

Redesigning Flood Insurance

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Insurance and government assistance play central roles in ensuring economic and social resilience in the aftermath of catastrophes in developed countries. Around the globe in the past decade, disasters have led to unprecedented claims payments to insured victims, and government relief to aid the uninsured and the affected communities has risen to historic levels (1–3). Increases in population, property values, and concentration of assets in hazard-prone areas are primary causes (2). Recent climate studies indicate we should also expect more extreme weather-related events in the future (4–6). The cumulative expected exposure of the U.S. government to catastrophes over the next 75 years could reach \$7 trillion (7).

We propose routes to improve flood insurance coverage through the U.S. National Flood Insurance Program (NFIP), one of the largest government disaster-insurance programs in the world. The U.S. Congress is discussing options for continuing the NFIP, which now operates under a 1-year extension, set to expire on 30 September 2011. The Federal Emergency Management Agency (FEMA), which is responsible for the NFIP, is reanalyzing the program. We argue that a new strategy for managing floods can increase personal responsibility, decrease risk, and lower government exposure. Improved scientific knowledge from a range of disciplines will be needed to price the proposed financial products appropriately. If successful in the United States, the approach could be explored by other countries.

Insuring Flood Risk

Floods are one of the most destructive hazards (8). In the United States, floods account for nearly two-thirds of all presidential disaster declarations over the period 1953–2010 (see supporting online material). Hurricanes Katrina, Rita, and Wilma and their resulting storm surge in 2005 cost over \$180 billion (2011 prices) (9). In the summer of 2010, one of the worst floodings in Pakistan's his-

tory affected more than 20 million people and inflicted \$8 billion to \$10 billion in recovery and reconstruction costs (10). China also experienced the worst floods in a decade, which cost \$50 billion (11). In December 2010, Australia suffered historical flooding.

Low-income countries typically rely on government and international aid to cope with major floods. As countries reach a higher level of economic development, insurance mechanisms are used more broadly. Flood insurance can be private, as in Germany and the United Kingdom. In the United States, residents purchase flood insurance mostly through the federally run NFIP, established in 1968 as a result of increased federal relief triggered by disasters in the 1960s and the insurance industry's refusal to cover this hazard because of their inability to accurately assess the risk (12). The NFIP covers \$1.2 trillion of property today (mainly in coastal states), over three times what was covered 20 years ago (13, 14).

NFIP premiums are established by the federal government. A homeowner can purchase building and contents coverage up to \$250,000 and \$100,000, respectively, but only if the community that he or she lives in participates in the program. This requires that a flood-risk map has been completed and that the appropriate public body has adopted adequate floodplain management regulations. Homeowners in high-risk areas (defined as "100-year" or "base" levels, expected to be flooded at least once every 100 years) are required to purchase coverage if they hold a federally backed mortgage.

Limits of the NFIP as Currently Designed

The absence of a large reserve has forced the NFIP into debt, as it has borrowed over \$19 billion from the U.S. Treasury to cover losses caused by the 2005 and 2008 hurricanes and floods (13). Subsidized insurance is part of the problem: Buildings that are near or below base flood elevation but that were in place before community flood-risk maps were completed are still charged rates that are considerably below the actuarial risk. This was

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Devastating losses require better insurance.

done originally to maintain property values. About one-fourth of insured properties are still subsidized that way (15, 16). And even properties constructed after flood mapping are charged premiums based only on an average historical loss year (17).

The NFIP has not been able to enroll and retain many homeowners exposed to flood risk. Recent studies show that insurance penetration in flood-prone areas remains only at about 50% (18, 19). This lack of coverage is likely to increase the need for disaster relief after major floods. This situation is not specific to the United States. In Germany, flood insurance penetration is only 10% for single-family homes (20). After the major 2002 Elbe floods, the German government provided the largest amount of public funds ever paid in the country's history to compensate uninsured flood victims. In China, only 1 to 2% of the \$50 billion losses of last year's floods were insured (11).

Do a large proportion of homeowners never buy coverage, or do many who once purchased insurance let their policies lapse? To answer this question, we analyzed all new policies issued by the NFIP over the period 1 January 2001 to 31 December 2009 ($n = 8.9$ million) (21). The median length of time before these new policies lapsed is 3 to 4 years. On average, only 74% of new policies were still in force 1 year after they were purchased; after 5 years, only 36% were still in place. The lapse rate is high even after correcting for migration and does not vary much across flood zones (21).

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Behavioral research can shed light on the underinsurance problem. As the probability of flood in a given year is low, individuals often treat these potential disasters as below their threshold level of concern. Studies on risk perception show that individuals do not understand low probabilities well and often simply ignore likelihood information when making decisions (22, 23). The language used to communicate risks is also a problem. Scientists often talk about a “100-year return flood,” but many individuals do not understand what that means. Some who have suffered a flood believe that they will not have another flood for 100 years. Homeowners are often myopic: If they paid insurance premiums for a few years but have not collected on their policy, they often view insurance as a bad investment and cancel their policy (12). Finally, there might be rational reasons for not purchasing coverage when this expense competes with other needs that have to be satisfied with a limited budget.

Better Tools for Disaster Financing

Our proposal for redesigning flood insurance has five prongs, to be implemented simultaneously because they complement each other. First, to account for myopic behavior, we recommend that flood insurance be sold not as 1-year contracts but as multiyear contracts (e.g., 5 or 10 years) that would be attached directly to the property at risk rather than to the homeowner (as is currently done). We propose that this be made mandatory for all homeowners in high-risk areas. To ensure that the requirement is enforced, FEMA could be empowered by Congress to monitor both existing and new construction in those areas. This reform will generate several benefits. It would avoid cancellation of insurance after just a few years. If a homeowner were to move to another location, the contract would be transferred to the new owner. As a result, many more properties will be covered and remain so over time. This should also increase the diversification of the NFIP’s portfolio.

Second, premiums must be risk-based for all, so that homeowners will be informed of the true exposure of their residence to potential flood damage.

Third, such insurance contracts could be complemented with multiyear home-improvement loans provided by the government or commercial banks to encourage investment in cost-effective risk-reduction measures, such as flood-proofing one’s house; the reduction in insurance premiums could offset the annual cost of the loan. The benefits of mitigation may also become more apparent over a 5- or 10-year period.

Fourth, we recommend a new flood insurance voucher program to address issues of equity and affordability to complement the strategy of risk-based premiums for all. Property owners currently residing in a high-risk zone who require special treatment would receive a voucher by the NFIP as part of its budget or through special appropriations. This program would be similar to the Supplemental Nutrition Assistance Program (“food stamps”) and the Low Income Home Energy Assistance Program, which in the United States assist millions of low-income households meet food and energy needs every year.

This proposal will require that building vulnerability be updated at policy renewal (every 5 or 10 years) and be reflected in the new premiums. Reevaluation of the flood hazard across the country will be needed over time to reflect hydrological changes due to factors such as additional runoffs caused by new construction, loss of wetlands, and possible effects of a changing climate (24).

Fifth, given the current level of U.S. public debt and the desire to lower taxpayers’ financial liability, we propose that the NFIP reduce its catastrophe exposure by purchasing private reinsurance and catastrophe bonds (13, 25). We recommend a four-layer approach. After the NFIP determines how much risk to retain, private reinsurers would provide coverage for a second layer of losses. Investors would then provide capital through catastrophe bonds to cover a third layer of losses. For truly exceptional events, the NFIP would utilize its borrowing capacity from the U.S. Treasury (fourth layer). Determination of these layers will be based on their price and how much exposure the program opts to retain or transfer.

Transparent measurement of risk exposure is critical. Sophisticated catastrophe-modeling techniques must be used to determine average annual loss, standard deviation, probable maximum loss, and other features that enter into the pricing of disaster risk-financing instruments. Catastrophe models developed by the scientific community can be used to update U.S. flood maps, as about half of the NFIP’s roughly 106,000 maps were more than 15 years old in April 2008 (26). Some steps have already been taken to address this problem. FEMA has begun to digitize flood maps using geographic information systems so that they are easier to update. After the failure of the New Orleans’ levee system in 2005, the U.S. Army Corps of Engineers began reevaluating levees throughout the United States using data from hydrology, climatology, soil science, and engineering. These studies have helped determine which levees no longer

meet the standards for which they had been designed. These developments in assessing risk more accurately could be useful in determining costs and benefits of the proposed redesign of flood insurance.

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Supporting Online Material

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