 years, and

others once every thousand years. Given these significant time spans, sufficient data to make tight pricing estimates is lacking. Whether the likelihood is able to be calculated sufficiently and accurately to allow for the risk to be transferred in the private market is debatable. Advances in science and technology hold out the promise of greater pricing accuracy for floods that are highly infrequent.

Unpredictability: Some areas flood so regularly that there is little risk in the occurrence of the loss. In these situations, private market insurance fails as a risk transfer tool as the administrative costs are too large to make risk transfer desirable from the viewpoint of the property owner.

Information Symmetry: Research suggests that many individuals have a very limited understanding of flood risk. Kunreuther (1984) hypothesizes that property owners do not purchase flood insurance because they underestimate the probability of loss. This is consistent with Kunreuther (1978) which reports empirical results indicating that the likelihood that an individual purchases insurance against natural disasters is positively related to whether the property owner suffered a prior loss as a consequence of a natural disaster. Chivers and Flores (2002) report that most of the individuals they surveyed in Boulder, Colorado were unaware of the risk flood posed to property they were purchasing prior to the closing on the property. Browne and Hoyt (2000) find that flood insurance purchases increase following flood losses. They suggest that more individuals may purchase flood insurance if public service announcements were directed at increasing individuals' understanding of the risk posed by flooding.

If, as the research suggests, individuals underestimate the likelihood of a flood loss, many individuals will not purchase flood insurance because they will feel that the cost is too high in relation to the risk.

Independence: When it occurs, a flood typically inflicts widespread damage. Whole communities may suffer as the result of a single storm. The Law of Large Numbers, which is the statistical basis for insurance pooling, is premised on the assumption that risks are independent. In theory, insurers could come close to creating a pool of independent flood risks, if the risks were geographically dispersed. Reinsurance markets are beneficial in this regard as they allow for the pooling of flood risks worldwide. Nonetheless, significant correlation is likely to exist within reinsurer pools. To the degree correlation exists within an insurer's pool of business, all else equal, the insurer is at greater risk of bankruptcy. The premiums that must be charged in a competitive market are greater to reflect the increased risk borne by the insurance company as a result of the correlation. The increased cost decreases the likelihood that the risk is passed through a competitive market.

Flood risk, like that of other natural disaster perils, does not lend itself well to transfer in a private market transaction. In fact, the history of the NFIP indicates that demand for flood coverage is not substantial even when it is provided by the government at a rate that is below the fair market cost of coverage. There is little private market demand for or supply of flood insurance. As is discussed in the following section, the federal government has historically expanded its role in supplying flood insurance in response to the failed development of a private market to insure against most flood losses. The government's role in supplying flood insurance is in some ways an anomaly; particularly since the government does not provide comparable insurance protection against the peril of earthquake. Moreover, many of the other insurance programs that the government writes provide protection against risks that individuals can not choose to avoid, such as premature death, unemployment, disability and superannuation. Most individuals can choose to avoid, or at least greatly minimize, the risk of the flood peril by moving.

3. History and Development of the National Flood Insurance Program (NFIP)

Prior to the establishment of the NFIP, the government's flood risk management strategies consisted of ex-ante loss control and ex-post loss financing. Beginning in the 1800's, the government initiated various flood control projects, such as the construction of dams and levees, which arguably encouraged development in flood zones. An early example of flood control legislation was the Swamp Land Acts of 1849 and 1850 which transferred federal swamp and overflow land along the lower Mississippi River to states, contingent on states using sales revenue from these lands to construct levees and drainage channels. By 1890, the entire lower Mississippi Valley was divided into state and local levee districts. However, not everyone agreed with this "levees-only" approach advocated by the U.S. Army Corps of Engineers. Noted U.S. geologist, anthropologist and ethnologist Dr. W.J. McGee wrote, "Indeed, as population has increased, men have not only failed to devise means for suppressing or escaping this evil [flood], but have, with singular short-sightedness, rushed into its chosen paths" (McGee, 1891). Even today, many would agree with McGee's assessment; coastal populations continue to grow, particularly in the Southeast. One estimate of residential and coastal property exposures in Florida alone stands at \$2T; a number that will certainly increase as coastal growth continues.

Historically, the government also provided ex-post financial disaster relief to those victimized by flood. In 1934 as part of the New Deal, Congress passed Public Law 73-160 (PL 73-160) which made \$5M in low interest loans available to victims of all natural disasters, including floods. The Disaster Relief Act of 1950 (PL 81-875) created the first permanent system for disaster relief (including floods) whereby states formally requested the president to declare a major disaster. If granted, the federal government then provided disaster assistance that supplemented the efforts of

state and local governments. This Act was significant in establishing a guaranteed framework for federal disaster assistance ex-post.³

While these flood risk management strategies were well intentioned, they did little to ease the ultimate financial burden of most flood victims. Moreover, private insurance companies tended not to sell flood insurance (neither directly nor as a covered peril in a standard property insurance policy), because it was not profitable. Insurers could not establish an affordable, feasible price due to the catastrophic nature of the flood risk and their inability to develop actuarial rates that reflected the risk. During the 1920s, several dozen fire insurers sold flood insurance, but due to severe river flooding in nearly all parts of the U.S. in 1927 and 1928, all of these insurers withdrew from the market. From the late 1920s until today, flood insurance has not been considered profitable (U.S. Congressional Research Service, 2005). Next is a discussion of legislative development of the NFIP, and a description of how the program operates.⁴

3.1 Federal Flood Insurance Act of 1956 (PL 84-1016)

Several U.S. presidents attempted to establish a national flood insurance program prior to 1968. In 1951 (and again in 1952) President Harry S. Truman first proposed a “flood-disaster insurance” program following excessive flooding in Kansas and Missouri. Truman’s proposal called for private insurers to issue flood insurance with the federal government acting as a reinsurer, or issuing insurance directly but not competing with private insurers. This proposed legislation included a \$250,000 maximum amount of insurance available for any one person or business, established rates to cover all expenses including federal loss reserve levels, and authorized federal

³ Examples of other federal, financial disaster relief acts include the 1965 Southeast Hurricane Disaster Relief Act (PL 89-339), the Disaster Relief Act of 1970 (PL 91-606), the 1988 Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 100-707) and the 2000 Disaster Mitigation and Cost Recovery Act (PL 106-390).

⁴ For a complete chronological history of the development of the NFIP, please see American Institutes for Research, 2003.

agencies that made or guaranteed loans to require borrowers to purchase flood insurance where it was available (Woolley and Peters, 2008(a)). Many of these features exist in today's NFIP.

In 1956, President Dwight D. Eisenhower signed the Federal Flood Insurance Act (PL 84-1016) which established a five-year, \$3B federal flood insurance and reinsurance program. Some features of this act included a \$10K limit per dwelling with the encouragement of private coverage above this amount, subsidized insurance rates for all policyholders regardless of location, and private insurer involvement in the marketing of the insurance policies (Woolley and Peters, 2008(b)). This program was short-lived as not a single policy was written. Congress pointed to a lack of any technical study in determining the costs of starting such a federal flood insurance program (U.S. Congressional Research Service, 2005). Cost determination would continue to be a challenge for the NFIP.

3.2 National Flood Insurance Act of 1968

A series of natural disasters in the early 1960s triggered a renewed interest in creating a federal disaster insurance program. This crested in September of 1965, when Hurricane Betsy became the first hurricane to cause over one billion dollars in damages (\$1.42B in 1965 dollars, \$9.7B in 2008 dollars). The significant losses prompted Congress to direct the Department of Housing and Urban Development (HUD) to undertake a comprehensive study on flood insurance. In 1966, President Lyndon B. Johnson submitted to the Senate Committee on Banking and Currency this study conducted by HUD entitled, "Insurance and Other Programs for Financial Assistance to Flood Victims" (U.S. Senate Committee on Banking and Currency, 1966). The study reported that the appropriate pricing and allocation of federally backed, and in some cases subsidized, flood insurance could not only help individuals bear the risk of flood damage, but would

also discourage occupancy of and development in floodplains. Thus, the study concluded that federal flood insurance was both feasible and could promote the public interest, although rates in certain areas would be high.

The recommendations from the HUD study led Congress to pass the National Flood Insurance Act of 1968 which created the NFIP and the Federal Insurance Administration (FIA) within HUD. The initial goals of the NFIP were three-fold: (1) to reduce the nation's flood risk through appropriate floodplain management, (2) to improve flood hazard data and risk assessment by mapping the nation's floodplains; and (3) to provide direct, affordable flood insurance to both individuals (i.e. residential homeowners) and businesses (i.e. nonresidential property owners) of flood-prone communities that adopt and enforce measures designed to reduce the consequences of flooding.⁵

A locality was an identified flood-prone community when the FIA determined that a significant flood hazard existed. The establishment of flood insurance premiums, however, required topographical, hydrologic and engineering studies to estimate the actuarial risk of flood. Once these studies were completed, a Flood Insurance Rate Map (FIRM) was published which provided detailed information on flood hazards in the community, and provided a basis for calculating premiums. Once the review process for the FIRM was completed, a community was considered a regular member of the NFIP.⁶ Notably, this allowed existing property owners in high-risk flood areas (later named special flood hazard areas (SFHAs)) to obtain subsidized flood insurance. Property owners of structures built in floodplains after the Act's passage would pay actuarial, non-subsidized premiums for insurance through the NFIP (American Institutes for Research, 2003).

⁵ Here, the term "affordable" simply implies an amount that a consumer would be willing to pay to acquire flood insurance. Hence, premiums may be capped and ignore or limit any risk adjustment. An economic definition of an "affordable" premium is different in that it considers all risk adjustments needed for efficient outcomes. NFIP premium determination is discussed in a later section.

⁶ The time period for establishing a flood insurance program in a community was one to three years.

NFIP funding was created through the National Flood Insurance Fund where collected premiums were to be deposited.⁷ The NFIP was intended to be self-supporting for the average historical loss year. This meant that flood losses, operating expenses, and administrative expenses were to be paid solely through premiums collected for policies sold, and not by additional taxpayer dollars.^{8,9} In the event that flood losses were excessive, the NFIP could initially borrow \$1B from the Department of the Treasury with a promise to repay with interest (Hartwig and Wilkinson, 2005).

In December 1969, Congress enacted the St. Germain Amendment (to the original 1968 Act) which instituted the Emergency Program. Here, the necessary completion of actuarial studies was waived so that otherwise eligible communities could become almost immediate ‘emergency’ participants in the NFIP (Power and Shows, 1979). The Emergency Program provided a maximum amount (first layer) of flood protection at federally subsidized, uniform rates, regardless of flood risk. The Emergency Program continues to be in effect today.

3.3 Flood Disaster Protection Act of 1973

From 1968 until 1973, the purchase of flood insurance by property owners in the U.S. was entirely voluntary. During this time period, it became evident that offering flood insurance, even at subsidized rates for existing properties, did not provide sufficient incentive for communities to join the NFIP or for individuals to purchase flood insurance.¹⁰ In 1972, Hurricane Agnes produced record flood property losses of \$3B which highlighted the lack of growth and interest in the NFIP as

⁷ The National Flood Insurance Fund was established in the Department of the Treasury by the 1968 Act.

⁸ While NFIP pricing is discussed and evaluated in a later section, by statute NFIP was not designed to be actuarially sound. Premium rates for most properties were intended to fully reflect the risk of flooding on an actuarial basis, but the rates for the remaining properties were subsidized as mandated by statute. Hence, risk loading or risk premiums were excluded from pricing.

⁹ Fiscal year 1986 was the first year that no taxpayer funds were required to meet NFIP flood insurance expenses. Prior to 1986, NFIP administrative expenses, surveys, and studies were financed through congressional appropriations (American Institutes for Research, 2003).

¹⁰ By January 1970, only four communities had joined the NFIP, only 16 flood insurance policies had been sold, and only \$392,000 of coverage was in force (American Institutes for Research, 2003).

only a small amount of this loss was covered under the NFIP.

In response, Congress passed the Flood Disaster Protection Act of 1973 to provide stronger incentives for community and individual participation in the NFIP. First, Section 102(b) of the 1973 Act established the mandatory purchase requirement (MPR). Specifically, for communities participating in the NFIP, property owners in high-risk flood areas (SFHAs) were now required to purchase flood insurance, at least to the extent of the loan, if they received financial assistance for their property from any federally insured, regulated, or supervised lending institution.^{11,12} The National Flood Insurance Reform Act of 1994 (PL 103-325) later strengthened the MPR by directing federal agencies to create general flood regulations for all lending institutions and lending servicers subject to their supervision. The objective was to further reduce the risk of flood damage to properties and to reduce federal expenditures for uninsured properties damaged by floods (U.S. Congress, 1994).

Second, Section 102(a) of the 1973 Act mandated that after July 1, 1975 no federal agency could provide financial assistance for purchase of or construction of property in an identified flood-prone area unless the property was covered by the NFIP. This also applied to federal disaster assistance loans and grants for reconstruction following any type of natural disaster, not just flood. Hence, Section 102 of the 1973 Act essentially made NFIP participation compulsory for communities in flood-prone areas; otherwise a failure to participate could significantly restrict the community's economic development. Finally, the 1973 Act encouraged communities to adopt and enforce loss control measures, such as appropriate land use, to reduce the probability of flood losses.

¹¹ The federal financial regulatory agencies affected by the 1973 Act were the Office of the Comptroller of the Currency (OCC), the Federal Deposit Insurance Corporation (FDIC), the Office of Thrift Supervision (OTS), the National Credit Union Administration (NCUA), and the Board of Governors of the Federal Reserve System (FRB) (U.S. Department of the Treasury, 1999).

¹² Loans on homes in SFHAs sold to government-sponsored enterprises such as the Federal National Mortgage Association (Fannie Mae) and Federal Home Loan Mortgage Corporation (Freddie Mac) were also subject to the MPR.

The 1973 Act improved government disaster assistance by substituting insurance indemnification for an old system of disaster loans, which often just added to the financial woes of victims. By January 1974, 2,850 communities had joined the NFIP, and approximately 312,000 policyholders had \$5.5B in NFIP flood coverage. By March 31, 1978, 15,898 of 18,826 officially identified flood-prone communities had joined the NFIP. About 13,000 of these communities were in the Emergency Program and the other 2,800 were in the Regular Program (American Institutes for Research, 2003).

3.4 (Bunning-Bereuter-Blumenauer) Flood Insurance Reform Act of 2004 (PL 108-264)

The objective of the Flood Insurance Reform Act of 2004 was “reducing losses to properties for which repetitive flood insurance claim payments have been made” (U.S. Congress, 2004).¹³ It was estimated that 10,000 repetitive-loss properties had experienced two or three losses that cumulatively exceeded building values (and the values of the flood policies). This ultimately cost taxpayers \$200M annually. Furthermore, most of these repetitive-loss properties were eligible for subsidized flood insurance because they were built before the 1974 implementation of floodplain management standards created under the original NFIP.

This 2004 legislation contained reforms designed to more equitably distribute flood insurance premium costs by reducing the number of policyholders who file repeated flood damage claims. Under a pilot program outlined in this Act, owners of repetitive-loss properties would accept flood loss mitigation assistance from state and local governments (e.g. property elevation, relocation, flood-proofing or a complete buy-out of the property), or incur flood insurance premium increases of up to 150 percent (U.S. Congress, 2004).

¹³ When this bill was originally introduced into the House of Representatives on January 8, 2003, it was called the “Two Floods and You Are Out of the Taxpayers’ Pocket Act of 2003.”

3.5 Flood Insurance Reform and Modernization Act (FIRM) of 2008

The Flood Insurance Reform and Modernization Act of 2008 recently passed through both houses of Congress (House of Representatives on September 27, 2007; Senate on May 13, 2008). The bill may now proceed to a conference committee of senators and representatives to work out differences in the versions of the bill each chamber approved including whether to forgive the NFIP's \$18B debt. The bill then goes to the President before becoming law.

Under the version passed by the House, the NFIP's maximum coverage limits would increase for the first time since 1994, from the current ceilings of \$250,000 for residential properties and \$500,000 for commercial properties, to \$335,000 and \$670,000, respectively. The coverage limit on contents would rise to \$135,000 from \$100,000. Coverage for additional living expenses, business interruption and finished basements would also be introduced. (U.S. Congress, 2008).

Other notable items of the bill include: (1) extending the NFIP through fiscal year 2013; (2) allowing the Federal Emergency Management Agency (FEMA) to increase flood policy rates by 15% a year, up from 10%; (2) increasing the NFIP's borrowing authority to \$20.8B; (3) raising civil penalties on federally regulated lenders who fail to enforce the MPR of flood insurance for mortgage holders; (4) increasing program participation incentives; and (5) encouraging revisions of dated flood maps. Hence, the 2008 Act was intended to protect the integrity of the NFIP by fully funding existing legal obligations and increasing incentives for communities to participate. This would significantly increase the likelihood that the NFIP could continue to offer flood insurance coverage and pay claims in a timely manner.

4. Contemporary Challenges Facing the National Flood Insurance Program

4.1 Current Status of NFIP

The prior section highlighted the historic development of the NFIP as well as how it operates (e.g. how a property owner could procure flood insurance through the NFIP). Today, the NFIP is officially administered by FEMA, which is part of the U.S. Department of Homeland Security (DHS). Flood insurance under the NFIP is sold to eligible property owners through two mechanisms: 1) state-licensed property and casualty insurance agents and brokers who deal directly with FEMA; and 2) private insurance companies under a program known as “Write Your Own” (WYO).¹⁴ Under the WYO program, insurers receive an expense allowance for policies written and claims processed while the federal government retains responsibility for underwriting losses. The federal government pays for flood losses through a letter of credit and sets the rates, coverage limitations, and eligibility requirements. The premium charged for NFIP flood coverage by a WYO company is the same as that charged by the federal government through the direct program (U.S. Department of Homeland Security, 2008). Unlike other property insurance, agents who write policies under the NFIP cannot “bind” coverage. A purchaser of flood insurance must wait 30 days from the date the application is completed and the premium presented before the policy becomes effective. As of July 2008, ninety-one private insurance companies issue policies and adjust flood claims under the WYO program which accounts for about 95% of all the flood policies issued under the NFIP (Insurance Information Institute, 2008).

At the end of 2007, more than 20,000 communities were participating in the NFIP and more than 5.65 million flood policies were in place providing coverage for over \$1.14 trillion in property.¹⁵ In 2007, the average amount of flood coverage provided was \$201,598 per policy, the average annual premium paid was \$505 per policy and the average flood claim paid by the NFIP

¹⁴ In October of 1983, flood insurance became available from private-sector property insurers who had entered into an agreement with the FIA to sell and service flood insurance under the WYO program in accordance with the National Flood Insurance Act of 1968. The first WYO policies were sold in November 1983 (American Institutes for Research, 2003).

¹⁵ Approximately 5 million of the 5.65 million flood policies were residential policies. An NFIP residential flood insurance policy covers 1 to 3 unit structures as well as condominiums.

was \$24,579 (U.S. Department of Homeland Security, 2008). A recent poll by the Insurance Information Institute found that 17% of homeowners have a flood insurance policy although this percent varies slightly by geographic region: 15% in the West, 17% in the North Central states, 17% in the South and 20% in the Northeast (Insurance Information Institute, 2008).

As discussed, there are features of the NFIP that limit the amount of flood insurance that may be acquired. Two separate flood programs continue to be administered by the NFIP: the Emergency Program and the Regular Program. Table 1. shows the current flood coverage limits available under both of these programs for both building coverage and contents coverage. These limits have existed since 1995, which is perhaps why the current 2008 FIRM Act proposes increasing these limits. The proposed new limits of coverage would better reflect the current value of homes. For example, average and median sales price of new residential homes sold in the U.S. were \$313,600 and \$247,900 in 2007, respectively; compared to \$158,700 and \$133,900 in 1995, respectively (U.S. Census Bureau, 2008). Of course, these values varied by geographic location as shown in Table 2. Moreover the average and median sales price of existing single-family homes in the U.S. rose from \$141,500 and \$117,000 in 1995, respectively; to \$266,200 and \$217,900 in 2007, respectively. If an objective of the NFIP is to provide adequate flood coverage for both new and existing homes across the U.S., current coverage limits should be increased.

[Insert Table 1.]

[Insert Table 2.]

4.2 Pricing Flood Coverage by NFIP

In the aggregate, the NFIP collected \$2.85 billion in annual premiums in 2007 and paid out

\$5.23 million in losses.¹⁶ Table 3. shows that in most years since 1978, annual premiums collected by the NFIP exceeded annual losses paid out. Over this thirty year period, the NFIP has paid out average annual claims of \$1.16 billion while collecting average annual premiums of \$1.10 billion, perhaps suggesting adequate insurance pricing. However, this type of conclusion is flawed as many significant insurance pricing principles are violated under the current NFIP pricing mechanism.

[Insert Table 3.]

First, consider how a private insurance company would go about establishing a price for flood insurance coverage.¹⁷ Due to the catastrophic nature of flood peril, insurers would be unable to reserve adequately for floods in a given geographic area. Hence, flood risk would have to be viewed as an inter-temporal risk as opposed to a cross sectional risk. Is it possible for an insurer to transform flood risk into a cross sectional risk? Yes, if it is possible to construct a sufficiently large pool of independent risks to allow the Law of Large Numbers to reduce the risk. Fundamental insurance pricing shows that as the size of the risk pool increases, the expected loss of each pool member approaches the pure premium more certainly as the standard deviation of each pool member's loss amount decreases. Conversely, the smaller the risk pool, the larger the risk loading an insurer operating in a competitive market will have to charge. The risk loading is an administrative cost that accounts for the uncertainty faced by an insurer in predicting the future losses of the pool. Hence, a larger standard deviation of losses leads to larger risk loading. This would be the challenge faced by a private insurer. Given the catastrophic nature of flood risk, if the insurer were unable to construct a sufficiently large enough risk pool, the risk loading would become significant. If the risk loading was too large, there will be little to no demand for flood insurance because the insurance premium would not be feasible or desirable in the eyes of a

¹⁶ The average rate was 0.25 per \$100 of coverage in 2007.

¹⁷ To our knowledge, private insurers do not compete directly with the NFIP in writing flood coverage.

potential insurance purchaser.¹⁸

The NFIP follows a different path in establishing its insurance pricing which ultimately leads to significantly subsidized rates on one-fourth of the policies it sells. The NFIP has established a two-tier rate classification consisting of “full risk” rates and “subsidized” rates. About 75% of NFIP policies are based on “full risk” rates which are considered “actuarial” rates. Here, the NFIP uses what appears to be a non-commercial model based on outdated flood probability estimates from the 1970s and 1980s. The full risk rate is calculated by determining expected losses and adding expected loss adjustments and other operating expenses (i.e. risk loading). The other 25% of NFIP policies are based on “subsidized” rates which ultimately generate premiums sufficient to cover only 35%-40% of the “full risk.” In other words, these policies receive 60%-65% subsidization from the NFIP. Here, the NFIP subtracts the aggregate expected full risk premium from some average historical loss year target. The average historical loss year target set by the NFIP significantly limits the impact of major past catastrophes by ignoring them outright or considering a small portion of the losses they generated (Government Accountability Office, 2008). Moreover, these subsidized policies tend to cover high-risk properties. Finally, the NFIP does not require all properties that are re-mapped into higher-risk areas to pay rates based on these new high-risk designations, but rather allows these property owners to pay premiums based on previous rates. This policy is known as “grandfathering” and further contributes to the financial inadequacies of the NFIP.

Given this mechanism for establishing premiums, it is not surprising that the NFIP continues to be underfunded on an annual basis. The current NFIP flood insurance premiums are feasible, affordable and attractive levels for potential insurers, but they do not accurately reflect the true risk

¹⁸ For a detailed discussion of why private insurers are not willing to provide insurance against catastrophic events, see Jaffee and Russell, 1997.)

of flood, and cannot be considered acceptable under any insurance pricing standard. Further, by providing insurance at below competitive market rates, the NFIP may be encouraging development in high flood risk areas, while simultaneously discouraging loss control.

4.3 Evaluation of the National Flood Insurance Program

We state above that an evaluation of a government insurance program should be based on eight criteria. The NFIP has provided insurance coverage for many who otherwise likely would have none. By other criteria the NFIP is less than a perfect solution to the risk posed by the flood peril.

1. **Administrative Efficiency:** To the best of our knowledge, there is no study that assesses the administrative efficiency of the NFIP. The program offers few options to insureds, which one would expect keeps administrative costs low. On the other hand, the program does not integrate well with homeowners insurance purchased against other perils. This increases both the costs of issuing coverage and adjudicating claims.
2. **The Amount of Risk Transferred:** Perhaps the NFIP's greatest success has been its ability to allow property owners to transfer at least some flood risk to the government by paying a fixed premium. In the absence of any NFIP policy limits, property owners would have the ability to transfer as much flood risk as they desired to the government, so long as the property owner was willing to pay the established premium.
3. **Control of Moral Hazard:** The NFIP attempts to control moral hazard through the establishment and enforcement of floodplain management ordinances. However, this is limiting and may establish a false sense of security by property owners who may simply comply with the ordinances, which may be outdated. A tremendous responsibility is placed on the NFIP to ensure these ordinances (and building codes) are sufficient.
4. **The Party Best Able to Control the Risk Should Typically Bear the Risk:** As mentioned, the occurrence of flood is not controllable by property owners or the government; however, through adoption of loss prevention and loss reduction measures, the cost of damage can be minimized. A property owner can minimize flood risk by choosing where to live. If the choice is to live in a flood risk area, then they should bear that risk. The NFIP prevents this from efficiently occurring by making the purchase of flood insurance compulsory in some cases and by offering non-risk adjusted insurance.
5. **Minimization of Negative Externalities:** Historically, the NFIP has imposed significant externalities on taxpayers. Because of the pricing methods utilized by the NFIP, it is inevitable that taxpayers will ultimately subsidize the financial shortfalls created by the NFIP's underpricing.

6. **Consideration of All Parties:** Legislative changes over the past forty years have addressed concerns of other parties outside of the property owner facing flood risk. By making the purchase of flood insurance mandatory, other community members are protected. Increased land use restrictions in high risk flood areas also protect general taxpayers from further subsidizing property owners in these areas.
7. **Participation Decision:** Participation has increased in the NFIP since its inception, arguably due to the increased mandatory participation requirements by property owners. However, participation is still ultimately voluntary (one can choose where to live!).
8. **Premium Determination:** Clearly, the premiums charged by the NFIP are not strictly risk-based. This is perhaps the NFIP's most significant shortcoming as it leads to significant loss control inefficiencies and uninformed decision making regarding flood insurance purchases.

Over time purchases of flood insurance have increased as the government has adopted mandatory purchase requirements and has become increasingly strict in enforcement of these requirements. The development of purchase requirements highlights the fact that many people seem to need to be coerced into buying coverage that is priced below the level necessary to pay losses and cover administrative expenses. Since it is well established in the literature that purchases of flood insurance increase following a flood, lack of sensitivity to the risk may indicate why many do not buy coverage unless forced to do so. To the degree the NFIP under invests in raising awareness of the risk that flood poses to households, less risk transfer occurs than otherwise would. This is a continuing challenge for the NFIP.

Significantly, despite the existence of the NFIP and the risk transfer that it does facilitate, the taxpayers continue to get soaked by hurricanes and floods. Since the population living in coastal areas continues to increase and since flood insurance is both underpriced and often not purchased, the federal government's exposure to flood risk remains substantial. Reform needs to both decrease the government's exposure to loss following floods and establish premium levels for insurance that are

commensurate with the risk that is insured. These two goals, which in essence are for more insurance being purchased at a higher price, are in conflict with one another. We discuss potential solutions to this conundrum in the following section.

5. Alternative Means to Handle the Flood Peril

As discussed in the first section of this paper, the National Flood Insurance Program (NFIP) has been the primary provider and financier of flood insurance in the United States since 1968. While there have been changes to the program, these have been relatively minor and have neither altered the essential scope of the program nor the general approach to financing flood risk for individuals or businesses. Although deficiencies in the NFIP have received considerable attention from both academics and government officials, an improved risk-bearing mechanism has not yet made significant inroads in either the public or private sphere. Private market mechanisms over the last twenty years that have provided for some risk transfer, albeit relatively little, have included the following: options and futures contracts that were traded on the Chicago Board of Trade (CBOT) during the 1990s that were withdrawn due to lack of demand; private flood insurance placed by lenders on behalf of mortgagees in compliance with mortgage requirements imposed on federally regulated lenders; bond instruments whose interest rates are linked to the occurrence of natural catastrophes; and, both voluntary and forced-placed private flood insurance provided by traditional property insurance companies.

5.1 Private Market Contracts for Flood Risk Transfer

The likelihood of significant correlation across risks in insurance pools is a significant impediment to the development of a private market for flood insurance. To some degree, reinsurers can overcome this problem by creating pools with significant geographic diversity.

A reinsurance contract can be as narrowly defined as the parties (the primary insurer and the reinsurer) wish to write the contract. Common forms of treaty reinsurance contracts are those written for loss layers above a cedant's (primary insurer's) retention limit and those written on a proportional basis. As is true with insurance of any type, the insuring agreement creates the potential for moral hazard. Since the cedant transfers the risk in whole or part to the reinsurer, the cedant may be less diligent in its own loss control measures, such as underwriting and claims adjudication, than it otherwise would have been. To some degree moral hazard is minimized by the mutually beneficial long term relationships that are common between many insurers and reinsurers. These relationships would be negatively impacted by excessive moral hazard. The risk sharing provisions of the reinsurance arrangement also serve to mitigate moral hazard.¹⁹

In addition to moral hazard, a reinsurance arrangement creates credit risk for cedants. Here, credit risk refers to the reinsurer's ability to make good on its promise to pay a reinsurance claim. If the reinsurer to whom risk was transferred goes bankrupt, the bearing of the primary risk reverts to the cedant. Like any insurer or financial institution, reinsurers may become insolvent for numerous reasons including bad management, poor underwriting and unfavorable investment experience. A potential cause of reinsurer bankruptcy is the occurrence of a catastrophic event to which the reinsurer is over-exposed. Cummins, Doherty and Lo (1999) assert that a catastrophe loss, depending on the destruction inflicted, would result in many insurers, including reinsurers, becoming insolvent. A particularly destructive flood, even if partially insured and reinsured against, would have the potential to imperil the financial capacity of the entire insurance industry, including both primary insurers and reinsurers.

¹⁹ Moral hazard is detrimental to both parties in a risk sharing arrangement. The party purchasing insurance faces a higher cost for coverage than in the absence of moral hazard (see, Pauly (1968)). The party selling coverage faces greater uncertainty if it is unable to distinguish between the likelihood of different parties' actions subject to moral hazard. A long term relationship can lower the cost of insurance to the buyer and provides greater predictive ability to the seller of coverage.

Innovation in the financial markets has resulted in the development of alternative risk transfer contracts. These contracts, which are not insurance, tap into the greater capacity of the financial markets to bear risk. In 1992 the CBOT began trading derivative contracts whose payoffs were contingent on the occurrence and magnitude of losses following natural catastrophes. The instruments were traded for seven years and then removed from the market due to insufficient demand for the contracts. The instruments were clearly not intended for individual property owners, but rather for commercial enterprises, such as primary insurers, who were seeking to hedge their exposure to catastrophe related losses. (For a review of various catastrophe securities, see Sheehan, 2003.)

Unlike reinsurance, which may target a specific risk (facultative reinsurance) or may target a specified portfolio of risks (treaty reinsurance), the payoff on the catastrophe options contracts traded on the CBOT was linked to an index of losses occurring across a specified region during a specified period of time.²⁰ For an insurer purchasing such an instrument, the protection against fluctuations in its own insurance portfolio afforded by the options contract depended on the degree to which the diversification of the insurer's pool of risks matched the loss index underlying the contract. The degree of correlation, or lack thereof, between an insurer's risk pool and the index of the options contract is called basis risk. The greater (lower) the correlation, the more (less) protection the contract provided. Other things equal, the greater the basis risk, the less valuable an options contract is to an insurer. While a thorough discussion of the paucity of demand for the CBOT catastrophe options is beyond the scope of this paper, significant basis risk made the contracts less attractive to many potential buyers, including insurers, who had other means of hedging their risk. (For a discussion of CBOT catastrophe options, see White, 2001.) In particular,

²⁰ The index did not include losses that were insured by the NFIP.

Doherty (1997) notes that a reinsurance policy provides an alternative hedge for an insurer bearing flood risk. By providing coverage on specifically defined risks, reinsurance eliminates basis risk.

The CBOT options contracts were among the first non-insurance financial instruments aimed at tapping into the greater capacity of the financial markets to bear catastrophic losses. An increasing number of securities have been developed since their introduction. Of greater significance than the CBOT options and of proven viability are catastrophe (CAT) bonds, which Swiss Re (2006) reports grew significantly in volume from 1998 to 2006. The outstanding volume on these bonds was \$7.7 billion at the end of 2006.²¹ Cat bonds account for the largest share of any form of risk securitization. With a CAT bond, a special purpose vehicle (SPV) – a legal entity established to sit between the seller of the risk, often a primary insurer, and the purchaser of the bond – contracts with both the cedant to provide reinsurance and with the investors to borrow money with a contingent repayment schedule. Depending upon the structure of the CAT bond, the investors may have at risk the interest payments on the debt, the principle, or both. The established interest rate payable on the bond reflects the risk of the instrument and may be viewed as an objective risk measure.

Industry loss warranties (ILWs), another alternative risk transfer instrument, are written very similarly to ordinary reinsurance policies. An ILW contract results in the transfer of risk from one party, usually a primary insurer, to a second party. However, unlike a reinsurance policy, an ILW specifies a payoff amount in the event of a loss that is linked to an industry loss index. For the ceding company, the ILW introduces basis risk to the extent the cedant's risk pool profile deviates from the profile underlying the specified industry loss index. ILWs are often sold with letters of credit from large commercial banks that secure the agreement. This allows unrated reinsurers

²¹ In short, insurers who issued these CAT bonds had access to \$7.7B to pay for catastrophe related claims.

owned by hedge funds to compete successfully for this business.

Another alternative risk transfer arrangement, a contingent capital agreement, allows the purchaser (e.g. a primary insurer) to issue and sell securities to a second party at a predetermined price for a set period of time, if a specified contingent event occurs. The securities may be either equity, debt or some combination. These agreements transfer risk associated with the contingent event to the second party, who need not be a reinsurer.

Reinsurance and non-insurance risk transfer contracts permit private market transfer of flood risk to parties willing to bear the risk for an agreed upon price. ILWs, cat bonds, and other financial instruments that permit the transfer of flood risk to the capital markets are relatively new innovations which were not available when the NFIP was created. The pricing of these contracts reflects the assessment of the risk by the parties of the contracts. Since the implementation of the NFIP in 1968, significant advances in meteorology and computer technology have allowed for increasingly sophisticated pricing of catastrophic risks, including flood. The advances in science also allow for increasingly accurate pricing of the risks transferred through these financial contracts, and have contributed to their growth.

5.2 Contract Imbedded Risk Transfer for the Flood Peril

The typical mortgage on a house stipulates that the house serves as collateral on the loan. If the borrower fails to make promised mortgage payments and the loan goes into default, the bank has the right to put the property into foreclosure. In the normal course of events, this is a highly undesirable outcome from the viewpoint of the homeowner as the use of the home will be lost, the equity built up in the home may be lost, and the individual's credit rating will suffer. Following a major flood loss (and in the absence of flood insurance), however, this ultimate outcome may be

preferred by the homeowner relative to the alternative of continuing to make mortgage payments on a property that may now be worth less than the amount of the mortgage on the house. The right of the homeowner to quit making mortgage payments and surrender the property to the bank is equivalent to a put option. Exercising this option following a flood loss shifts the excess of the flood loss over the homeowner's equity to the bank. Thus, in situations where homeowners have little equity in their houses, the banks are indirectly significantly exposed to potential flood losses.

Consistent with property owners exercising their put options following a disaster - whether by necessity or choice - Lawless (2005) provides empirical evidence based on 18 major hurricanes between 1980 and 2004 where bankruptcy filings increased significantly 12 to 36 months after a major hurricane. Similarly, Overby (2007) finds that mortgage default rates significantly accelerated in New Orleans following Hurricane Katrina which made landfall in Louisiana on August 29, 2005. Further, she finds that the uptick in the rate of foreclosures that would have been expected to accompany the increase in mortgage defaults was actually suppressed by secondary market responses, including Fannie Mae and Freddie Mac suspending mortgage payment requirements for three months immediately after Katrina. Fannie Mae and Freddie Mac also established a moratorium on foreclosures that extended until August 31, 2006. Her data indicate that foreclosures following Katrina that arose out of a post-Katrina default increased significantly between May and August of 2006.

To address the flood risk that banks face, they could purchase insurance or transfer the risk through an alternative risk transfer contract, such as a CAT bond, to another party. Another possibility, at least in theory, for funding this risk would be for banks to charge a higher interest rate on mortgages in areas exposed to the flood peril. The interest rate would reflect all characteristics which would reasonably be expected to impact the likelihood of default from a flood loss, such as

the amount of equity the homeowner holds in the property and the risk control measures built into the structure itself.

5.3 Private Insurance Market Contracts for Flood Risk Transfer

Prior to the creation of the NFIP the private insurance market facilitated the transfer of flood risk. As previously discussed, there was a considerable push by both the federal government and the insurance industry to create a federal flood insurance program following several highly destructive hurricanes in the 1960s. Currently, property owners may obtain additional flood insurance in excess of the limits provided by the NFIP through the private market. In addition, some private market flood coverage is obtained by lenders when it is required for them to do so as mandated by federally backed mortgages. The Federal Disaster Protection Act of 1973 requires that homeowners purchase flood insurance if they live in an area at high risk of flood and obtained a mortgage on their property from a federally backed lender. The mandatory purchase requirement also applies to homeowners whose loans are sold to a government-sponsored enterprise, such as Fannie Mae or Freddie Mac. The Act does not require that the insurance be purchased from the NFIP, although it usually is. If coverage is obtained from another source, the coverage must meet or exceed that provided by the NFIP.

Dixon, Clancy, Bender and Ehrler (2007 a, b) estimate that there are roughly 50,000 to 75,000 flood insurance policies voluntarily purchased in the private market. Advantages to purchasing private market coverage rather than a policy from the NFIP include higher available coverage limits and flood coverage enhancements. For instance, the NFIP policy provides actual cash value coverage whereas private market coverage often provides replacement cost coverage. Other examples of differences are that private market coverage typically insures carpets, wallpaper,

and personal items in a basement, whereas NFIP coverage does not; and, private coverage applies to mudslides, while NFIP coverage does not.

In 2006, Chubb Insurance Company introduced a private market flood insurance policy that could be purchased with a limit up to \$15 million (Chubb, 2006). (Recall, the NFIP limit on an insured residential home is currently \$250,000.) Private market flood insurance is typically designed for homeowners whose home values exceed the NFIP policy limit. Other carriers providing private flood coverage include AIG, Fireman's Fund, and Lloyds of London. Private insurance coverage may be written in a number of different ways, including as a supplement to NFIP coverage, as a stand-alone policy, or as an endorsement to a homeowners insurance policy (Silverman, 2005). The insurers who do sell private flood insurance are more often willing to provide coverage in high flood risk areas. Since these policies are not subsidized, the premiums reflect the insurers' true estimates of the cost of this risk.

The vast majority of flood insurance purchased in the private market is lender placed coverage. Lender forced-placed coverage is insurance purchased by a lender on behalf of a borrower. The borrower repays the lender for the cost of the coverage typically through higher mortgage payments. Mortgage contracts typically give a lender the right to purchase insurance coverage on mortgaged property when the borrower does not satisfy a loan condition stipulating that coverage be maintained.²² Dixon, Clancy, Bender and Ehrler (2007a) estimate that there are between 130,000 and 190,000 lender forced-placed flood insurance policies with private insurers. Their estimate is based on a survey of market participants.²³ In a separate report, Dixon, Clancy et

²² The lender could place the coverage with the NFIP under its Mortgage Portfolio Protection Program (MPPP). Most lender placed coverage, however, is obtained in the private market. Private insurers typically provide more extensive coverage and administrative features that are preferred by lenders. See Dixon, Clancy, Bender and Ehrler (2007a) for a detailed discussion and comparison of private placed coverage and the MPPP policy.

²³ The market participants surveyed included insurance companies, lenders, and trackers. Trackers are hired by lenders to track compliance with mortgage requirements.

al. (2006) find that 75% to 80% of homes subject to the mandatory flood insurance purchase requirement, which is the impetus for forced placements, are indeed insured. In contrast, they find that only about 20% of homes not subject to forced placement are insured against flood.

Approximately 45% of all homes in special flood hazard areas (SFHAs) are not subject to forced placement. While forced placement has not resulted in 100% of all homes subject to the mandatory purchase requirement being insured, the requirement is associated with a significantly higher rate of flood coverage and has led to the development of a non-trivial market for private flood insurance. Dixon, Clancy et al.'s (2006) estimates of the size of the private flood insurance market suggests that it accounts for a mere 6% of the total flood risk coverage of condominium and homeowners.

Of the two segments of the private insurance market – the truly voluntary market and the lender forced-placed market – the first segment satisfies many of the criteria specified earlier for optimal risk transfer. Here, the premiums reflect the risk, the cost of the risk is borne by the party best able to mitigate the risk, the administration of the policy is efficient, individuals are not forced to participate in the program, and the financing of the risk does not impose a negative externality on others. However, the amount of flood risk that is transferred in the private market through voluntary transactions is a relatively small piece of the total risk faced by homeowners and condominium owners. The percentage of those insured voluntarily in the private market is less than 1% of those facing flood risk.²⁴ There are roughly five million policies sold by the NFIP. Voluntary private market flood insurance purchases account for a small portion of the total flood insurance risk.

6. Going Forward

The NFIP is a less than perfect mechanism for providing homeowners protection against the

²⁴There are approximately 50,000 to 75,000 voluntarily placed private market policies. There are roughly 5 million NFIP policies in place and the NFIP penetration rate is about 50%.

personal and financial devastation that are brought in the wake of severe flooding. Many at risk simply choose not to purchase coverage for reasons discussed previously. This creates an economic distortion to the degree that others bear the risk, including taxpayers, family members, friends and fellow members of social groups. Moreover, the cost charged by the NFIP does not completely reflect the cost of the risk. Likely, this results in individuals making less than optimal tradeoffs between purchasing insurance and investing in other risk management strategies, including loss prevention and loss reduction (see Dehring and Halek (2008)). The NFIP is for all practical purposes a monopoly insurer that does not face competitive market pressures to innovate or provide superior service to customers. The NFIP demonstrates little flexibility in modifying its practices to serve specific needs of customers. For instance, the available coverage limits are insufficient for many homeowners. Marketing of its product, despite the fact that research has demonstrated that greater awareness of the flood risk leads to greater demand for flood insurance, is minimal compared to that of private insurers. In spite of the weaknesses of the NFIP, the program has provided protection for many and provided needed relief that would have otherwise likely been borne in whole or part by taxpayers through general revenue funds.

If the United States continues to provide aid to needy homeowners following floods, a program that encourages or requires homeowners to fund the potential loss prior to its occurrence will protect other U.S. taxpayers from bearing the cost by placing it on those who choose to face the risk. This is what the NFIP attempts to accomplish, although as mentioned, this program has flaws. Changes in the way the flood peril is financed are improvements to the extent they lead to increases in the coverage put in place at prices that accurately reflect the risk.

Flood risk can be passed through private markets. Private flood insurance is currently offered and sold by some insurers in the U.S. expanding flood insurance availability beyond that

provided by the NFIP. Further, flood risk is increasingly being passed between parties in the financial markets with a variety of different contracts.

Flood coverage is currently a required purchase for many homeowners. Federally backed mortgages stipulate that flood insurance must be purchased by homeowners in areas at high risk of flood. The requirement protects the quality of the loans by increasing the likelihood that the debt will be paid. Banks have been successful in force-placing coverage when homeowners allow policies to lapse.

To achieve complete coverage of the flood peril at a price that reflects the risks, one approach the federal government could take in theory is to require that all property owners purchase flood insurance in the private market. Whether or not insurance industry capacity would expand sufficiently to absorb this action is an open question. There is reason to believe that it might. Following major losses, including Hurricane Andrew and 9/11, new capital came quickly into the industry. The opportunity to provide flood coverage may result in a similar flow of capital into the industry. A slower approach would be to raise rates offered by the NFIP. If the rates were at a sufficient level to cover the costs of the program, private insurers would likely enter the market. With financial instruments available to access the capital markets, insurers and reinsurers would likely transfer the risk to the capital markets where it would be further spread to willing investors. Significantly, when the NFIP was implemented this opportunity was not available to insurers. As mentioned above, advances in computer modeling and understanding of the science behind flood increases the accuracy of pricing and the ability of flood risk to be passed in the private market.

If the government was unwilling to mandate flood coverage, a likely possibility as health insurance is not even mandated in the U.S., an alternative means for expanding flood coverage at an appropriate price would be to place the risk on the banks providing mortgages in flood prone areas.

This could be accomplished by passing legislation stipulating that following a flood of a particular size in a specified area the outstanding balance on all mortgages in the affected area would be considered paid in full. The loss arising from the unpaid value of the mortgages would revert to the credit markets – the banks that underwrote the loans or those that bought the loans from the banks in a secondary transaction. Lenders faced with this risk would price it into the interest rate charged for a mortgage.²⁵ An important advantage of this approach is that financial markets have significantly greater capacity than the property and casualty insurance industry.

There are several reasons to believe that the financial markets may charge a lower risk premium for bearing flood risk than the insurance market. First, since some participants in the financial markets may achieve a desirable portfolio diversification by adding flood risk, they may charge a lower price for bearing the risk. Second, since the financial markets are able to disperse risk broadly, whereas insurers aggregate risk, the risk premium need not be as large. Insurance is an ideal tool for risk transfer when the risks that are insured are homogenous and independent. Flood risks within a geographic area, in contrast, are highly correlated. The ability of insurers to reduce risk through pooling is therefore limited.

Requiring banks to bear the flood risk associated with outstanding mortgage balances would clearly drive up the cost of home ownership for many, but most significantly those whose homes are located in high risk flood areas. The loan process would be more cumbersome and expensive in areas subject to flood, if this proposal were implemented. Bank underwriting of the risk would require a determination of risk remediation measures at the home: pilings, distance from water, etc. This would presumably be an additional duty performed by a home inspector. Therefore, the cost of the home inspection would increase as well.

²⁵ This approach is similar to a bottomry bond.

Many of the criteria for an ideal risk transfer program would be satisfied by this proposal. The cost of the risk would be borne by the individual deriving the benefit of the risk, the homeowner. The cost of the risk would be fairly priced, as long as the mortgage market is competitive. Administrative costs, while not negligible, would be reasonable relative to the size of the risk. An important drawback to this approach is that it is only applicable to the value of unpaid mortgages.

The history of the National Flood Insurance Program is a story of incremental change. The program has expanded coverage limits, homes eligible for coverage, and requirements compelling homeowners to purchase coverage. Change frequently follows floods demonstrating shortcomings in the program. As a governmental program, the NFIP is responsive to the political process. Advances in computer technology, meteorology, and finance have created the opportunity for fundamental change in the financing of flood risk. We offer two proposals. First, we propose a requirement that all homeowners purchase flood insurance. We believe that if this proposal were enacted, capital would enter the insurance industry to meet the demand. Our expectation is that insurers would transfer a significant portion of this risk to the financial markets through types of instruments discussed earlier in this paper. Our alternative proposal is that banks be required to forgive mortgage debt following a flood of a specified magnitude in a specified area. Our expectation is that banks would price this risk into mortgage contracts through adjustments in the cost of debt. We further expect that banks would pass this risk with credit risk in the financial markets. Both proposals would result in those deriving the benefits of homeownership in areas exposed to the flood peril bearing the cost of that risk.

References

- American Institutes for Research (AIR) et al. "A Chronology of Major Events Affecting the National Flood Insurance Program." Washington, DC: AIR, October 2003.
- Boggs, Chris. "Fixing the NFIP – The Most Inefficient Insurer in the World." *Insurance Journal*, October 17, 2008. http://www.mynewmarkets.com/article_view.php?id=94730 (accessed October 2008).
- Browne, Mark J. and Robert E. Hoyt. 2000. "The Demand for Flood Insurance: Empirical Evidence," *Journal of Risk and Uncertainty*, 20(3), 291-306.
- Chivers, James and Nicholas E. Flores, 2002, "Market Failure in Information: The National Flood Insurance Program," *Land Economics*, 78 (4), 515-521.
- Chubb Group of Insurance Companies. 2006. "New Flood Insurance Policy Provides Up to \$15 Million in Limits." Available at <http://chubb.com/corporate/chubb4991.html> (accessed November 2008).
- Cummins, J. David, Neil A. Doherty, and Anita Lo. 1999. "Can Insurers Pay for the "Big One"? Measuring the Capacity of an Insurance Market to Respond to Catastrophic Losses." Working Paper. Financial Institutions Center, The Wharton School, University of Pennsylvania.
- Dehring, Carolyn A. and Martin Halek. 2008. "Do Coastal Building Codes Mitigate Hurricane Damage to Residential Property?" Working Paper.
- Dixon, Lloyd, Noreen Clancy, Seth A. Seabury, and Adrian Overton. 2006. "The National Flood Insurance Program's Market Penetration Rate: Estimates and Policy Implications." Rand Corporation, Santa Monica, CA.
- Dixon, Lloyd, Noreen Clancy, Bruce Bender, and Patricia K. Ehrler. 2007(a). "The Lender-Placed Flood Insurance Market for Residential Properties." Rand Corporation, Santa Monica, CA.
- Dixon, Lloyd, Noreen Clancy, Bruce Bender, and Patricia K. Ehrler. 2007(b). "Private Insurers Play a Limited, but Key, Role in Underwriting Residential Flood Insurance." Rand Corporation, Santa Monica, CA.
- Drew, Christopher, and Joseph B. Treaster. "Politics Stalls Plan to Bolster Flood Insurance." *New York Times*, May 15, 2006. <http://www.nytimes.com/2006/05/15/us/15flood.html> (accessed October 2008).
- Doherty, Neil A. 1997. "Financial Innovation in the Management of Catastrophe Risk." Working Paper. The Wharton School, University of Pennsylvania.
- Government Accountability Office. 2008. "Flood Insurance: FEMA's Rate-Setting Process Warrants Attention." GAO-09-12, October.
- Hartwig, Robert P. and Claire Wilkinson. 2005 "Public/Private Mechanisms for Handling

Catastrophic Risks in the United States.” Insurance Information Institute, New York, NY.

Insurance Information Institute. 2008. Facts and statistics available at <http://www.iii.org/media/facts/statsbyissue/flood/> (accessed October 2008).

Jaffee, Dwight M. and Thomas Russell. 1997. “Catastrophe Insurance, Capital Markets, and Uninsurable Risks,” *Journal of Risk and Insurance*, 64(2), 205-230.

Kunreuther, Howard, 1978, *Disaster Insurance Protection: Public Policy Lessons*. New York: John Wiley.

Kunreuther, Howard, 1984, “Causes of Underinsurance Against Natural Disasters,” *The Geneva Papers on Risk and Insurance*, 31, 206-220.

Kunreuther, Howard and Mark Pauly. 2006. “Rules Rather Than Discretion: Lessons from Hurricane Katrina.” NBER Working Paper Series, No. 12503.

Lawless, Robert M. 2005. “Bankruptcy Filing Rates after a Major Hurricane,” *Nevada Law Journal*, 6, 7.

McGee, William J. 1891. “Flood Plains of Rivers,” *The Forum*, 2, 221-234.

National Association of Realtors. 2008. “Existing Home Sales.” Available at <http://www.realtor.org/research/research/ehsdata> (accessed October 2008).

Overby, A. Brooke. 2007. “Mortgage Foreclosure in Post-Katrina New Orleans.” *Boston College Law Review*, 48(4), 851-908.

Pauly, Mark V. 1968. “The Economics of Moral Hazard: Comment.” *American Economic Review*, 58, 531-537.

Power, Fred B. and E. Warren Shows. 1979. “A Status Report on the National Flood Insurance Program-Mid 1978,” *Journal of Risk and Insurance*, 46(2), 61-76.

Sheehan, Kevin P. 2003. “Catastrophe Securities and the Market Sharing of Deposit Insurance Risk,” *FDIC Banking Review*, 15(1), 1-16.

Silverman, Rachel Emma. “Flood Coverage for Costly Homes.” *The Wall Street Journal Online*, September 2, 2005.
<http://www.realestatejournal.com/buysell/taxesandinsurance/20050902-silverman.html> (accessed October 2008).

Swiss Re. 2006. “Securitization – New Opportunities for Insurers and Investors,” *Sigma*, 7, 1-42.

U.S. Census Bureau. 2008. “Census of Housing.” Available at <http://www.census.gov/hhes/www/housing/census/histcensushsg.html> (accessed October 2008).

U.S. Congress. House. 1994. National Flood Insurance Reform Act of 1994. 103rd Congress, H.R. 3191. Available at <http://thomas.loc.gov/cgi-bin/query/z?c103:H.R.3191>. (accessed October 2008).

U.S. Congress. Senate. 2004. Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004. 108th Congress, S. 2238. Available at <http://thomas.loc.gov/cgi-bin/query/z?c108:S.2238>; (accessed October 2008).

U.S. Congress. House. 2008. Flood Insurance Reform and Modernization Act of 2008. 110th Congress, H.R. 3121. Available at <http://thomas.loc.gov/cgi-bin/query/z?c110:H.R.3121>; (accessed October 2008).

U.S. Congressional Research Service. "Federal Flood Insurance: The Repetitive Loss Problem." (RL32972; June 30, 2005), by Rawle O. King.

U.S. Department of Homeland Security. 2008. "The Write Your Own (WYO) Program." Available at <http://www.fema.gov/business/nfip/wyo.shtm> (accessed October 2008).

U.S. Department of the Treasury. "Flood Disaster Protection." Office of the Comptroller of the Currency (OCC). Washington, DC: OCC, May 1999.

U.S. Senate Committee on Banking and Currency, 89th Congress. 1966. "Insurance and Other Programs for Financial Assistance to Flood Victims." Washington, DC: U.S. Government Printing Office.

White, Rodney R. 2001. "Catastrophe Options: An Experiment in the Management of Catastrophic Risk in the United States," *Journal of Environmental Management*, 62, 323-326.

Woolley, John T. and Gerhard Peters. 2008(a). "The American Presidency Project [online]." University of California, Santa Barbara. Available at <http://www.presidency.ucsb.edu/ws/index.php?pid=14105> (accessed October 2008).

Woolley, John T. and Gerhard Peters. 2008(b). "The American Presidency Project [online]." University of California, Santa Barbara. Available at <http://www.presidency.ucsb.edu/ws/index.php?pid=10557> (accessed October 2008).

Table 1.

Available Limits of Coverage for Existing and New Construction Under the Regular Program (1995-2008)

	Emergency Program (First Layer) (\$000)	Basic Insurance Limits (\$000)	Additional Insurance Limits (\$000)	Total (\$000)
Building Coverage				
Single Family	35	50	200	250
2-4 Family	35	50	200	250
Other Residential	100	150	100	250
Non-Residential/Small Business	100	150	350	500
Contents Coverage				
Residential	10	20	80	100
Non-Residential/Small Business	100	130	370	500

Table 2.

Panel A

Average and Median Sales Price of New Single-Family Homes Sold

Geographic Region	1995 Average	1995 Median	2007 Average	2007 Median
United States	\$158,700	\$133,900	\$313,600	\$247,900
Northeast	\$216,600	\$180,000	\$437,700	\$320,200
Midwest	\$157,200	\$134,000	\$256,800	\$208,600
South	\$142,000	\$124,500	\$269,800	\$217,700
West	\$169,800	\$141,000	\$403,700	\$330,900

Panel B

Average and Median Sales Price of Existing Single-Family Homes Sold

Geographic Region	1995 Average	1995 Median	2007 Average	2007 Median
United States	\$141,500	\$117,000	\$266,200	\$217,900
Northeast	\$164,200	\$146,500	\$313,300	\$288,100
Midwest	\$115,100	\$96,500	\$196,100	\$161,400
South	\$122,500	\$99,200	\$225,900	\$178,800
West	\$182,000	\$153,600	\$372,500	\$342,500

Table 3.**National Flood Insurance Program Statistics**

Calendar Year	Premium	Number of Policies in Force	Number of Losses Paid	Loss Dollars Paid Out	Amount of Coverage Provided
1978	\$111,250,585	1,446,354	29,122	\$147,719,253	\$50,500,956
1979	\$141,535,832	1,843,441	70,613	\$483,281,219	\$74,375,240
1980	\$159,009,583	2,103,851	41,918	\$230,414,295	\$99,259,942
1981	\$256,798,488	1,915,065	23,261	\$127,118,031	\$102,059,859
1982	\$354,842,356	1,900,544	32,831	\$198,295,820	\$107,296,802
1983	\$384,225,425	1,981,122	51,584	\$439,454,937	\$117,834,255
1984	\$420,530,032	1,926,388	27,688	\$254,642,874	\$124,421,281
1985	\$452,466,332	2,016,785	38,676	\$368,238,794	\$139,948,260
1986	\$518,226,957	2,119,039	13,789	\$126,388,812	\$155,717,168
1987	\$566,391,536	2,115,183	13,399	\$105,422,538	\$165,053,402
1988	\$589,453,163	2,149,153	7,758	\$51,022,523	\$175,764,175
1989	\$632,204,396	2,292,947	36,247	\$661,668,435	\$265,218,590
1990	\$672,791,834	2,477,861	14,766	\$167,919,559	\$213,588,265
1991	\$737,078,033	2,532,713	28,554	\$353,684,967	\$223,098,548
1992	\$800,973,357	2,623,406	44,651	\$710,247,980	\$236,844,980
1993	\$890,425,274	2,828,558	36,044	\$659,069,808	\$267,870,761
1994	\$1,003,850,875	3,040,198	21,584	\$411,079,605	\$295,935,328
1995	\$1,140,808,119	3,476,829	62,441	\$1,295,581,467	\$349,137,768
1996	\$1,275,176,752	3,693,076	52,679	\$828,040,301	\$400,681,650
1997	\$1,509,787,517	4,102,416	30,338	\$519,505,659	\$462,606,433
1998	\$1,668,246,681	4,235,138	57,350	\$886,305,129	\$497,621,083
1999	\$1,719,652,696	4,329,985	47,245	\$754,965,083	\$534,117,781
2000	\$1,723,824,570	4,369,087	16,361	\$251,719,208	\$567,568,653
2001	\$1,740,331,079	4,458,470	43,562	\$1,276,963,290	\$611,918,920
2002	\$1,802,277,937	4,519,799	25,287	\$433,603,879	\$653,776,126
2003	\$1,897,687,479	4,565,491	36,716	\$778,793,929	\$691,786,140
2004	\$2,040,828,486	4,667,446	55,669	\$2,214,303,484	\$765,205,681
2005	\$2,241,264,140	4,962,011	210,893	\$17,575,117,955	\$876,679,658
2006	\$2,604,844,133	5,514,895	24,457	\$632,688,511	\$1,054,087,148
2007	\$2,854,071,096	5,653,949	21,287	\$523,219,557	\$1,139,822,517
Total	\$32,910,854,743		1,216,770	\$33,466,476,902	
Average	\$1,097,028,491	3,195,373	40,559	\$1,115,549,230	\$380,659,912