

A Changing Climate for the National Flood Insurance Problem: How to Fix NFIP

1. Introduction

Flood damages cost \$54 billion annually in the US (14). Insurance can help diversify across uncorrelated flood risks, and reduce the overall risk level. In the US, this insurance is the National Flood Insurance Program (NFIP), which accounts for over 95% of the flood insurance market, and was created through the National Flood Insurance Act of 1968 in response to the pullback of existing insurers after large floods in Louisiana (16,13). NFIP is a public-private partnership covering \$1.23 trillion worth of properties, and is structured so risk is held on the government's books, but private companies administer policies which are sold at below-actuarial rates (16,13). On average, this subsidy is 33% (16). However, NFIP's condition has grown increasingly precarious under climate change. Payouts have increased by over 2,000% in the latest 20 years, and while this is primarily driven by rising property values, the underlying risk has also increased (16). Over the next 50 years, climate change is predicted to cause an increase in rainfall by up to 10%, and increase the depth of the 100-year flood (a common standard representing the flood with a 1% chance of occurring in any given year) by over 50% in select markets, as shown in Figure 1 (9,7). A myriad of problems, ranging from inaccurate data, to uptake bias, subsidy requirements, moral hazard, and insufficient capital structurally plague NFIP, reducing the program's efficacy and making it financially unsustainable. A new flood insurance program utilizing multiple scales of insurance, data updates, an aggressive educational campaign, catastrophe bond backing, and a conversion of insurance subsidies to mitigation subsidies could help solve these structural challenges, although some climate change and justice risks remain.

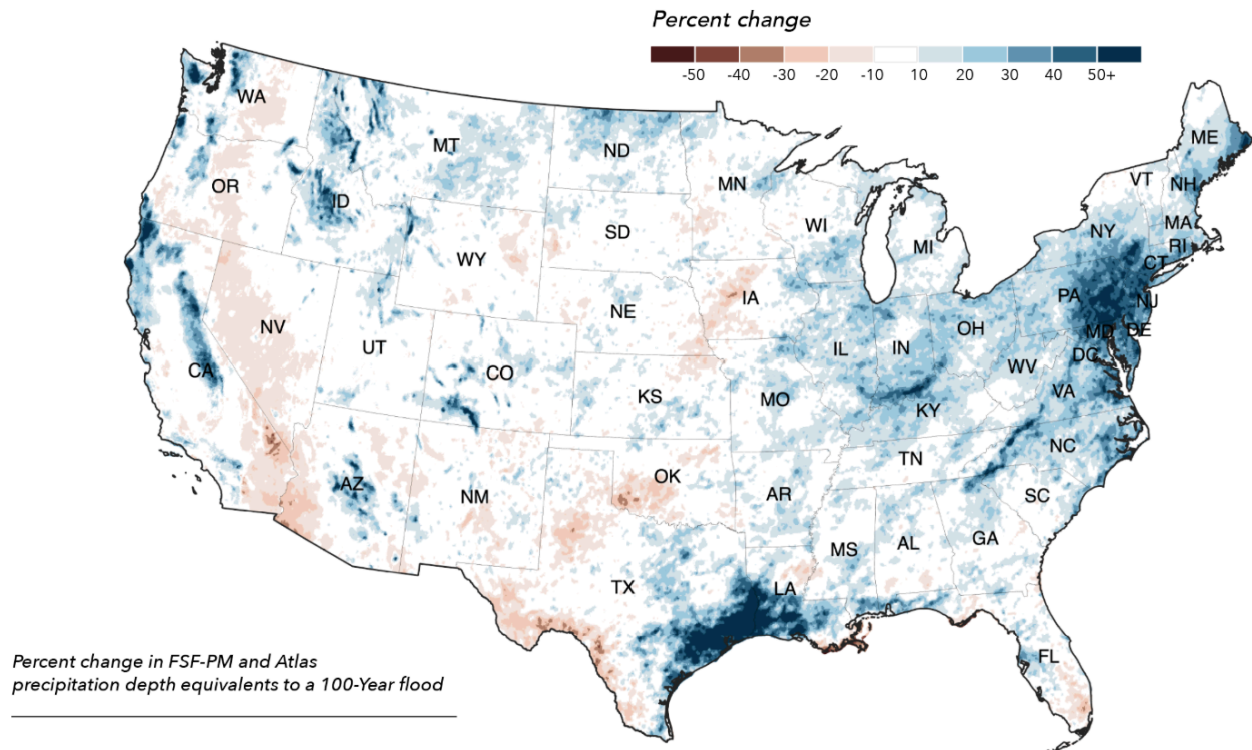


Figure 1: Predicted change in the 100-year flood depth from the First Street Foundation, a leading independent flood risk modeling organization (7).

2. The National Flood Insurance Problem

2. a. Damaged Data

Fundamentally inaccurate flood maps underlie many of NFIP's challenges. NFIP relies on FEMA's 100-year floodplain maps for risk and premium calculations, but the majority of these maps are 15 or more years old, and no longer accurately reflect the real risk or the effects of new construction (13). Ironically, NFIP is a leading cause of these maps' inaccuracies, as it is well-documented that politicians push for the delayed release of new FEMA maps or challenge their accuracy (13). New FEMA maps tend to include new properties in the floodplain, as climate change is continually expanding these floodplains, and that designation can harm property values (13). Bin and Polasky (2004) confirmed that there is a significant decrease in the property values of identical homes within and without the floodplain, likely due to buyers' risk-averse behaviors, whose expected utility is lowered by the possibility of the asset being

destroyed (13). Furthermore, the use of the 100-year floodplain discounts the meaningful risk to other properties, which have an up to 26.5% chance of flooding over the course of a 30-year mortgage. Only 5% of homes within a larger designation, the 500-year floodplain (greater than 0.2% odds of flooding in any given year) possess flood insurance (14). Even property owners within the 100-year floodplain often badly underestimate their risk – 40% report having no concern of flooding at all, and 60-70% underestimate their risk (16). This underestimation is likely due limited information and an undervaluation of flood risk, as flood insurance uptake rates increase 9% in an immediately post-flood year across counties of all average income levels (8). These post-flood years have no greater odds of a flood, indicating that hearing about the flood led to an upwards revision of risk perceptions, a finding corroborated by the increase of 3% in uptake after surrounding counties flood (8). However, these increases both become statistically insignificant after a 9-year period, indicating a cross-period informational loss.

2. b. Biased Buyers

Inaccurate data means that only high-risk buyers still judge their properties as requiring insurance, and are disproportionately likely to possess flood insurance. This effect compounds on a general adverse selection effect in the insurance of non-uniform markets, like property, where consumers with higher willingness to pay are more costly to insure (16). That creates a vicious cycle where rising risk, due to climate change and selection bias towards higher risk consumers, require an increase in premiums to maintain capital reserves. However, this increase in premiums leads to a lower marginal rate of substitution for marginal consumers, leading to only higher-risk inframarginal individuals maintaining their insurance, starting the cycle again. In practice, this is apparent in the greater proportion of non-elevated homes that are insured, with these non-elevated homes having a higher than average cost to insure (16). Disproportionately, these higher-risk, higher-willingness to pay individuals tend to be wealthier, as they have higher home values, face greater potential for losses, and have greater ability to pay the fixed costs of insurance (search costs, plan overhead fees, etc.) (16). In fact, Botzen

and Bergh (2012) found that these individuals sometimes have higher willingness to pay than the expected value of flood risk, likely due to expected risk-averse behaviors, while lower willingness to pay consumers do not demonstrate this risk-averse behavior (4). Botzen and Bergh suggest this difference might be due to different time discount factors, and thus smaller time horizons over which risk is considered, for these lower willingness to pay consumers, and also a greater relative benefit from relatively property-value independent bailouts from state and federal government agencies after major disasters (4).

2. c. Subsidizing Safety

In an attempt to improve willingness to pay and prevent reduction of home values, NFIP includes subsidies for all plans, particularly for legacy homes, by selling plans at below-actuarial rates (12). These subsidies have led to an expected return on flood insurance payouts in some states – like Texas – of up to 33% over a 10 year period (16). Despite this ability to reduce risk with a negative premium, only 60% of homes in 100-year floodplains possess insurance, counter to expected risk-averse behavior (16). These subsidies have also led to major, and accumulating, debt for NFIP totalling over \$22 billion (8).

2. d. Major Moral Hazard

Agents being unwilling to take cost-effective steps to reduce their own risk, as with low uptake of flood insurance, indicates the presence of moral hazard, as they believe someone else is bearing the costs of the risk. No proposals are able to fully capture the size of the moral hazard effect for flood insurance. While bailouts do pass some risk costs off to the government, the risk transfer is insufficient on average to justify the lack of insurance (16). Hassle costs increasing the cost of risk reduction are also not a cause, as flood insurance is readily available and easy to renew (16). The “walking away” phenomenon, where the net benefit is smaller than home equity and it becomes beneficial to abandon a property or let it enter into foreclosure and thus discharge the risk costs, are also unable to explain this phenomenon (16). There is only a slight increase in foreclosure risk after flooding events, and those with insurance are more likely

to move after flooding events (16)! The increase in uptake in post-flood years, described above, further indicates that credit constraints do not explain low uptake, as more individuals are able to pay than possess insurance (16). Moral hazard is also pervasive in flood mitigation, with less than 3% of those living in the floodplain taking steps to mitigate their risk, despite a high benefit-cost ratio of >3 , and >50 for about 75,000 very high risk properties (12). Subsidies may contribute to moral hazard for mitigation, by allowing excess risk costs to be passed off to the insurance company (12).

2. e. Capital Challenges

The lack of mitigation, adverse selection effects, and the presence of subsidies already press on the financial stability of NFIP, exacerbating an underlying stability challenge for flood insurance. Individual storms can lead to over \$15 billion in damages, a major fraction of most insurers' size, leading to a large risk of insolvency for flood insurers, which was a key cause of NFIP's creation (1). The annual nature of flood insurance contracts further reduces the capital insurers have on hand, increasing insolvency risk (1). Underlying forecasting difficulties, high correlation among losses, and these high capital requirements lead to even greater challenges (1). Reinsurance payouts, which could backstop insurers, and redistribute costs and risks across a pool lead to moral hazard for insurers, where they are incentivized to take on high risk values and declare bankruptcy or get bailed out if they become insolvent (6). For NFIP, these effects produce large debts after large catastrophes, produce the same capital requirements, and the same high risk and bailouts from the Treasury department (13). When combined with the underlying subsidies and a very high overhead rate of 40%, much larger than for other insurance types, NFIP serves as a continual loss and a very large correlated risk on the government's books (16,13).

3. The New Flood Insurance Proposal

3. a. Scaled Solutions

The underlying challenges of NFIP are inaccurate data and risk misperception, leading to low and biased uptake. This low uptake, in turn, causes adverse price selection, moral hazard, and leads to subsidies being required to increase uptake, all of which collectively cause financial instability. Without a solid explanation for risk misperception, which is in the opposite direction of the typical behavioral economics phenomenon of an overestimation of high impact tail events, this underestimation is particularly difficult to address (16,15). The proposed multi-scale solution thus addresses the low and biased uptake, by replacing a uniform personal insurance scheme with county level insurance policies and the opportunity for additional individual insurance. County-level insurance promotes uptake and ensures flood insurance universality as all properties would be covered under the scheme and pay into it via taxes, preventing an opt-out moral hazard. A county-level scale is natural, as counties are the smallest universal partition of the nation associated with a government, and state or federal level plans would lead to more lower-risk consumers subsidizing higher-risk consumers rather than actual diversification. Higher-risk or more risk averse consumers would still be able to purchase additional insurance coverage, with an additional higher premium, creating a price discrimination that reverses the adverse selection trend as higher-risk, inframarginal individuals would pay more. Subsidies are also no longer necessary, as uptake is high regardless. Property values are increased as they are all covered by insurance, and flood insured properties in the floodplain have higher property values than noninsured ones (3). Wealthier counties are likely to have larger willingness to pay, due to higher revenues, while poorer counties are more likely to have more uninsured homes initially and thus see an increase in property values and tax revenue to offset insurance costs. An end to subsidies, reductions in plan overhead due to fewer plans to administer, and expansion of uptake and geographies all increase revenue and thus reduce the underlying financial instability. Lastly, the use of an insurance plan at the local administration level makes it more familiar to consumers, reducing the likelihood of rejection,

and the use of an identical system for higher risk consumers and the overall municipal plan reduces the risk of differing insurance service quality between different consumer classes.

3. b. Data Driven

With property value reductions limited by insurance expansion, more accurate, modern flood maps can be adopted, helping reduce inaccuracies and biases. The use of accurate maps also allows for more accurate adjustments of rates and payouts based on climate risks and more accurate diversification, improving system resiliency to external shocks. However, updated maps may reduce property values for high-risk properties without additional insurance (in which case consumers can buy the additional insurance), or very high risk properties in general (which can qualify for the mitigation scheme addressed below).

3. c. Expanding Education

Public flood reduction plans, including insurance efforts, mitigation efforts, and social acceptance, are highly conditioned on social norms (2,11). An expanded education program focused on the benefits of guaranteed payouts can help promote these new social norms, prevent internal risk misperceptions, and allow for more rapid recovery (2).

3. d. Bond Backing

Due to high geographic correlation, large storm size, and the presence of high damage tail events mean that financial backing for the overall insurance plan is necessary to ensure financial stability. Catastrophe bonds, which are bonds that would be issued by municipalities and purchased by investors and involve payouts from the municipalities in the case of no catastrophe and payouts to them in the case of a catastrophe, would provide a good backstop. These could be agglomerated for collections of counties with municipal flood insurance on the state level, allowing for a reduction in the risk of each bond, improving the amount of capital able to be backed by the bond, reducing the number of bonds on the market to prevent crowding out, and taking advantage of states' excellent credit ratings. Agglomeration at the state level also allows for the creation of multiple risk tranches, diversification across states, and

prevents the subsidies from very low risk states that would occur under national agglomeration. This division also aligns with current governmental changes focused on shifting disaster relief to the states. Furthermore, this system has a variety of advantages over traditional reinsurance, including the ability to raise funds from across a wider array of financial players, reducing the risks of reinsurance insolvency, and provides additional access for state governments to the credit markets. Catastrophe bonds also allow financial players to potentially diversify across national borders as well.

3. e. Moving to Mitigation

For the about 75,000 very high risk properties in the US, insurance premiums would be extremely high, and covering them via a municipal plan would lead to significant losses (16). These properties typically flood annually, and incur large costs for NFIP, but also have extremely high benefits for mitigation, with a >50 benefit to cost ratio (16). These are disproportionately legacy homes built in very low lying floodplains, where mitigation efforts could help reduce insurance payouts, reduce damages, and improve property values. Rather than mandating mitigation, as some mitigation measures may greatly reduce the utility for consumers who greatly care about external home aesthetics, these homes could be excluded from the public insurance program unless they accept highly subsidized mitigation efforts. The offer for highly subsidized mitigation efforts would allow for low willingness to pay consumers without access to credit to remain in their houses, while consumers with strong and unusual utility preferences to not be forced into decisions.

4. Lingering Challenges

4. a. Climate Change Risks

While this proposal would solve many of the existing challenges of NFIP, major risks remain. A much higher rate of flooding due to climate change over longer periods of time could meaningfully depress property values, leading to pullback and financial insolvency of municipal plans, if properties in floodplains are foreclosed or abandoned in response. Extremely large and

costly storms could also reduce the demand of catastrophe bonds, making them prohibitively expensive and exposing the system to risk, while reducing the ability of states to access debt markets. A rapid increase in the rate of floods due to climate change or increases in uncertainty in models could also lead to inaccurate forecasts and rates, and undermine the system. Lastly, increasing spatial correlation of events, and physically larger storms, could increase the correlation of the whole system and prevent diversification, increasing the risk of a series of storms that would reduce catastrophe bond demand.

4. b. Inequality Issues

Inequality issues also persist, as biased administration of additional policy plans could lead to lower-quality service for those without additional insurance coverage in the case of a disaster, harming the ability for communities to bounce back. County spending on insurance could also reduce budgets in general, adding further stress to already financially stressed communities. The underlying challenge of flood insurance's inability to protect or mitigate the risks of temporary residents, those without homes, and renters also persists, requiring some form of additional coverage or insurance system not solely tied to property as well.

5. Conclusion

NFIP is plagued by incorrect flood maps and misestimation of risk lead to scattered and unequal consumption of insurance, which leads to adverse price selection, moral hazard, and subsidy requirements. These in turn lead to financial instability. A new system using a tiered system with universal coverage under county-level plans and additional insurance available on the market for high-risk properties would help reverse the scattered and unequal consumption issue, especially combined with data updated, educational campaigns, backstopping with catastrophe bonds aggregated on the state level, and mitigation subsidies for very high risk properties. However, this plan may run into many challenges in practice, as partnerships can run into issues with misaligned goals, reducing risk sharing efficiency (5). It also suffers from the same root challenges as NFIP, namely irrational behaviors in the face of risk and a wide range

of risk tolerances. This irrationality undermines both the economic implementation of NFIP, the new proposal, and even modeling of climate change for flooding itself, due to policy and economic uncertainty. Thus, it is important to construct economic and policy systems resilient to irrational actors in the face of external pressures.

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