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CBO

The National Flood Insurance Program: Financial Soundness and Affordability

SEPTEMBER 2017

Notes

Except as noted, all monetary values are expressed in 2016 dollars, and all years are calendar years. (Federal fiscal years run from October 1 to September 30 and are designated by the calendar year in which they end.)

Numbers in the text, tables, and figures may not equal totals because of rounding.

Supplemental information accompanies this report on the Congressional Budget Office's website (www.cbo.gov/publication/53028).

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The National Flood Insurance Program: Financial Soundness and Affordability

Summary

The National Flood Insurance Program (NFIP) was established in 1968 to provide insurance that had proved difficult for the private sector to provide at affordable rates and to promote floodplain management. Authorization for the program, which is administered by the Federal Emergency Management Agency (FEMA), expires on September 30, 2017. Lawmakers have sought information from the Congressional Budget Office about the NFIP's financial soundness and its affordability for policyholders.

CBO analyzed roughly 5 million policies in effect on August 31, 2016, which approximate the policies currently in place. The agency assessed the program's financial soundness by comparing expected annual costs and premiums; expected costs included estimates of expected claims projected using commercially available models that simulate large numbers of potential flooding events along with their probability. To assess the NFIP's affordability for policyholders, CBO compared premiums with household income.

CBO's estimate of expected claims accounts for low-probability, high-cost events, such as Hurricane Harvey, which first made landfall in Texas one week before this report was published. As a result, the estimate is probably greater than actual costs would be in a typical year, although lower than costs could be in the aftermath of a catastrophic storm.

How Do Expected Costs Compare With Premiums?

The difference between the program's expected costs and premiums depends on which costs are considered. CBO estimated that overall, considering all expenditures and premium income, the program had an expected one-year shortfall of $1.4 billion. An alternative measure is the actuarial shortfall, which amounted to $0.7 billion, according to CBO's estimate. The actuarial shortfall compares premium income with the subset of costs associated with paying claims for existing policies and writing and servicing those policies; it excludes $0.7 billion for mapping floodplains, mitigating flood risk, and making interest payments on debt accumulated from previous claims.

What Accounts for the Estimated Program Shortfall?

The $1.4 billion estimated shortfall has two main sources:

- CBO's estimate of expected claims exceeds FEMA's estimate by about $1.0 billion. Because FEMA's estimate is its basis for premium setting, the difference between the two estimates causes premiums to fall $1.0 billion short of CBO's estimate of expected claims.

- The cost of providing discounted rates for certain policies is about $0.3 billion more than the receipts from surcharges created to help cover the costs of those discounts. The discounts are mainly for properties built before flood insurance rate maps (FIRMs) were developed. They are intended to prevent households from facing significant new costs that could impose hardship and cause some homeowners to forgo coverage.

The costs of activities other than writing, servicing, and paying claims for existing policies include the costs of mapping, mitigation assistance, and debt service—about $0.7 billion altogether. Offsetting those additional costs were collections of two charges paid by policyholders—a federal policy fee and a reserve fund assessment. (CBO's estimate of the actuarial shortfall excludes the costs of those activities but includes the premium income from those fees, along with all other sources of income.) On net, those costs and charges did not contribute to or reduce the program shortfall. They may not balance in the future, however. Moreover, although the reserve fund assessment can be accessed at any time and can be used to cover nonclaim costs, it was created to build a fund to pay claims in years when costs are particularly high.

How Do Coastal and Inland Counties Contribute to the Program Shortfall?

The difference between expected costs and premiums varies from one region to another. In particular, the overall shortfall of $1.4 billion is attributable largely to premiums' falling short of expected costs in coastal counties, which constitute roughly 10 percent of all counties with NFIP policies but account for three-quarters of all NFIP policies nationwide. Although some coastal counties generated surpluses of premiums over expected costs and some inland counties had shortfalls, the net shortfall measured over all coastal counties is $1.5 billion, whereas the net surplus measured over all inland counties is $200 million. A contributor to the coastal counties' shortfall is the fact that premiums on policies for most homes in those areas do not cover the expected cost of wave damage from storm surges.

How Might Expected Costs and Premiums Differ in the Future?

The estimates of expected costs and premiums in this analysis approximate those for the NFIP currently, but those costs and premiums will change over time. Some changes, such as increases in costs because of rising sea levels or increases in premium receipts attributable to the phaseout of discounted policies, would occur over years or decades. Other changes could occur more quickly. For example, CBO expects that the NFIP's interest payments to the Treasury (for borrowing to cover past claims) will increase because of a projected rise in interest rates.

How Does This Analysis Compare With CBO's Baseline Projections?

CBO makes regular 10-year projections of annual expenditures and receipts for the NFIP assuming that the program will continue to operate as specified in current law. CBO uses such baseline projections as a basis for estimating the budgetary effects of proposed legislation that would affect the program. In CBO's most recent baseline, for the 2018–2027 period, the NFIP's receipts are projected to fall short of expected claims and other costs by about $1 billion. That amount is likely to change as a result of Hurricane Harvey.

The baseline projections differ from the estimates in this report in two important ways. First, although this report reflects a snapshot of the annual expected costs and premiums associated with the policies in effect on August 31, 2016, CBO's baseline considers factors affecting costs and premiums that are likely to change over time, such as the share of policies that are discounted and their effects on the program's income and expenditures. Second, CBO's baseline projections are based on FEMA's estimates of expected claims and not on the estimates used for this analysis, which were derived from commercial models. (CBO is exploring the applicability of those models for future baseline estimates.)

What Does a Flood Insurance Policy Cost?

The median annual premium for residential coverage under an NFIP policy in effect on August 31, 2016, was $520. Those premiums varied significantly, however. The central two-thirds' range of the payments for such policies was $420 to $1,330. (That central two-thirds is often used to represent the most likely part of a range.) Premiums tend to be lower for primary residences than for others, in part because the annual surcharge of $250 for nonprimary residences and nonresidential properties is higher than the surcharge of $25 per year for primary-residence policies.

CBO's analysis of premiums compared with household income (with both approximated by the median values observed in each census tract) suggests that premiums for primary single-family homes generally amount to less than 1 percent of household income, although the percentage could be significantly higher for individual households. (CBO lacked the data to compare premiums with income for each household with an NFIP policy.) The agency also found that, on average, NFIP policyholders tend to live in census tracts in which median income is somewhat higher than median income averaged across all tracts.

How Might Alternative Policies Affect Three Competing NFIP Objectives?

This report outlines 12 policy approaches that would generally involve tradeoffs between varying objectives. Although some could be difficult to implement, each could help achieve at least one of three goals for the NFIP:

- *Improve solvency* by increasing premium income from policyholders in general, reducing the use of discounted rates, or increasing the share of costs borne by certain categories of policyholders or by taxpayers generally;

- *Better align premiums with risks* by reducing the use of subsidies, including discounted rates and cross-subsidies (in which some policyholders are charged rates that are higher than their expected claims so that other policyholders can pay rates that are lower than

their expected claims), or by adjusting premiums to better reflect underlying risk factors; or

- *Keep costs low for some policyholders* (perhaps while raising them for others) by targeting subsidies to low-income policyholders, shifting costs to taxpayers, or adjusting premiums to reflect the value of insured properties.

Goals and Activities of the National Flood Insurance Program

The NFIP was established by the National Flood Insurance Act of 1968 and was most recently reauthorized by the Biggert-Waters Flood Insurance Reform Act of 2012. The program serves two general purposes: to offer flood insurance for properties with significant flood risk and to promote floodplain management. Communities that volunteer to participate in the NFIP in order to have access to federal flood insurance must meet certain requirements, such as adopting minimum standards for building codes. The NFIP also seeks to reduce flood risk by offering mitigation grants to certain properties that are judged likely to incur damage.

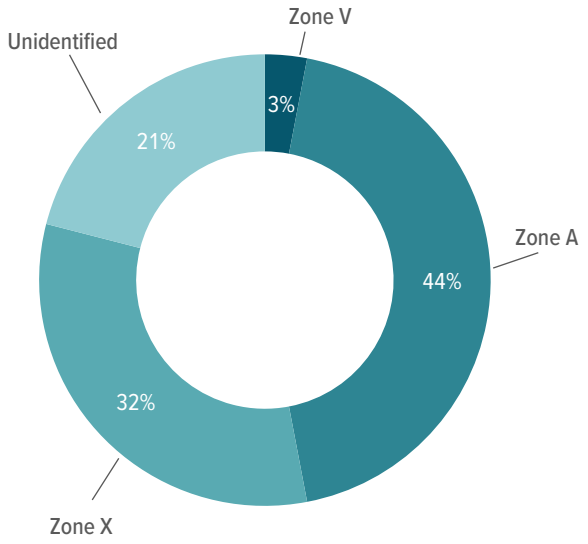
A cornerstone of FEMA's effort to promote floodplain management has been the development of the flood maps that inform communities of their flood risk and are the basis for insurance rates on most NFIP policies. FIRMs delineate three general zones of flood risk:

- Zone V designates a coastal area in which "velocity" wave action adds at least 3 feet to the water level that is reached in a 100-year flood (a flood with a water level that has a 1 percent annual probability of being reached);
- Zone A designates a 100-year floodplain (in which there is at least a 1 percent annual probability of flooding) not in Zone V; and
- Zone X designates any mapped area that is not inside a 100-year floodplain.

Owners of properties with federally guaranteed mortgages that are located in Zone V or Zone A must carry flood insurance. Other property owners may purchase flood insurance at their discretion. Most NFIP insurance policies are sold and serviced by private insurers under FEMA's Write Your Own program; however, those companies bear none of the risk associated with paying claims.

Figure 1.

Distribution of Policies Under the NFIP, by Type of Flood Zone



Source: Congressional Budget Office, using data from the Federal Emergency Management Agency.

The data encompass all 5.1 million NFIP policies in effect on August 31, 2016, for the 50 states, the District of Columbia, and the U.S. territories.

Policies are matched to flood zones on the basis of their location on the Federal Emergency Management Agency's collection of digital flood maps.

Zone V designates a coastal area in which "velocity" wave action adds at least 3 feet to the water level reached in a 100-year flood (the level of flooding that has a 1 percent annual probability of being reached). Zone A designates a 100-year floodplain (in which there is at least a 1 percent annual probability of flooding) not in Zone V. Zone X designates any mapped area that is not inside a 100-year floodplain. The "Unidentified" portion consists of policies that cover properties that are not included on digital flood maps or that did not list precise location information for the covered property.

NFIP = National Flood Insurance Program.

Using information from FEMA's digital flood maps, CBO identified the flood zones in which 79 percent of the 5.1 million properties with NFIP policies in effect on August 31, 2016, were located. Three percent of the policies were for properties located in Zone V, where flooded properties are likely to incur the greatest damage (see Figure 1), another 44 percent were for Zone A properties, and 32 percent were for Zone X properties.[1]

1. CBO had access to policy data for all 5.1 million policies in effect on that day, but the available estimates of flood risks covered only the 48 contiguous states and the District of Columbia. Therefore, this analysis of expected costs and premiums is based on that subset of 5.0 million policies.

The remaining properties could not be located because they were not included in FEMA's digital flood maps or because the policies covering them lacked precise location information.

Since the NFIP's inception, lawmakers have struggled to find the appropriate balance between applying actuarial principles (more closely linking rates and expected costs) and keeping premiums low. Actuarially sound rates would help communicate flood risk to homeowners and ensure the program's sustainability (see Box 1 for a discussion of actuarial soundness), but holding rates down could save policyholders from facing large new costs or rate increases that could impose financial hardship and depress property values, potentially causing some to forgo coverage. To balance those goals, the NFIP includes a mix of rates: full-risk rates that FEMA considers sufficient, on average, to cover (or more than cover) administrative costs and expected claims, and discounted rates that are not offset by higher rates charged to other policyholders.

The Congress has periodically altered the emphasis placed on achieving actuarial goals versus holding premiums down, as illustrated by two laws enacted in the past five years. The Biggert-Waters Flood Insurance Reform Act of 2012 pushed the program in the direction of better aligning policyholders' premiums with their actual flood risks by removing or accelerating phaseouts of discounted rates. Following that act's passage, lawmakers received testimony and letters expressing concern that elimination or phaseout would result in unreasonably high premiums and could cause disruption to communities. Subsequently, the Congress passed the Homeowner Flood Insurance Affordability Act (HFIAA) of 2014, which slowed or reversed some changes required under the Biggert-Waters Act.[2]

Comparison of Expected Costs and Premiums

Using its own estimate of expected claims, CBO found that for the 5 million policies active in August 2016 in the 48 contiguous states and the District of Columbia (which roughly approximate the set of policies currently in place), the NFIP's expected costs, totaled over each policy's one-year term, was $5.7 billion. Those costs exceed the $4.3 billion in premiums collected for each policy's one-year term (see Table 1).

Expected Costs

Of the total expected costs of $5.7 billion, $5.0 billion is for claims and administrative expenses associated with writing and servicing policies. The remaining $0.7 billion covers map preparation, grant-making to minimize flood damage in the future, and interest payments on debt owed to the Treasury.

Expected Claims. Expected claims, as estimated by CBO, total $3.7 billion and constitute the largest single component of expected costs. The magnitude of the expected claims depends on the flood risks faced by policyholders and the terms of their insurance contracts (coverage amounts and deductibles, for example). Expected claims are based on the full range of potential flooding events, weighted by their estimated probabilities. Because they account for the small probability that very costly events would occur, in most years, expected claims are higher than actual claims.

Over the past 35 years, claims have arisen for flooding from a variety of sources, as follows:[3]

- Hurricane-related storm surges (37 percent),
- Hurricane-related precipitation (16 percent),
- Inland flooding—primarily from rivers, streams, lakes, and ponds—not associated with the other categories (36 percent),
- Tropical storms (5 percent), and
- Other forms of flooding (2 percent), primarily nor'easters (coastal storms that typically affect the northeastern and mid-Atlantic states).

2. For a more detailed discussion, see Committee on the Affordability of National Flood Insurance Program Premiums, National Research Council, *Affordability of National Flood Insurance Program Premiums: Report 1* (National Academies Press, 2015), http://tinyurl.com/ya4b7wzd.

3. Estimates do not sum to 100 percent because claims payments include expenses that are not associated with a loss, such as the additional costs of servicing claims that are not reflected in the fees paid to private companies. See John Kulik and Andy Neal, "C-8: NFIP Update: Initial Steps Toward Sharing U.S. Flood Risk With the Private Sector, Presentation 1" (Casualty Actuarial Society, Seminar on Reinsurance, Boston, Mass., June 7, 2016), p. 4, http://tinyurl.com/yah7hf5o.

Box 1.

Defining Actuarial Soundness

Although the term *actuarial soundness* is in common use in the insurance industry and in discussions of public insurance programs (such as Social Security), its specific definition depends on context. In this report, the Congressional Budget Office uses the term to mean the adequacy of premiums charged by the National Flood Insurance Program (NFIP) to cover both the expected costs of flood claims and the administrative costs associated with issuing and servicing flood insurance policies. When income from premiums is too low to cover those costs, an *actuarial shortfall* is said to exist.[1]

As used in this report, actuarial soundness does not account for the economic cost of the risk that the NFIP imposes on taxpayers. For private insurance, premiums would be designed to compensate investors for that risk as well as covering the costs of expected claims and writing and servicing policies. The NFIP's premiums include other charges—the federal policy fee, a reserve fund assessment, and a surcharge required under the Homeowner Flood Insurance Affordability Act of 2014—that do not have direct counterparts in private insurance. Therefore, premiums that this report considers actuarially sound might be high enough that private insurers could compete with the NFIP for at least some policies.[2]

Actuarial soundness as used here also is not the same as *financial sustainability*, which CBO defines in this case as the result of premiums that equal or exceed all expected costs. In particular, achieving financial sustainability would require that premiums cover the costs of program activities that are unrelated to underwriting the current set of flood insurance policies: floodplain mapping and management, mitigation assistance, and payments of interest on the debt owed to the Treasury. Accounting for those costs yields a *program shortfall* that exceeds the NFIP's actuarial shortfall.

Because this report is based on the NFIP's costs for the fiscal year that ended September 30, 2016, it does not consider the reinsurance purchased by the Federal Emergency Management Agency (FEMA) in January 2017.[3] It is unclear whether reinsurance should be viewed as directly related to providing flood insurance or as resulting from other policy objectives, such as stabilizing the program's costs or reducing the need to borrow from the Treasury. If viewed as directly related to providing flood insurance, the net cost of reinsurance—the premium FEMA paid for it less the expected payout for claims—would count toward estimates of the actuarial shortfall. If viewed as achieving other objectives, the net cost would count toward the program shortfall but not toward the actuarial shortfall. If FEMA increased its rates for flood insurance to offset some or all of the cost of reinsurance, the additional income would reduce both the actuarial and the program shortfall. Increases in FEMA's rates to offset the cost of reinsurance—a cost that reflects the returns required by the companies to provide the reinsurance—would also bring the rates closer to those that private insurers would charge.

1. In contrast, an earlier CBO report on the NFIP defined actuarial soundness as inclusive of all program costs, among them the costs of floodplain mapping, management, and mitigation assistance and payments to the Treasury on the NFIP's debt. That report focused on the Federal Emergency Management Agency's methods for estimating expected claims costs; it did not quantify any net shortfall, so the conceptual inclusion or exclusion of other costs was immaterial. See Congressional Budget Office, *The National Flood Insurance Program: Factors Affecting Actuarial Soundness* (November 2009), www.cbo.gov/publication/41313.

2. Private insurers provide some flood insurance coverage in the United States, but primarily through policies that complement rather than substitute for NFIP coverage.

3. Reinsurance is purchased by private or public insurance providers to protect against unusually large losses. In 2012 and 2014, the Congress authorized reinsurance purchases for FEMA, which is using reinsurance to cover some of its losses from any 2017 single flood event that results in more than $4 billion in claims.

Table 1.

One-Year Expected Costs and Premiums for the NFIP

Billions of Dollars

Expected Costs	
Costs Associated With Writing and Servicing Policies	
Expected claims	3.7
Payments to companies selling and servicing policies	1.1
Salaries and operating expenses	0.2
Subtotal	5.0
Additional Costs	
Floodplain mapping and management	0.2
Mitigation assistance	0.2
Interest on debt[a]	0.3
Subtotal	0.7
Total	**5.7**
Premiums	
Rate-Based Receipts[b]	3.3
Additional Charges	
Reserve fund assessment[c]	0.5
Surcharges[d]	0.4
Federal policy fee[e]	0.2
Subtotal	1.1
Total	**4.3**

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency and Guy Carpenter and Company.

The data encompass 5.0 million NFIP policies in effect in the 48 contiguous states and the District of Columbia on August 31, 2016. Alaska, Hawaii, and the U.S. territories were excluded from the analysis because of the lack of estimates of expected claims.

Expected costs and premiums exclude increased cost of compliance coverage, which helps policyholders with significant or repeated flood damage to bring their properties into compliance with local regulations for floodplain management. Any imbalance between the $59 million collected for that coverage and the associated payments would be too small to affect the analysis.

NFIP = National Flood Insurance Program.

a. Interest payment on debt accumulated from previous claims.

b. Policyholders' payments, excluding additional assessments, surcharges, and fees.

c. Assessment to establish and maintain a reserve fund to cover debt expenses and future claims, especially from catastrophic disasters.

d. The annual surcharge of $25 for primary residences and $250 for all other properties that was established by the Homeowner Flood Insurance Affordability Act of 2014.

e. Covers some administrative and floodplain-mapping costs.

Hurricane-related storm surges and inland flooding accounted for nearly three-quarters of NFIP claims in the past. CBO constructed county-level estimates of the expected value of such claims in the future, using two types of information provided by FEMA. First, CBO used gross loss estimates that were commissioned by FEMA as it prepared to purchase commercial reinsurance.[4] Gross losses are estimates of the expected amount of covered damage that properties insured under the program would incur, but they do not include loss adjustment expenses, which are related to investigating and adjusting the claims filed by policyholders. Next, on the basis of information provided by FEMA on the ratio of loss adjustment expenses to gross losses, CBO constructed estimates of expected claims costs by adding 5.4 percent to the estimate of annual gross losses. (For brevity, this report uses *expected claims* to mean gross losses plus adjustment expenses.)

The estimates of gross losses from hurricane-related storm surges and inland flooding, which FEMA commissioned and CBO used, were constructed by applying policy-specific information about property value, coverage, and deductibles to estimates of flood damage produced by three commercially available models used widely in the private and public sector.[5] The estimates of property damage from coastal storm surges were derived from two models: One led to an estimate of expected claims from storm surges of $1.7 billion; the other led to an estimate of $1.8 billion. Because of the estimates' similarity, CBO averaged them for its analysis.[6] The estimates of property damage from inland flooding were based on the results of a single model.

4. Those losses were estimated by Guy Carpenter and Company, a reinsurance intermediary that advises businesses and governments.

5. Guy Carpenter developed the estimates of gross losses from storm surges by applying policy-specific information to estimates of damage produced by models developed by AIR Worldwide and Risk Management Solutions. Guy Carpenter developed estimates of gross losses from inland flooding by applying policy-specific information to estimates of damage produced by an inland flood model developed by AIR Worldwide.

6. State- and county-level results from the models also were similar. For example, if one showed that expected claims from a storm surge in a given state, such as Florida, exceeded expected claims from a storm surge in another state, such as Maine, the other model tended to show that as well. The Pearson correlation coefficients (which indicate the linear correlation between two variables) for the models' estimates of expected storm surge claims were .98 at the state level and .84 at the county level.

Commercial models of flood risks resulting from precipitation from hurricanes and tropical storms are not available, however, so CBO developed its own estimates using information from several sources (see Appendix A for details). Over the past 35 years, such precipitation has accounted for more than 20 percent of claims.

Additional Costs. In fiscal year 2016, the NFIP incurred costs in three areas that are not associated with paying claims or writing and servicing existing policies: First, it spent $0.2 billion to develop flood-risk maps, or FIRMs. FEMA develops FIRMs in coordination with participating communities, and the maps serve as the basis for setting flood insurance rates. FEMA also spent about $0.2 billion on its Flood Mitigation Assistance grant program, which offers assistance to governments for state and local mitigation planning; helps policyholders raise, relocate, demolish, or flood-proof structures; and pays for the acquisition of property. Finally, FEMA paid the Treasury $0.3 billion in interest. Under current law, FEMA can borrow up to $30.4 billion from the Treasury to operate the NFIP.[7] As of the date of publication of this report, the agency owed $24.6 billion, leaving $5.8 billion in remaining borrowing authority.[8] Although FEMA's debt cannot be directly attributed to any single incident, the program was forced to borrow heavily to pay claims in the aftermath of the 2005 hurricane season (which included Hurricanes Katrina, Rita, and Wilma) and the 2012 season (which included Hurricane Sandy). The current debt includes $1.6 billion that the NFIP borrowed in January 2017. CBO allocated those additional costs to counties on the basis of a county's share of the total number of policies.

Premiums

Of the $4.3 billion total in premiums collected for the 5 million policies considered in this analysis, about $3.3 billion stems from the portion that is based on the rates that FEMA sets for insurance coverage. An additional $1.1 billion is collected, as follows:

- $0.5 billion from an assessment that is intended to establish and maintain a reserve fund to cover future claims and debt expenses, especially from catastrophic disasters;
- $0.4 billion from surcharges intended to offset part of the cost of providing discounted rates to some policyholders; and
- $0.2 billion from a federal policy fee intended to cover some costs of administration and floodplain mapping.[9]

The Difference Between Expected Costs and Premiums

The difference between the expected costs and premiums of the 5 million policies that CBO analyzed depends on which components of the two are considered; inclusion of different components may be relevant for different purposes. CBO assessed several measures of the difference, and for each, the agency found that premiums fall short of expected costs.

Program Shortfall. Comparing the $5.7 billion of total expected costs for the NFIP with the $4.3 billion of total premiums indicates a shortfall of $1.4 billion for the program as a whole. That comparison of total expected costs with total premiums is the basis for the regional estimates described below.

Actuarial Shortfall. The NFIP's actuarial shortfall measures the difference between the program's total premiums (including all additional charges) and the program's costs associated with paying claims on existing policies and with writing and servicing those policies. The agency estimates an actuarial shortfall of $0.7 billion for the 5 million policies, reflecting the difference between $4.3 billion collected in premiums and $5.0 billion to cover costs related to existing policies.

Alternative Measures. Other comparisons of expected costs and premiums could be relevant as well:

- A comparison that focused on the costs of current policies and floodplain-related activities but did not

7. The authorization for borrowing drops to $1.5 billion after September 30, 2017, when the program's current legislative authorization expires. If the NFIP is not reauthorized by that date, it will still be able to pay claims on current policies from funds on hand, but it will not be able to borrow additional funds, renew policies, or issue new ones.

8. Those amounts are likely to change as a result of Hurricane Harvey, which made landfall in Texas on August 25, 2017.

9. FEMA also receives funding for mapping through an appropriation from general revenues: The Congress appropriated $190 million in fiscal year 2016 and $178 million in fiscal year 2017 for the budget account for flood hazard mapping and risk analysis.

account for interest paid on the debt resulting from past claims would indicate a shortfall of $1.1 billion.

- A comparison that did not count income from the reserve fund assessments toward the amount of premiums that were available to pay annual expected costs might better account for policymakers' goal of building up and maintaining a reserve fund in addition to covering those annual expected costs. Excluding collections from the reserve fund assessments ($0.5 billion from the 2016 policies) would increase the program shortfall to $1.9 billion and the actuarial shortfall to $1.2 billion.

- A comparison of the $5.0 billion in costs associated with paying expected claims for the 5 million policies and writing and servicing those policies with the $3.3 billion in rate-based receipts (that is, policyholders' payments excluding additional assessments, surcharges, and fees) would yield a shortfall of $1.7 billion.

- A comparison of the total expected cost of $5.7 billion with the $3.3 billion in rate-based receipts yields a shortfall of $2.4 billion. Such a comparison would be particularly relevant if the NFIP maintained responsibility for all of its current activities and no longer collected the additional charges.

Sources of the Program's Expected Shortfall

Two primary factors contribute to the $1.4 billion expected program shortfall estimated in this analysis:

- The roughly $1.0 billion difference between the expected claims estimated by CBO for the 5 million policies analyzed and FEMA's estimate of expected claims, which were used to determine the premiums for those policies; and

- The roughly $0.3 billion difference between the $0.7 billion cost of charging discounted rates for certain policies and the $0.4 billion in receipts from a surcharge intended to help cover the cost of the discounts.[10]

The $1.4 billion program shortfall estimated in this analysis is based on CBO's $3.7 billion estimate of expected claims, and it accounts both for the cost of the discounted rates and for the related surcharge. CBO also estimated the program shortfall under two alternative policies regarding the discounted rates: one in which discounts would be eliminated (that is, in which all policyholders paid rates that FEMA considered to be full risk) and the related surcharge would be kept in place and another in which both the discounts and the surcharge would be eliminated. Because of the uncertainty surrounding estimates of expected claims, CBO analyzed the same scenarios using FEMA's estimates (see Table 2).

Differences in Expected Claims as Estimated by CBO and FEMA

CBO's $3.7 billion estimate of expected claims is $1.0 billion more than FEMA's estimate of $2.7 billion.[11] Because FEMA's estimate is used to set the NFIP's rates, there is a substantial gap between CBO's estimate of the program's expected costs (including the $3.7 billion estimate of expected claims) and premiums. Using FEMA's estimate (and retaining both the discounted rates and the related surcharge) would reduce the estimate of the NFIP's shortfall to $0.3 billion.

As described below, all estimates of flood damage—and the resulting estimates of expected claims—are inherently uncertain, and CBO cannot determine whether its estimate is more accurate than FEMA's. In particular, the two estimates cannot be evaluated by comparing them with past claims because floods are not cyclical or predictable and the amount of damage that they produce can depend on a variety of factors. In addition, extremely

10. As explained later, the estimate of the net cost of the discounted policies is based on FEMA's estimate of expected claims. The roughly $1.0 billion difference between FEMA's and CBO's estimates covers the discounted policies as well as those insured at FEMA's full-risk rates. An alternative breakdown of the $1.4 billion program shortfall would start with the cost of the discounted policies relative to CBO's estimate of expected claims (more than $0.3 billion) and then add the difference between CBO's and FEMA's estimates of expected claims for the full-risk policies (less than $1.0 billion).

11. FEMA does not report that estimate of expected claims. CBO used four types of information to calculate it: rate-based receipts for the full-risk and discounted policies that it analyzed ($1.9 billion and $1.3 billion, respectively) and FEMA's estimates, as of September 30, 2016, of the percentage of those receipts that pay for claims (rather than covering the writing and servicing of policies) and of the average percentage value of the subsidy for the discounted policies (65 percent and 40 percent, respectively). Those figures imply that total expected claims are equal to 0.65 * ($1.94 billion + $1.32 billion / (1 – 0.4)) = $2.7 billion.

Table 2.

One-Year Expected Costs and Premiums Under Alternative Scenarios for the NFIP

Billions of Dollars

Scenario	Expected Costs			Premiums				Program Shortfall (-) or Surplus
	Expected Claims[a]	Other Costs[b]	Total	Rate-Based and RFA Receipts[c]	Surcharge[d]	Federal Policy Fee	Total	
Based on CBO's Expected Costs								
Retain Discounted Rates and Related Surcharge (Reference case)	3.7	1.9	5.7	3.7	0.4	0.2	4.3	-1.4
Eliminate Discounted Rates and Retain Related Surcharge	3.7	2.2 [e]	6.0	4.7	0.4	0.2	5.3	-0.7
Eliminate Discounted Rates and Related Surcharge	3.7	2.2 [e]	6.0	4.7	n.a.	0.2	4.9	-1.1
Based on FEMA's Expected Costs								
Retain Discounted Rates and Related Surcharge	2.7	1.9	4.6	3.7	0.4	0.2	4.3	-0.3
Eliminate Discounted Rates and Retain Related Surcharge	2.7	2.2 [e]	4.9	4.7	0.4	0.2	5.3	0.4
Eliminate Discounted Rates and Related Surcharge	2.7	2.2 [e]	4.9	4.7	n.a.	0.2	4.9	0

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency and Guy Carpenter and Company.

The data encompass 5.0 million NFIP policies in effect in the 48 contiguous states and the District of Columbia on August 31, 2016. Alaska, Hawaii, and the U.S. territories were excluded from the analysis because of the lack of estimates of expected claims.

Expected costs and premiums exclude increased cost of compliance coverage, which helps policyholders with significant or repeated flood damage to bring their properties into compliance with local regulations for floodplain management. Any imbalance between the $59 million collected for that coverage and the associated payments would be too small to affect the analysis.

FEMA = Federal Emergency Management Agency; NFIP = National Flood Insurance Program; RFA = reserve fund assessment; n.a. = not applicable.

a. CBO's estimates of expected claims are based largely on commercial models used in an analysis that was commissioned by FEMA. FEMA does not report its own estimate of expected claims; CBO determined the estimate shown on the basis of information supplied by FEMA. The text and Appendix A provide more details on CBO's and FEMA's approaches.

b. "Other Costs" consist of non–claims-related costs, including payments to companies that sell and service policies, and costs in FEMA's 2016 budget that are not related to individual policies.

c. If the discounted rates were eliminated, rate-based receipts would increase by the amount of the subsidy cost plus the amount needed to cover the increased payments to the companies that sell and service policies. Those amounts would total $882 million, by CBO's estimates. RFA receipts would increase by an estimated $132 million because they are proportional to rate-based receipts.

d. The annual surcharge of $25 for primary residences and $250 for all other properties was established by the Homeowner Flood Insurance Affordability Act of 2014. Collections of that surcharge will continue until all discounts are eliminated.

e. "Other Costs" are higher in the scenarios without discounted rates because of increased payments to the companies that sell and service policies. Higher premiums paid on the currently discounted policies would cover those increased payments.

costly floods occur only infrequently. A potential advantage of the modeling approach underlying CBO's estimate of expected claims is that it relies less heavily on historical data that may not accurately reflect current conditions or represent the full potential risk of catastrophic events.

Sources of Uncertainty in Predicting Flood Damage. Predicting flood events and the resulting damage is difficult for many reasons, including the following:

- Storms that create flooding occur sporadically, and their frequency depends on complicated, and not fully understood, interactions among a multitude of factors. For example, scientists are seeking to better understand how climate change might affect sea surface temperatures and wind shear and how those changes, in turn, could affect the frequency and intensity of hurricanes.[12]

- Specific features of a storm (for example, whether a storm surge occurs during a high or low tide) can have a large influence on the severity of flooding.

- Two locations with the same amount of rainfall can have different probabilities and severities of flooding because of differences in topography, such as the slope and permeability of surrounding land.

- Two locations with the same amount of flooding can have different amounts of damage because of differences in the extent to which they are developed.

- Structure-specific features (such as the value of a home or the quality of its construction) affect the amount of expected flood-related claims.

Implications of Uncertainty for Modeling Expected Claims. Because of challenges in predicting flooding and the ensuing damage, different models may produce different estimates of expected claims under similar climatic conditions and for the same set of insured properties. CBO has no basis for assessing the accuracy of the models used in its analysis, although the models have been in wide use elsewhere: FEMA used them in 2016, for example, to assess its aggregate risk exposure. Despite that, FEMA does not currently use the models to set its premium rates. Instead, FEMA relies on other information and methods (see Box 2), although it currently is considering revising its rate-setting method to make use of the same type of commercial models that CBO used for this analysis.[13]

According to an April 2017 report from the American Academy of Actuaries, the modeling tools available for estimating catastrophic risk in general and flood risk in particular (the types of tools used in CBO's analysis) have improved in recent years, thanks in part to general improvements in computer technology that allow more sophisticated simulation modeling and in part to the expanding quantity of data on property and hazard characteristics.[14] That report notes, however, that the data, maps, and models for coastal events are more developed than are those for inland floods.[15]

Despite recent improvements, estimates derived from commercial models, particularly estimates of gross losses from inland flooding, remain highly uncertain. For example, on the basis of an analysis of the modeled estimates of gross losses from inland flooding, the company that compiled those estimates advised CBO that a 50 percent reduction in the estimates could be justified. CBO's estimates incorporate such an adjustment. Using the original results of the inland flood model (that is, without that 50 percent adjustment) would have increased the estimate of expected claims by $1.0 billion (to $4.7 billion). By contrast, using a measure of expected claims that was consistent with FEMA's rate

12. See Congressional Budget Office, *Potential Increases in Hurricane Damage in the United States: Implications for the Federal Budget* (June 2016), www.cbo.gov/publication/51518.

13. FEMA has issued a request for information on industry capability in the area of catastrophic risk rating and classification, design and testing of risk-rating models, and implementation of alternative models. See Federal Emergency Management Agency, "NFIP Risk Rating and Classification Capabilities" (January 2017), https://go.usa.gov/xRbqF. FEMA's risk assessment and rate-setting methods have been criticized. See General Accounting Office, *Continued Progress Needed to Fully Address Prior GAO Recommendations on Rate-Setting Methods* (March 2016), www.gao.gov/products/GAO-16-59, and *FEMA's Rate-Setting Process Warrants Attention* (October 2008), www.gao.gov/products/GAO-09-12.

14. American Academy of Actuaries, Flood Insurance Work Group, *The National Flood Insurance Program: Challenges and Solutions* (April 2017), p. 38, http://tinyurl.com/yay6h88d.

15. Ibid., p. 45.

Box 2.

Comparison of CBO's and FEMA's Methods of Estimating Expected Claims

Estimates of expected flood insurance claims under the National Flood Insurance Program (NFIP) require two types of information: data about policies (deductibles and coverage limits, for example) and estimates of expected damage from floods.[1] Damage estimates also require two types of information: estimates of the likelihood of a flood of any particular degree of severity and vulnerability functions that specify the amount of damage associated with a flood of a given severity. Differences between the Congressional Budget Office's estimates of expected claims and those of the Federal Emergency Management Agency (FEMA) are not attributable to differences in data about insurance policies (CBO had access to FEMA's data for all policies in effect on August 31, 2016). Instead, the differences arise from the methods that CBO and FEMA use to estimate the likelihood and the effects of floods.

CBO's damage estimates in two main categories—flooding caused by storm surges from hurricanes and inland flooding—are directly based on modeled simulations. (See Appendix A for details of the methods CBO used for all categories of flood damage.) For example, the damage attributable to storm surges is estimated on the basis of tens of thousands of simulations in which storms of various strengths make landfall at the frequencies observed over the past 100 years—if not necessarily at the same locations or following the same paths (all simulations represent plausible cases, however).[2] The simulations generate a set of probabilities for all potential floodwater depths and levels of wave action.

For its part, FEMA derives its estimates of flood probabilities not from simulations of possible future events, but from historical analyses of floods. In particular, for each of two zones in which the annual chance of flooding is at least 1 percent (designated Zones A and V), FEMA analyzes flood data for communities in six topographical groups, ranging from plateaus to valleys, applying statistical methods to estimate the probability for each group that any given flood depth would be met or exceeded.[3] For each zone, FEMA combines the six curves into a weighted national average curve on the basis of estimates of the shares of NFIP policies in each of the six groups.

CBO's and FEMA's estimates of the relationship between floods of different severity and the resulting damage—the vulnerability functions—are derived using similar methods. CBO's estimates use functions that reflect observations compiled by the Army Corps of Engineers from major U.S. floods and adjustments that account for the effects of building height and type. The functions are calibrated and validated using historical claims data. FEMA's vulnerability functions reflect its own analyses of how best to combine claims experience and the Corps of Engineers' observations.

1. Expected claims also include loss adjustment expenses (that is, the costs of investigating and settling insurance claims), which are not discussed here.

2. Two independent sets of simulations, which led to similar estimates of damage from storm surges, were produced by the modeling companies Risk Management Solutions and AIR Worldwide. Guy Carpenter and Company used the simulations to generate county-level estimates of expected losses for all properties and of expected claims for NFIP-insured properties.

3. More precisely, each curve represents a set of probabilities that flood depths will exceed or fall short of the base flood elevation (BFE) by various amounts. (The BFE is the water depth that has a 1 percent annual probability of being reached in a flood.) Thus, for example, one curve might indicate a 0.6 percent annual probability of flood waters that exceed the local BFE by 1 foot or more and a 0.2 percent probability of exceeding the BFE by 2 feet or more, regardless of whether the local BFE itself is 2.0 feet or 3.5 feet. For more detail, see Congressional Budget Office, *The National Flood Insurance Program: Factors Affecting Actuarial Soundness* (November 2009), www.cbo.gov/publication/41313.

setting would reduce expected claims by $1.0 billion, to $2.7 billion.

The Cost of Discounted Rates

The discounting of rates for some flood insurance policies also contributes to the NFIP's shortfall. Lawmakers incorporated rate discounts into the NFIP's 1968 founding legislation as a way to provide coverage at affordable rates and to encourage widespread participation among property owners. Discounts are applied to about 20 percent of the 5 million policies that CBO analyzed, mostly for properties that were built before the creation of a local flood map. (See Appendix B for more detailed descriptions of subsidies in the NFIP.)

On the basis of information provided by FEMA, CBO estimates a net cost of roughly $0.7 billion for the policies that are issued at rates other than FEMA's estimates of full-risk rates.[16] Thus, estimating the program shortfall using CBO's estimate of expected claims, but replacing all discounted rates with rates that FEMA would consider full risk, would cut the program shortfall in half if the surcharge to cover the discounts was kept in place (see Table 2 on page 9). However, under current law, the surcharge would not apply if the discounts were eliminated.

The surcharge yielded $0.4 billion in 2016; if both the discounts and the surcharge were eliminated, the shortfall would be reduced by $0.3 billion, from $1.4 billion to roughly $1.1 billion, using CBO's estimate of expected claims.

Based on FEMA's lower estimate of expected claims, eliminating the discounted rates but keeping the surcharge would result in a program surplus of $0.4 billion. Eliminating both would cause expected costs to equal premiums.

Regional Differences in Comparisons of Expected Costs and Premiums

In addition to estimating the difference between expected costs and premiums for the NFIP as a whole, CBO identified the difference for the District of Columbia and each county in the 48 contiguous United States. Although there is considerable uncertainty about estimates of expected costs, CBO's analysis resulted in the following findings:

- The NFIP shows a surplus (with premiums that exceed expected costs) in most counties that is outweighed by large shortfalls in a smaller group of counties;
- Small groups of counties account for the bulk of total shortfalls and total surpluses; and
- On net, coastal counties show a large shortfall and inland counties show a relatively small surplus.

Distribution of Shortfalls and Surpluses

The NFIP had a shortfall in about one-fourth of all 2,984 counties that CBO analyzed; the program had a surplus in the rest of the counties. CBO estimates that the largest shortfall was $251 million and the largest surplus was $30 million; the shortfalls totaled $2.0 billion, whereas the surpluses amounted to $0.6 billion. For most counties, the difference between premiums and expected costs was small. In more than 1,900 counties, or roughly two-thirds, the difference between premiums and expected costs yielded a shortfall of less than $35,000 or a surplus of less than $85,000.

Concentration of Shortfalls. CBO estimates that the 33 counties with a shortfall of more than $10 million accounted for nearly 90 percent of the $2 billion total from all 823 counties with shortfalls (see Table 3). Those 33 counties, which are located mostly along the southeast coast and the Gulf of Mexico (see Figure 2), had both large numbers of policies (41 percent of all NFIP policies) and high average shortfalls per policy ($840, compared with $220 for the 790 counties with smaller shortfalls).

16. That figure includes about $0.6 billion for the portion of the forgone rate-based receipts that otherwise would have been available to pay claims and about $0.1 billion in forgone reserve fund assessments. Using the same information cited above, CBO calculated forgone rate-based receipts as follows: $1.32 billion [rate-based receipts from the discounted policies CBO analyzed] * 0.65 [FEMA's estimate of the rate-based receipts available to pay claims rather than for policy sales and servicing] * (1/0.6 – 1) [reflecting FEMA's estimate that the receipts available to pay claims represent 60 percent of expected claims on the discounted policies] = $0.57 billion.

    Payments by the federal government to the insurance companies that sell and service NFIP policies, which are determined as a percentage of each premium, would increase by $0.3 billion if all policyholders were charged full-risk rates. Because that $0.3 billion would not be available to pay claims or build reserves, it is not included in CBO's estimate of the discounts' net cost to FEMA.

Table 3.

Contribution of Selected Counties to the Overall One-Year Shortfall in the NFIP

	Counties With Shortfalls			Counties With Surpluses		
	Less Than $10 Million	More Than $10 Million	Total	Less Than $2 Million	More Than $2 Million	Total
Number of Counties	790	33	823	2,102	59	2,161
Percentage of All U.S. Counties[a]	25	1	26	68	2	70
Total Shortfall (-) or Surplus (In millions of dollars)	-270	-1,720	-1,990	270	370	640
Percentage of Total Shortfall	13	87	100	n.a.	n.a.	n.a.
Percentage of Total Surplus	n.a.	n.a	n.a.	42	58	100
Percentage of All NFIP Policies	24	41	65	19	16	35
Average Per-Policy Shortfall (-) or Surplus (In dollars)	-220	-840	-610	280	480	370

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency, Guy Carpenter and Company, and Risk Management Solutions.

The data encompass 5.0 million NFIP policies in effect in the 48 contiguous states and the District of Columbia on August 31, 2016. Alaska, Hawaii, and the U.S. territories were excluded from the analysis because of the lack of estimates of expected claims.

Shortfall and surplus amounts represent the difference between one year's expected costs and premium revenue. Expected costs consist primarily of expected claims payments as estimated by CBO. Other costs associated with writing and servicing claims, funding for floodplain mapping, mitigation of flood risk, and interest payments on the program's debt are apportioned to counties on the basis of their shares of policies.

Calculations of shortfalls and surpluses exclude increased cost of compliance coverage, which helps policyholders with significant or repeated flood damage to bring their properties into compliance with local regulations for floodplain management. Any imbalance between the $59 million collected for that coverage and the associated payments would be too small to affect the analysis.

NFIP = National Flood Insurance Program; n.a. = not applicable.

a. Figures do not total 100 percent because no NFIP policies had been written in 4 percent (124 of 3,108) of the counties and county equivalents in the District of Columbia and the 48 contiguous states.

Concentration of Surpluses. The surpluses also were geographically concentrated, although not as much as the surpluses. CBO estimates that 59 counties with surpluses of more than $2 million accounted for roughly 60 percent of the $0.6 billion total from all 2,161 counties with surpluses. Those 59 counties, mainly located along the northeast and west coasts, contained 16 percent of all NFIP policies. Their average surplus per policy was $480 compared with $280 for the roughly 2,100 counties with smaller surpluses.

Comparison of Coastal and Inland Counties

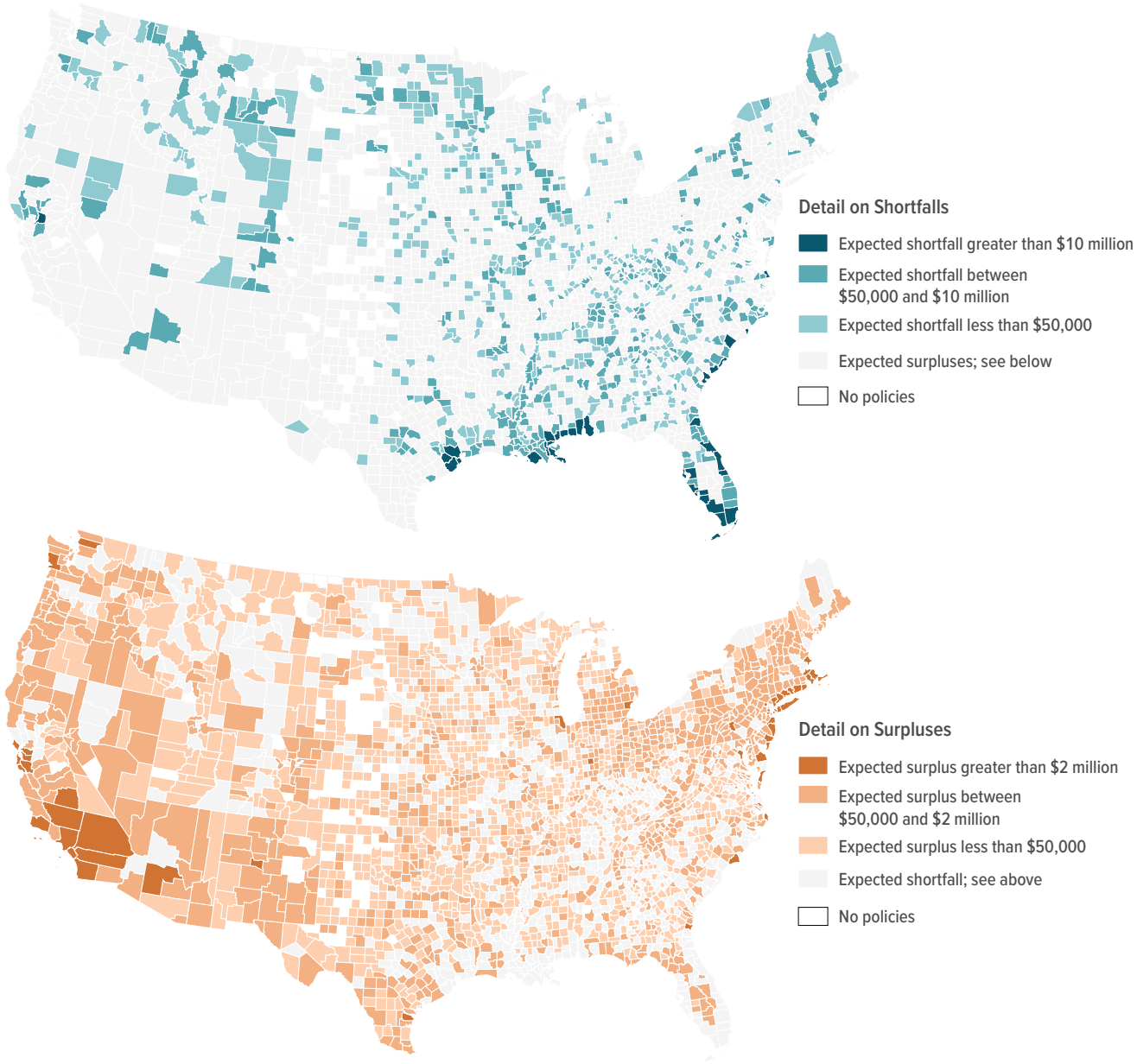
CBO examined the contributions of coastal and inland counties to the $1.4 billion difference between total expected costs and premiums. The agency estimates that the shortfall for the NFIP program as a whole stems largely from premiums' falling short of expected costs in coastal counties, rather than in inland counties. Although some coastal counties generated surpluses and some inland counties contributed to the aggregate shortfall, on the whole, coastal counties generated a shortfall that was greater than the aggregate shortfall, and inland counties generated a small surplus.

Coastal Shortfalls and Inland Surpluses. Counties that CBO defined as coastal for this analysis—those with at least some expected claims from storm surges or for which precipitation from coastal storms (hurricanes, tropical storms, and nor'easters) accounted for more than 75 percent of expected claims—represented only 10 percent of all counties with NFIP policies.[17] However, they accounted for most of the program's total shortfall. Specifically, the gap between premiums and expected claims totaled across all coastal counties was

17. CBO also included as coastal 10 counties for which estimated damage from storm surges was zero for properties currently insured under the NFIP but was positive for the county as a whole (including damage to uninsured properties or damage to insured properties that was too minor to result in claims, see Appendix A).

Figure 2.

NFIP Expected Shortfalls and Surpluses, by County



Source: Congressional Budget Office, using data from the Federal Emergency Management Agency, Guy Carpenter and Company, and Risk Management Solutions.

The data encompass 5.0 million NFIP policies in effect in the 48 contiguous states and the District of Columbia on August 31, 2016. Alaska, Hawaii, and the U.S. territories were excluded from the analysis because of the lack of estimates of expected claims.

The shortfalls and surpluses represent the difference between expected costs and premiums. Expected costs consist primarily of CBO's estimate of expected claims payments for each county. Other costs associated with writing and servicing claims, funding for floodplain mapping, mitigation of flood risk, and interest payments on the program's debt are apportioned to counties based on their shares of policies.

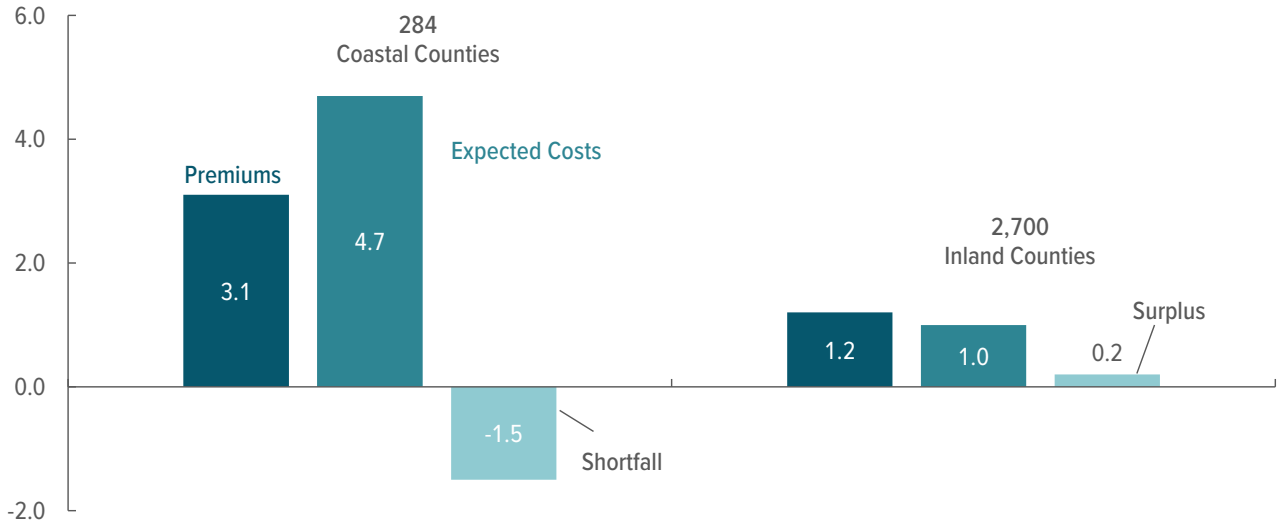
Calculations of surpluses and shortfalls excluded the increased cost of compliance coverage, which helps policyholders with significant or repeated flood damage to bring their properties into compliance with local regulations for floodplain management. Any imbalance between the $59 million collected for that coverage and the associated payments would be too small to affect the analysis.

NFIP = National Flood Insurance Program.

Figure 3.

One-Year Premiums, Expected Costs, and Shortfall or Surplus, by Location, for the NFIP

Billions of Dollars



Source: Congressional Budget Office, using data from the Federal Emergency Management Agency, Guy Carpenter and Company, and Risk Management Solutions.

The data encompass 5.0 million NFIP policies in effect in the 48 contiguous states and the District of Columbia on August 31, 2016. Policies in Alaska, Hawaii, and the U.S. territories were excluded from the analysis because of the lack of estimates of expected claims.

Premiums and expected costs exclude increased cost of compliance coverage, which helps policyholders with significant or repeated flood damage to bring their properties into compliance with local regulations for floodplain management. Any imbalance between the $59 million collected for that coverage and the associated payments would be too small to affect the analysis.

A county is coastal if there is at least some expectation that claims will arise as a result of flooding caused by a storm surge or if more than 75 percent of expected claims in that county are from coastal storms. This group also includes 10 coastal counties with no expected claims from storm surges but with estimates of expected damage from storm surges (including expected damage to uninsured properties or damage to insured properties that was too minor to result in claims).

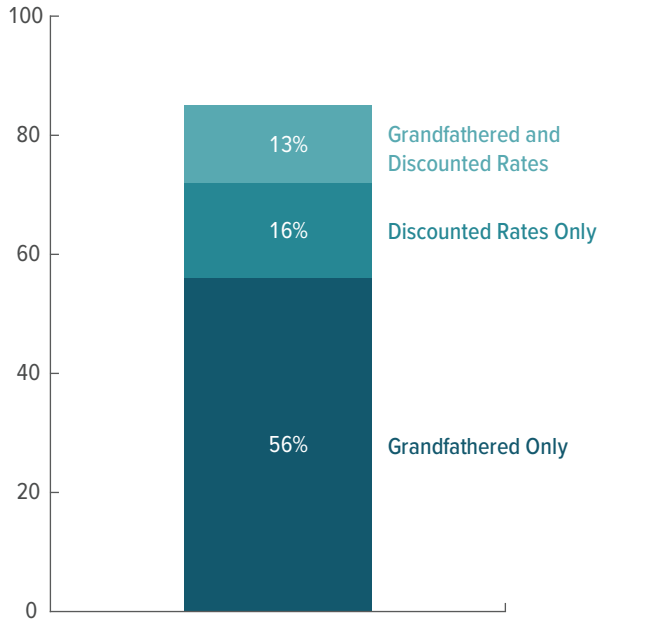
NFIP = National Flood Insurance Program.

$1.5 billion (see Figure 3). The average per-policy shortfall among those counties was $410. In contrast, taken as a whole, inland counties generated premiums in excess of expected claims, for a surplus of $200 million. The average per-policy surplus among those counties was $160.

The Sources of the Difference Between Coastal and Inland Counties. The difference between coastal and inland counties is explained, at least in part, by two factors: subsidies built into the NFIP and FEMA's rate-setting system. The result is that most policyholders whose property is at risk of wave damage from storm surges do not pay premiums that cover their expected costs. Instead, the additional expected costs from wave damage are spread broadly among the NFIP's policyholders, resulting in a cross-subsidy from inland counties (on average) to coastal counties: That is, some of the expected costs associated with coastal policies are covered by higher premiums paid by policyholders in inland counties.

Figure 4.

Share of Zone V Policies With Grandfathered and Discounted Rates Under the NFIP



Source: Congressional Budget Office, using data from the Federal Emergency Management Agency.

The data encompass roughly 130,000 NFIP policies in effect on August 31, 2016, for properties in Zone V (in which waves add at least 3 feet to the water level reached in a 100-year flood). Those properties are among the 79 percent for which CBO was able to identify flood zone location.

Grandfathered policies are those for properties that CBO identified as being in Zone V but charged Zone A or Zone X rates. CBO could not identify policies that were grandfathered into lower-risk rates after an increase in FEMA's estimate of the floodwater depth that has a 1 percent annual probability of being reached.

Discounted rates primarily apply to policies for buildings that were in place before a flood map was created for the area in which they are located. The total also includes 2 percent of policies for Zone V properties that were constructed before revised building standards were developed for those areas and 1 percent of policies with preferred rates under FEMA's "newly mapped" designation, which applies to properties that were newly mapped from Zone X to Zone A or Zone V and have favorable loss histories.

Some properties are eligible for both subsidies; that is, policyholders pay a discounted rate that corresponds to their grandfathered zone.

FEMA = Federal Emergency Management Agency; NFIP = National Flood Insurance Program.

Role of Subsidies. Eighty-five percent of the policyholders for properties located in Zone V, the highest-risk zone, do not pay rates that reflect their actual flood risk. Their policies receive one or both of two types of subsidies (see Figure 4).

Most Zone V policies—69 percent—are cross-subsidized through a grandfathering system that allows policyholders to pay the lower rates associated with a lower-risk zone into which the property was previously mapped (including 56 percent that benefit only from grandfathering and 13 percent that benefit from grandfathering and from discounts, discussed below, associated primarily with pre-FIRM properties). When local FIRMs were updated, grandfathered properties were mapped into higher-risk zones but their premiums are set according to the earlier-estimated risk. (The objective of grandfathering is to encourage policyholders to maintain coverage and to reduce local resistance to the adoption of new maps, which provide updated information about flood risks.) The cost of grandfathering properties into lower-risk zones is explicitly accounted for by offsetting rate increases for other policyholders (including those in coastal and inland counties) in the zone that serves as the basis for grandfathered property's rate (see Appendix B).

Moreover, NFIP policyholders for 29 percent of all Zone V properties—primarily pre-FIRM properties, which were in place before the creation of flood maps—pay discounted rates. (That 29 percent includes the 13 percent of Zone V properties insured at rates that are both grandfathered and discounted.)[18] Pre-FIRM properties (in all zones) account for the bulk of the $0.7 billion cost of discounted rates described above. Those costs are met in part by a surcharge on all policies.

Role of Broad Categories Used in Setting Rates. A second source of the cross-subsidies from inland to coastal counties is FEMA's method of setting rates, which relies on broadly defined categories of risk. That system does not account for differences in exposure to wave damage for properties that are outside Zone V.

18. The 29 percent includes 2 percent of Zone V policies that were in place before Zone V building standards were updated and 1 percent of Zone V policies that carry a preferred rate under FEMA's "newly mapped" designation (see Appendix B).

All policyholders with Zone A properties (which account for at least 44 percent of all policies) pay the same rate if the properties are similar in four respects: All are in the same property category, such as single-family home; all have the same number of floors; all either have a basement or do not have one; and all are similarly situated with respect to the base flood elevation, which FEMA defines as the expected elevation of water during a 100-year flood. In such cases, the premium for a home that, although located in Zone A, is close to Zone V—and thus has *almost* a 1 percent annual chance of sustaining damage from waves of 3 feet and a 1 percent annual chance of experiencing damage from waves of *almost* 3 feet—is the same as that for a similar home in Zone A where there is no risk of wave damage. As a result, some Zone A policyholders face the risk of wave damage, but they pay the same rates as other policyholders in Zone A who face no such risk. Some Zone A policyholders in coastal areas are thus cross-subsidized by Zone A policyholders in noncoastal areas.

Potential Changes in Future Estimates of Expected Costs and Premiums

The estimated costs and premiums identified above are based on the specific set of policies that CBO analyzed and on information about additional costs contained in FEMA's fiscal year 2017 budget. Thus, the estimates approximate expected costs and premiums for the NFIP as of the fall of 2016 (and are a rough approximation of current amounts). Those costs and premiums will change over time, and consequently, the magnitude of expected shortfalls will change. Some changes will evolve slowly; others could occur much more quickly.

Potential Changes in Costs

The single largest component of expected cost for the NFIP is the total dollar amount of the claims expected to be filed for flood damage. The magnitude of expected claims is sensitive to the composition of the 5 million policies that CBO analyzed and will slowly change as that composition changes. The $3.7 billion estimate of expected claims most closely approximates such claims in the near future, when the composition of policies is likely to roughly match the set in place on August 31, 2016. The composition of the NFIP's policies could change if the private market began to provide a larger fraction of flood insurance coverage. In particular, if the private market was able to compete for the NFIP's lower-cost policies—that is, those for which the NFIP's premiums are (or would be) large relative to their expected claims—the NFIP could be left with relatively high-cost policies. In that case, the potential for a program shortfall would increase unless the premiums or the terms of the remaining NFIP policies (such as deductibles and coverage limits), or both, were adjusted to compensate.

Other costs will be affected by factors unrelated to the composition of policies and some could change relatively quickly. For example, CBO currently projects interest rates' rising over the coming decade. FEMA's payments to the Treasury therefore would increase as well, even if the principal balance on the debt remained the same. In addition, program costs could rise if the NFIP sought to transfer increasing amounts of risk to the private sector by purchasing reinsurance. In January 2017, the NFIP paid a $150 million premium to transfer up to $1.042 billion in potential losses to the private sector.[19] Although reinsurance would provide funds for the NFIP to pay claims from a high-cost flood, the purchase of reinsurance adds to expected program costs because the payments to private companies must include a return on the capital they provide. In contrast, before the purchase of reinsurance, the NFIP had not had to pay for capital to cover future claims, although it made payments to the Treasury to cover its debt on past claims.

Finally, in the coming decades, coastal development and the effects of climate change are expected to increase property damage from coastal flooding. Climate change could increase damage by raising sea levels and potentially also by increasing the intensity of hurricanes.[20]

Potential Changes in Premiums

CBO expects that premiums would be higher in the future for the same set of policies examined in this report because FEMA is obligated under current law to phase out a large share of its discounted rates (including those for properties that predate a community's first flood map) over time. Some comparatively low-risk policies will reach their full-risk rates in a few years. The relatively

19. Specifically, private-market reinsurers will cover 26 percent of losses between $4 billion and $8 billion arising from a single flooding event in 2017. Recent modeling of the NFIP portfolio suggests that there is a 17.2 percent chance of an event that would lead to a reinsurance payout. See Federal Emergency Management Agency, "National Flood Insurance Program's (NFIP) Reinsurance Program for 2017" (accessed August 30, 2017), www.fema.gov/nfip-reinsurance-program.

20. See Congressional Budget Office, *Potential Increases in Hurricane Damage in the United States: Implications for the Federal Budget* (June 2016), www.cbo.gov/publication/51518.

large discounts for others for which the risk is high will extend for 25 years or longer.[21] Premiums could change more rapidly if, on the basis of revised estimates of flood risk, FEMA increased its rates.

Comparison of the Expected Shortfall Estimates in This Analysis and CBO's Baseline

As part of its projections for the overall federal budget deficit, CBO's baseline includes annual projections of the NFIP's expenditures and receipts. Like the estimates provided in the current analysis, CBO's 10-year baseline projections reflect all operating costs and interest payments of the NFIP and all of the program's income, including the fees and assessments that it collects. However, those baseline projections differ from the estimates here in at least two important ways.

First, the shortfall described in this report is based on a snapshot of the annual expected claims and premiums associated with the policies that CBO examined as well as of interest payments and other program costs at a specific point in time. CBO's baseline accounts for factors that could affect the program's income and expenditures over time: changes in the number and composition of insured properties, changes to FEMA's rate-setting method, additional costs the program may incur, and any additional charges it might impose. The baseline also reflects the fact that flood claims may be paid out over two or more fiscal years; this estimate does not.

Second, the shortfall described here is based on expected-claims estimates that have been produced by commercially available models. CBO's baseline reflects the estimates of expected claims implied by FEMA's full-risk rates and subsidy estimates.

In its most recent baseline, which was prepared before Hurricane Harvey struck Texas, CBO projected that under current law, the NFIP would have insufficient receipts to pay claims and expenses over the period from 2018 to 2027 and that FEMA would need to use about $1.0 billion of the remaining $5.8 billion in borrowing authority from the Treasury to pay those claims.[22] (More, or perhaps all, of the borrowing authority would be expected to be used if the commercial models are accurate.) CBO's 10-year baseline estimates reflect projected growth in the number of policies written and projected increases in premiums set by FEMA, particularly for policies with currently discounted rates.

As better information becomes available, CBO could change the way it estimates the cost of future NFIP claims in its baselines. To determine whether it will make such a change, CBO is considering the differences between the method that FEMA uses to calculate the expected cost of future claims and the commercially available models that underlie this analysis.

Cost to Households of Flood Insurance

Since the inception of the NFIP, policymakers have voiced concern about whether premiums are "reasonable" or "affordable," particularly for residential coverage. There is, however, no generally accepted view of what that means, and CBO did not make a judgment. Instead, the agency examined the distribution of NFIP premiums for all residences and for selected categories of residences, and it compared measures of those premiums with local household incomes. Among the key results of the analysis are the following:

- The median annual premium for residential NFIP coverage was $520.
- The median value of the ratios of census tracts' median premium to median household income was 0.8 percent; the central two-thirds of the ratios fell in the range of 0.5 percent to 1.5 percent.

Distribution of Premiums

Residences for which CBO was able to identify individual premiums represent 89 percent of all NFIP

21. See Government Accountability Office, *National Flood Insurance Program: Options for Providing Affordability Assistance*, GAO-16-190 (February 2016), p. 3, www.gao.gov/products/GAO-16-190. For annual increases to cease, the company servicing a policy with a discounted rate must certify that the full-risk rate has been reached. Some properties insured at pre-FIRM rates are at sufficiently low risk that their full-risk premiums would be lower. For data on New York City, for example, see Lloyd Dixon and others, *The Cost and Affordability of Flood Insurance in New York City: Economic Impacts of Rising Premiums and Policy Options for One- to Four-Family Homes* (RAND Corporation, 2017), pp. 39–40, www.rand.org/pubs/research_reports/RR1776.html.

22. CBO's baseline projections incorporate the assumption that the NFIP would be reauthorized and that FEMA would be able to continue to borrow from the Treasury up to the currently authorized limit.

Table 4.

One-Year Premiums for Residential Policies in the NFIP

Dollars

	Median (50th Percentile)	Central Two-Thirds Range Around the Median	
		17th Percentile	83rd Percentile
All Residential	520	420	1,330
Condominiums[a]	440	260	810
Single-family noncondominiums	520	430	1,350
Primary residences	450	410	1,130
Nonprimary residences	740	600	1,950

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency.

The table reflects one-year premiums for the 4.5 million NFIP residential policies that were in effect in the 50 states and the District of Columbia on August 31, 2016. This analysis excludes policies covering nonresidential properties and the small number of residential policies located in the U.S. territories. It also excludes multifamily residences for which the number of insured housing units is unknown.

NFIP = National Flood Insurance Program.

a. Includes individually insured condominium units and single- and multifamily condominiums insured under a residential building association policy. Premiums for multifamily condominiums were calculated by dividing total premiums by the number of insured units. In this analysis, each insured unit is treated as having a separate policy.

policies in effect on August 31, 2016.[23] Most of the premiums—specifically, the central two-thirds of the distribution around the median of $520—were between $420 and $1,330 (see Table 4).[24]

Premiums differed somewhat by type of residence. In particular, the median premium for condominiums (one-fourth of the total) was about 15 percent lower than the median premium for single-family noncondominium homes ($440 per year versus $520 per year). Those differences reflect generally lower coverage for condominiums: The median coverage for condominium structures and contents was $175,000 per unit, nearly 40 percent less than the median coverage of $280,000 for single-family noncondominium homes.

Within the subset of single-family noncondominium residences, premiums tended to be significantly lower for primary than for nonprimary residences. The median annual premium was $450 for primary single-family residences (56 percent of all residential policies); it was $740 for nonprimary single-family residences (19 percent of all residential policies). Of that difference of $290, $225 can be attributed to lower fees for primary residences. Specifically, the surcharge that is intended to help cover the costs of discounted rates (primarily for pre-FIRM properties) is $25 for policies that cover primary homes and $250 for policies that cover nonprimary homes and nonresidential properties.

Premiums Compared With Local Household Incomes

CBO did not have access to data on the individual household income of NFIP policyholders. Instead, CBO compared the median premium payment in each census tract with that census tract's median income. That comparison was limited to policies covering primary single-family residences and to the median income of households in single-family residences (see Box 3). The comparisons of census-tract–level measures of median premiums to median household incomes offer some perspective on the affordability of NFIP premiums. Nevertheless, premiums paid by any given household could represent a significantly larger, or smaller, share of its income than indicated by the tract-level estimates. Moreover, insurance premiums that seem small in themselves

23. The remainder consisted of 5 percent in nonresidential properties and 6 percent in residential units in multifamily buildings that were not covered by a policy purchased by a condominium association. CBO could not identify individual premiums for the latter policies because the number of housing units in each building is unknown. In contrast to the comparison of premiums and expected costs discussed earlier in this report, the examination of the cost of premiums includes Alaska and Hawaii; thus, all 50 states and the District of Columbia. Both exclude policies in the U.S. territories.

24. The analysis includes the 2 percent of policies that cover the buildings' contents, but not the structures themselves. Excluding contents-only policies did not change CBO's estimates of the median premium or the two-thirds range.

Box 3.

CBO's Analysis of the NFIP's Premiums and Household Income at the Census-Tract Level

Because the Congressional Budget Office did not have access to data on household income for each policyholder in the National Flood Insurance Program (NFIP), the comparison of premiums and income was made using median figures for each census tract. Census tracts are relatively permanent, statistical subdivisions of counties (or equivalent entities) that generally are home to 1,000 to 8,000 people and—at the time they are drawn—are designed to be roughly homogeneous with respect to population characteristics, economic status, and housing stock.[1]

CBO's analysis focused on premiums paid for the subset of flood insurance policies covering primary single-family residences, which accounted for 57 percent of the residential NFIP policies in effect on August 31, 2016.[2] Policies covering nonprimary residences (19 percent of residential policies) were excluded from the analysis because an owner of such a residence, whose primary residence may lie elsewhere, may have income that is not well represented by the median income for the census tract in which the insured property is located. (Census tract income figures are gathered from year-round residents.) The analysis also excluded multifamily residences because of the lack of information on whether individual units were primary residences.

Household income was defined as before-tax income, consisting of earnings and such cash transfers as Social Security and public assistance payments but excluding housing subsidies and other in-kind benefits.[3] CBO used the data on tract-level median income for households in single-family homes in two ways. First, to compare the income of NFIP households in single-family homes with the income of all U.S. households in such homes, CBO used weighted averages of tract-level median income. Specifically, to represent the income of NFIP policyholders, CBO weighted each tract's median income by its share of NFIP policies covering single-family primary residences. Thus, the median income of a tract that had 2 percent of such policies would count for four times as much in the average as another tract that had 0.5 percent of such policies. To represent the income of all U.S. households in single-family homes, the agency weighted each tract's median income by its share of single-family residences.

Second, to compare income with NFIP premiums, the agency focused on the 13,800 tracts with at least 25 policies for primary single-family residences, calculating for each such tract the ratio of the median premium on those policies to the median income for households in single-family residences. Tracts with fewer than 25 such policies were excluded to avoid creating misleading results from small samples. The exclusion reduced by about 10 percent the number of NFIP policies for primary single-family residences in the analysis.[4]

1. Census Bureau, "Decennial Management Division Glossary" (accessed August 30, 2017), www.census.gov/dmd/www/glossary.html.

2. Of that 57 percent, condominium and noncondominium properties accounted for 1 percent and 56 percent, respectively.

3. See Census Bureau, *American Community Survey and Puerto Rico Community Survey: 2015 Subject Definitions*, pp. 80–81 (accessed August 30, 2017), https://go.usa.gov/xRRnC (PDF, 832 KB). CBO used tract-level median income for households in single-family residences derived from survey results for 2010 to 2014 and converted to 2016 dollars.

4. CBO had household income data for 58,435 census tracts in which there was at least one primary single-family residential NFIP policy—2.5 million policies in all. Most of that group (2.2 million policies) were in the 13,800 census tracts in which there were 25 or more policies.

could be more significant when added to other housing costs that might account for a significant share of household income.[25]

CBO's analysis suggests that, on average, NFIP policyholders tend to live in places where people have higher

25. A RAND Corporation study has compared a more comprehensive measure of housing costs (including mortgage principal and interest, property taxes, and insurance) with household income by using survey results for 569 owner-occupied homes in New York City. The results indicated that housing costs amounted to more than 40 percent of household income for 25 percent of the households. The study did not focus on the incremental effect of flood insurance premiums. See Lloyd Dixon and others, *The Cost and Affordability of Flood Insurance in New York City: Economic Impacts of Rising Premiums and Policy Options for One- to Four-Family Homes* (RAND Corporation, 2017), pp. 25–28, www.rand.org/pubs/research_reports/RR1776.html.

Table 5.

Median Income of NFIP Policyholders in Primary Single-Family Homes Compared With Median Income of U.S. Households in Single-Family Homes

	Estimated Income of Policyholders in Primary Single-Family Homes (Dollars)[a]	Ratio, Estimated Income of Policyholders to Estimated Income of All U.S. Households in Single-Family Homes[b]
All Areas	77,300	1.11
Coastal	74,600	1.07
Noncoastal	81,200	1.16

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency, the Census Bureau, and Risk Management Solutions.

The data encompass the 2.5 million primary single-family NFIP residential policies (including policies for single-family homes and individually insured condominiums) that were in effect in the 48 contiguous states and the District of Columbia on August 31, 2016. Policies for nonprimary residences were excluded because the owners, whose primary residence may be in a different jurisdiction, may have income that is not represented by the median income for the census tract in which the property is located.

Coastal tracts are those with a positive value for expected damage from a hurricane storm surge, based on estimates of potentially insurable damage.

Alaska, Hawaii, and the U.S. territories were excluded from the analysis because of the lack of estimates of expected damage.

NFIP = National Flood Insurance Program.

a. Each estimate is a weighted average of median income by census tract for households in single-family homes; each tract's weight is its share of NFIP policies for primary single-family residences.

b. The estimate of median income of U.S. households in single-family homes, covering the 48 contiguous states and the District of Columbia, is $69,800. That figure is the weighted average of median income by census tract; each tract's weight is equal to its share of such homes.

income. CBO compared two weighted averages of the same census-tract data on median incomes of households in single-family homes. The average that results when each tract is weighted by its share of NFIP policies for primary single-family homes is $77,300. That figure is 11 percent higher than the average obtained when each tract is weighted by its share of households in single-family homes (see Table 5). Thus, median income tends to be higher in census tracts with a larger percentage of single-family homes that are primary residences insured under the NFIP.

The NFIP-weighted average of median incomes is lower for coastal tracts ($74,600) than for noncoastal tracts ($81,200). That result may suggest that more households with relatively low income in coastal areas see flood insurance as a necessity than do their counterparts in noncoastal areas, or that mortgage lenders enforce the mandatory purchase requirement (which applies to properties in Zones A and V with federally insured mortgages) more thoroughly in coastal areas.

Comparing incomes and premiums, CBO found that for most census tracts included in the analysis, the median premium for policies covering primary single-family homes was between 0.5 percent and 1.5 percent of the median income of single-family households in the same tract (see Figure 5). (Those percentages indicate the central two-thirds of the distribution; the full distribution of ratios ranged from 0.1 percent to 8.4 percent; the median value was 0.8 percent.) Results were similar for the subsets of coastal and noncoastal census tracts.[26]

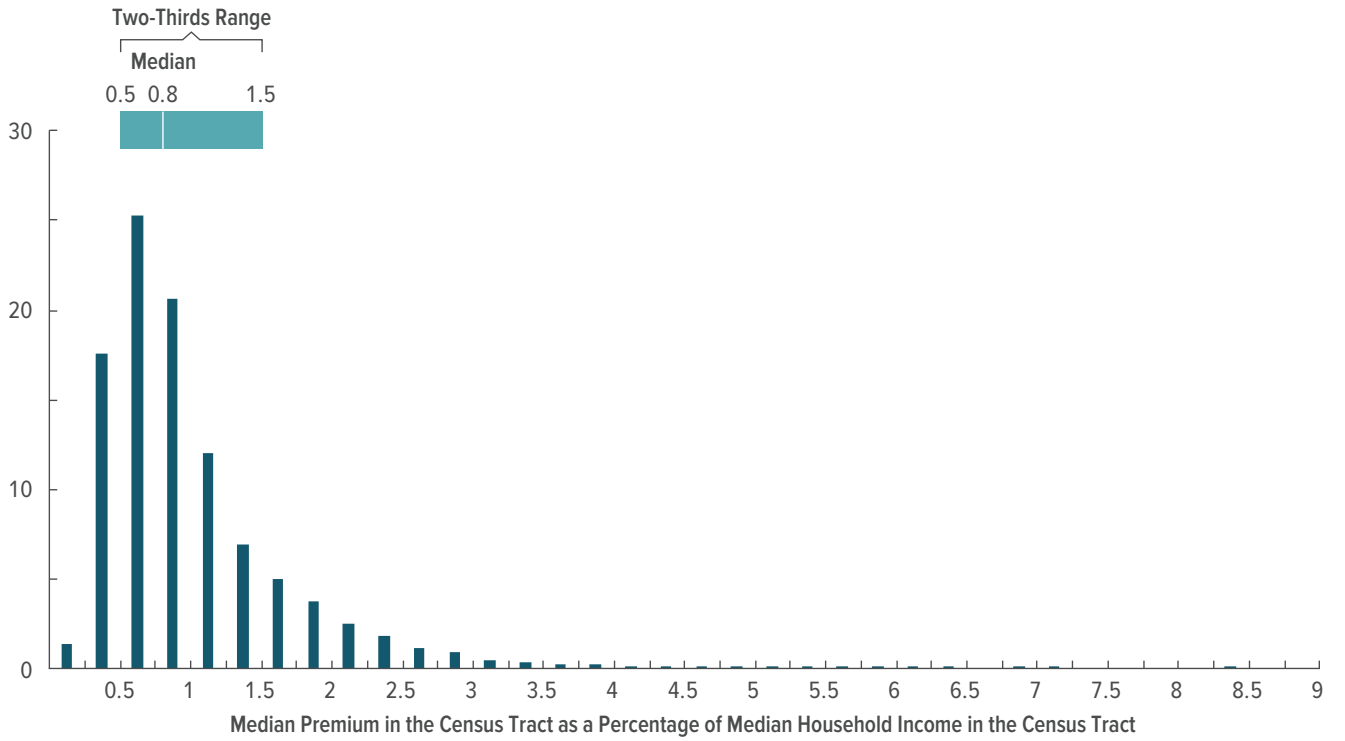
Policy Approaches

Over the course of the program's history, lawmakers have changed the NFIP in ways that have altered the emphasis on actuarial objectives—financial soundness and alignment of individual premiums with risks—and holding down premiums. Those changes include measures enacted in two laws passed within the past five years: the Biggert-Waters Flood Insurance Reform Act of

26. In two-thirds of coastal census tracts, the median premium for an NFIP policy for a primary single-family home was between 0.5 percent and 1.4 percent of the median income for single-family households in the same tract. In two-thirds of noncoastal tracts, that premium was between 0.4 percent and 1.5 percent of the median income for single-family households in the same tract.

Figure 5.

Share of Census Tracts in Which NFIP Premiums for Policies Covering Primary Single-Family Homes Comprise a Certain Percentage of Single-Family-Household Income



Source: Congressional Budget Office, using data from the Federal Emergency Management Agency and the Census Bureau.

Data on premiums are for NFIP policies in effect on August 31, 2016, and written for primary single-family homes. The data set was limited to the 13,800 census tracts in the 50 U.S. states and the District of Columbia that had at least 25 primary single-family residential policies. For each tract, the median premium is reported as a percentage of median single-family household income.

The median is the figure corresponding to the middle of the distribution, and the two-thirds range is the central two-thirds of the distribution.

NFIP = National Flood Insurance Program.

2012, which focused on the actuarial objectives, and the Homeowner Flood Insurance Affordability Act of 2014, which slowed or reversed some of the changes required by the Biggert-Waters Act.

This section discusses 12 approaches that lawmakers could consider—including some incorporated in the Biggert-Waters Act and the HFIAA that could be revisited—to make the program more solvent, align premiums with risks, or keep rates low. (Approaches that primarily serve other policy objectives, such as reducing the year-to-year variability of the NFIP's costs or strengthening the market for private flood insurance, are beyond the scope of this discussion.) In many cases, an approach can serve more than one objective. Although the approaches could be classified in different ways for different purposes, they are divided into four groups on the basis of effect: whether they would broadly increase receipts; reduce subsidies, shift costs away from the NFIP, or make rates better reflect underlying risk factors (see Table 6).[27]

27. Several approaches discussed here are described in more detail in Committee on the Affordability of National Flood Insurance Program Premiums, National Research Council, *Affordability of National Flood Insurance Program Premiums: Report 1* (National Academies Press, 2015), pp. 99–118, http://tinyurl.com/ya4b7wzd. The Government Accountability Office also has analyzed some potential policy changes; see *Flood Insurance: Comprehensive Reform Could Improve Solvency and Enhance Resilience*, GAO-17-425 (April 2017), www.gao.gov/products/GAO-17-425.

Table 6.

Objectives Served by Various Policy Approaches for the NFIP

	Improve Program Solvency	Better Align Premiums and Risk[a]	Keep Costs Low for Some or All Policyholders
Approaches That Would Broadly Increase Receipts			
Increase Fees or Surcharges	Yes	Generally no[b]	No
Target Policy Sales to Contribute to a Surplus	Potentially yes[c]	No	No
Approaches That Would Reduce Subsidies			
Shorten Phase-Out Periods for Discounted Rates	Yes	Yes	No
Reduce Cross-Subsidies for Grandfathering	No	Yes	For some[d]
Target Discounted Rates to Low-Income Households	Yes	Yes[e]	For low-income policyholders
Approaches That Would Shift Costs Away From the NFIP			
Encourage the Use of High-Deductible Policies	Potentially yes[f]	Potentially yes[f]	Reduces premiums but increases risk exposure
Forgive the NFIP's Debt to the Treasury	Yes, by shifting costs to taxpayers	Generally no[g]	Yes
Rely on General Revenues to Help Pay Claims in High-Cost Years	Yes, by shifting costs to taxpayers	Generally no[g]	Yes
Fund Floodplain Mapping, Management, and Mitigation Assistance From General Revenues	Yes, by shifting costs to taxpayers	Generally no[g]	Yes
Approaches That Would Adjust Premiums to Better Reflect Underlying Risk Factors			
Increase Funding for Assessing Flood Risk	Potentially yes[h]	Potentially yes[h]	Potentially for some[i]
Expand the Use of Premium Adjustments for Mitigation[j]	Potentially yes	Potentially yes	Potentially for some
Adjust Premium Rates for Property Value	No	Yes	For owners of lower-value properties

Source: Congressional Budget Office.

NFIP = National Flood Insurance Program.

a. For this analysis, CBO assumed that full-risk rates accurately reflect policies' expected claims, averaged over their flood zone.

b. For premiums below the full-risk level, higher surcharges could improve the premiums' alignment with risk; for premiums at or above the full-risk level, such surcharges would weaken that connection.

c. Policy approach could be challenging to implement.

d. Premiums that provided the cross-subsidies would tend to decrease; premiums at grandfathered rates would tend to increase.

e. Alignment would improve more if discounts for low-income policyholders were funded by taxpayers rather than through new cross-subsidies.

f. Effects would depend on whether existing low-deductible policies were subsidized by high-deductible policies and on any adjustments made to rates once the use of low deductibles was reduced.

g. Alignment with risk would improve for premiums that were currently above the full-risk level but worsen for premiums that were at or below the full-risk level.

h. Effects would depend on how much increased funding led to premium rates that were more accurate overall or in specific cases.

i. If more accurate risk estimates led to less reliance on cross-subsidies, premiums paid by cross-subsidy recipients would tend to increase and premiums paid by those providing the cross-subsidies would tend to decrease.

j. Effects in all three categories would depend on the extent to which the Federal Emergency Management Agency could specify additional mitigation and accurately quantify the resulting reductions in risk.

Approaches That Would Broadly Increase Receipts

A straightforward way for lawmakers to increase the funds available to the program would be to raise fees or surcharges. Another, less straightforward, way would be to direct FEMA to try to increase sales of policies that contribute to a net surplus for the program.

Increase Fees or Surcharges. The NFIP's expected shortfall could be reduced either by raising one or more of the fees and surcharges that currently are included in premiums or by creating a new fee or surcharge.[28]

For the 12 months covered by the policies in effect on August 31, 2016, three existing charges—the federal policy fee, the reserve fund assessment, and surcharges established by HFIAA—generated income of $191 million, $471 million, and $412 million, respectively. An argument in favor of increased reliance on fees and surcharges is that they distribute the burden of improving the program's solvency broadly among policyholders. However, such charges also increase the divergence between premiums and flood risks for properties that are insured at rates that are at or above their true full-risk level. In principle, increasing those charges could discourage purchases of insurance, although the evidence suggests that demand for flood insurance is relatively insensitive to price.[29] (Such demand is driven in part by the requirement that all Zone A or V residential properties with federally insured mortgages carry flood insurance; however, enforcement of that requirement by mortgage lenders is incomplete.)

The effects on individual households would depend on the structure of the increases. For example, a proportional increase in the current HFIAA surcharges—a doubling, say—would have more effect on policies covering nonprimary residences and nonresidential properties (the current annual surcharge is $250) than on those for primary residences (the current annual surcharge is $25).

Target Policy Sales to Contribute to a Surplus. Expanding coverage to more policyholders is sometimes suggested as a way to reduce the NFIP's expected shortfall. However, adding new policyholders would not yield the desired effect unless the new policies increased receipts more than they increased expected claims and other expenses.

Lawmakers could direct FEMA to prioritize sales of policies that are more likely to contribute to a net surplus. For example, FEMA could try to target sales for commercial and nonprimary residential properties, which face the larger HFIAA surcharge, through changes in its marketing and publicity efforts, or it could adjust its payments to the insurance brokers that sell the policies.

The success of such an approach would depend in part on FEMA's ability to target the growth in policies (which could be challenging) and in part on the adequacy of its full-risk rates. The more fully the rates cover the new policies' expected claims and related administrative costs, the more the HIFAA surcharge would be available to reduce the program's shortfall.

Approaches That Would Reduce Subsidies

The Congress could reduce the NFIP's subsidies in various ways; for example, by shortening phase-out periods, reducing cross-subsidies for grandfathering, or targeting subsidies on the basis of household income.

Shorten Phase-Out Periods. Lawmakers could reduce the time for which subsidies are provided through discounted rates. The discounts, which are currently provided on 20 percent of NFIP policies and contribute to an actuarial shortfall, are time limited under current law.[30]

Lawmakers could shrink those time limits, for example, by raising the annual rate increases (until full-risk rates are reached) for properties built before flood insurance maps were created or before construction standards were revised. Those two categories comprise most of the discounts.

Shortening the subsidy periods would more quickly allow rates to reflect policyholders' risk and would reduce

28. Alternatively, the Congress could direct FEMA to increase some or all of its rates for insurance coverage itself, although providing clear guidance on how rates should be raised could be more difficult than specifying increases in fees or surcharges.

29. See Carolyn Kousky, *Financing Flood Losses: A Discussion of the National Flood Insurance Program*, Discussion Paper 17-03 (Resources for the Future, February 2017), p. 11, http://tinyurl.com/y8prstgq.

30. The 20 percent figure does not include the discounts provided under the Community Rating System, which do not contribute to an actuarial shortfall (see Appendix B).

the extent to which the rate-based receipts underfund expected claims and other policy costs. Such underfunding would not be completely eliminated, however. Although under current law, policyholders who currently receive discounts ultimately will see their premiums increase to full-risk rates, over time other properties will become newly eligible for discounts. For example, as map revisions recategorize properties out of Zone X and into the higher-risk Zones A and V, some will become eligible under FEMA's "newly mapped" designation (see Appendix B).

Reduce Cross-Subsidies for Grandfathering. Lawmakers could direct FEMA to reduce the use of the intentional subsidies that are primarily financed by charging higher rates to other policyholders. Many of those cross-subsidies apply to properties that are mapped at a higher level of flood risk when maps are updated but are grandfathered into rates on the basis of previous, lower, assessments of risk. For example, properties in coastal regions that are remapped from Zone A into Zone V are generally grandfathered at the Zone A rate, but all policyholders in Zone A pay higher rates to offset the higher risk exposure of the grandfathered properties. In general, properties that are grandfathered into lower-risk rates continue to be subsidized indefinitely, even when the property is sold.[31]

Lawmakers could reduce the use of cross-subsidies in various ways—for example, by limiting the period during which a remapped property could be covered under rates for its previous mapping. If cross-subsidies were reduced, premiums could more accurately convey the flood risk associated with each property, thereby giving actual and potential policyholders better incentives to buy the appropriate amount of coverage and to take measures to reduce risk (which may include elevating a building or choosing to relocate, for example).

However, imposing higher rates for properties remapped at higher risk could create hardships for some property owners, reduce the value of their homes, and increase local resistance to the acceptance of newer maps that could better guide land-use management and construction. Also, unlike the discounts described above, cross-subsidies need not contribute to an actuarial shortfall, so reducing them would not be expected to improve the NFIP's financial soundness.

Target Subsidies to Low-Income Households. Under current law, subsidies, including discounted rates and cross-subsidies, are available to the NFIP's policyholders regardless of income or wealth; however, the Congress could impose income requirements on sales of subsidized flood insurance. Specifically, eligibility could rely on means-testing, as is the case for some other federal assistance programs.

One way to target subsidies would be to give qualifying households payment vouchers for premiums. Those vouchers could be taxpayer funded or paid for by surcharges on other policyholders' premiums. Subsidizing fewer policies would reduce both the cost of the subsidies (and the expected program shortfall, if the use of discounted rates was reduced) and the number of policies whose premiums understate their flood risks. However, the approach would add administrative complexity, and vouchers funded through surcharges would keep some policyholders paying premiums that were above true full-risk amounts.

Approaches That Would Shift Costs Away From the NFIP

Lawmakers could reduce premiums by encouraging the use of high-deductible policies that shift the responsibility for paying low-cost claims onto policyholders, or by shifting costs to taxpayers (for example, by forgiving the NFIP's current debt, or by tapping Treasury funds to help pay for claims in future high-cost years or to cover general program costs).

Encourage the Use of High-Deductible Policies. If deductibles were higher, premiums could be reduced without compromising financial soundness because expected claims would be lower. One method that lawmakers could use to try to increase the share of policies with high deductibles would be to require that information about the advantages of high-deductible policies be provided to purchasers of flood insurance. That method might be ineffective, however, because research shows that purchasers of insurance tend to choose lower deductibles.[32] Another possibility would be for

31. A property loses its eligibility for grandfathering if coverage lapses and if the structure did not conform to building codes for the relevant flood map zone in effect at the time of construction.

32. See Committee on the Affordability of National Flood Insurance Program Premiums, National Research Council, *Affordability of National Flood Insurance Program Premiums: Report 1* (National Academies Press, 2015), p. 110, http://tinyurl.com/ya4b7wzd.

lawmakers simply to increase the minimum deductible (currently $1,000 but raised to that amount from $500 in 2012 by the Biggert-Waters Act). FEMA has estimated that raising the deductible on a residential policy in a higher-risk area from $1,000 to $5,000 would reduce the full-risk premium by 25 percent.[33]

Although higher deductibles could decrease premium payments, in the event of a flood they might impose hardships on people in low-income households who must pay for damage below the deductible amount. The effect of higher deductibles on the program's financial soundness or on the alignment of individual premiums with flood risks would depend on the extent to which FEMA revised its rates in response to the resulting reduction in flood risk. Higher deductibles could affect federal costs outside of the flood insurance program by increasing the demand for disaster assistance.

Forgive the NFIP's Debt to the Treasury. Currently, the NFIP's debt totals $24.6 billion, nearly six times the program's total annual receipts of $4.3 billion from policies in effect on August 31, 2016. The NFIP's policyholders are servicing that debt: Payments in 2016 totaled $345 million on the $23 billion owed that year. CBO's current baseline does not project any principal being repaid in the next 10 years. Retiring the debt would require payments that were very large relative to the size of the program. For example, paying off the debt over 30 years at an interest rate of 2.5 percent would entail annual payments of roughly $1.2 billion for principal and interest.

Forgiving the NFIP's current debt would make money that is now spent for debt service available to pay claims (reducing the program's expected shortfall) and eliminate the potential for the large premium increases that would probably be required to repay the debt. Thereafter, if premiums were actuarially sound, they could generate enough income over time to cover debts incurred in high-cost years with surpluses accumulated in other years (assuming that the number and mix of policies did not change much).

However, according to both CBO's and FEMA's estimates of expected claims, the program as currently administered has a shortfall that would tend to generate additional debt over time, even if the current debt was retired. Because FEMA's current rates are below actuarially sound levels, forgiving the debt could hamper efforts to reach actuarial soundness by leading FEMA to expect forgiveness for future debts and by lessening the need for policymakers to increase rates to generate income for the program. If, however, premiums were raised to allow the NFIP to retire more of its debt to the Treasury, those increases might lead some homeowners to buy less flood insurance or none at all.

Rely on General Revenues to Help Pay Claims in High-Cost Years. Some observers suggest that premiums could be reduced if the Congress defined an annual threshold ($5 billion, for example) beyond which additional claims would be paid from the general fund. As the program now operates, rates for full-risk policies are intended to cover the expected cost associated with all potential flood events, including unlikely high-cost events. Including the expected claims associated with low-probability, high-cost events causes premiums to be higher than they would need be to cover claims in more typical years. Defining a threshold above which additional claims would be paid from general revenues would both reduce the program's expected shortfall and help keep rates low, but it would do so by creating an explicit subsidy from taxpayers to the NFIP's policyholders. (In effect, it would be a form of federal reinsurance that would—from the NFIP's perspective—provide a no-cost alternative to coverage from private reinsurers.) Moreover, that subsidy would provide a permanent rationale for premium rates that did not reflect the risks of high-cost events, thus undermining incentives for policyholders to undertake mitigation.

Fund Floodplain Mapping, Management, and Mitigation Assistance From General Revenues. In fiscal year 2016, FEMA spent about $0.4 billion of its income from premiums on floodplain mapping and mitigation assistance. The Congress could shift those costs to taxpayers by funding those activities out of general revenues. Some funds for mapping already are provided in separate appropriations: FEMA's program for flood hazard mapping and risk analysis received $190 million for fiscal year 2016 and $178 million for fiscal year 2017.

Like debt service, mapping and mitigation costs are not related to current policies. Consequently, if FEMA's premium rates based on coverage accurately reflected the expected costs for claims and policy-related administrative costs, additional charges to cover the costs of

33. Ibid., p. 109.

mapping and mitigation would be economically inefficient and could discourage some purchases of flood insurance that would otherwise be justified. In cases in which FEMA's premiums are below actuarially sound levels, however, reducing rates by shifting the costs of mapping and mitigation to taxpayers would further understate the flood risks faced by policyholders.

Approaches That Would Make Rates Better Reflect Underlying Risk Factors

The more accurate and specific the NFIP's rates are, the less likely they are to entail either unintended discounts or implicit cross-subsidies. To try to improve the rates' accuracy, specificity, or both, lawmakers could increase the funding available to assess flood risks, direct FEMA to expand the set of mitigation options that homeowners or communities can take to reduce their rates, or require FEMA to adjust rates on the basis of property value.

Increase Funding for Assessing Flood Risk. The Congress could improve FEMA's ability to accurately assess and map the nation's flood risks by increasing funding for the flood-mapping program. The Biggert-Waters Act directed FEMA to improve its mapping and mandated the creation of the Technical Mapping Advisory Council. In June 2016, that group reported that FEMA had fully or partially addressed most of its recommendations, but that the continued use of a paper-based, cartography-driven process for constructing FIRMs is time-consuming and expensive, and the lengthy study process jeopardizes technical credibility.[34]

As of November 2015, FEMA indicated that 94 percent of the U.S. population lived in an area with an updated flood map, an increase from 68 percent in 2008.[35] However, not all updated maps include modern, laser-generated data, which dramatically improve the quality of elevation and topographic information that is crucial to estimating flood risks. The Congress appropriated $178 million for FEMA's program for flood hazard mapping and risk analysis in fiscal year 2017; the annual authorized appropriations for that program under the Biggert-Waters Act are $400 million.

Increased funding for flood risk mapping could have two particular benefits:

- As flood risks increase over time—for example, because of changes in land use, rising sea levels, or increases in extreme weather—more up-to-date maps could improve the program's financial soundness by allowing FEMA to set rates to more accurately reflect current risks.
- If improved maps make it easier for FEMA to track differences in topography and other local conditions that affect risk, FEMA might be able use finer rate classifications, thereby reducing unintentional cross-subsidies among properties that currently are charged the same rate.

An argument against increased funding for mapping is that its benefits might not be fully realized. Constraints on FEMA's ability to raise rates (because of grandfathering, for example) or the added expense of applying finer rate classifications might limit the benefits of new information on flood risk or unintended subsidies that improved mapping might reveal.

Expand the Use of Premium Adjustments for Mitigation. Lawmakers could direct FEMA to identify additional mitigation measures that property owners or communities could take to minimize flood damage, to quantify those measures' effectiveness, and to revise rates to account for them. A variation on that approach would direct FEMA to offer financial assistance to low-income policyholders to help them pay for cost-effective mitigation.

Currently, only a limited number of measures (other than relocating) are available to homeowners to mitigate damage in exchange for lower premiums: A structure can be elevated, water-resistant materials can be used on the ground floor, and all improvements and habitable space can be placed on or above the second floor.[36] Property

34. See Technical Mapping Advisory Council, *National Flood Mapping Program Review* (June 2016), pp. 15–16, www.fema.gov/media-library/assets/documents/111853.

35. See Government Accountability Office, *National Flood Insurance Program: Continued Progress Needed to Fully Address Prior GAO Recommendations on Rate-Setting Methods*, GAO-16-59 (March 2016), p. 16, www.gao.gov/products/GAO-16-59.

36. See Committee on the Affordability of National Flood Insurance Program Premiums, National Research Council, *Affordability of National Flood Insurance Program Premiums: Report 1* (National Academies Press, 2015), p. 107, http://tinyurl.com/ya4b7wzd.

owners with basements have additional options: They can install flood vents (which allow the water to flow freely below the first floor) or fill in the basement.[37] Communities also can undertake flood mitigation through limiting development in floodways; constructing wetlands and other natural infrastructure to reduce water flows into floodways by increasing retention and enhancing drainage; and constructing levees, floodwalls, or dunes to control flood hazards. The NFIP's Community Rating System program provides discounts on policies in communities that exceed minimum requirements to reduce flood damage and support comprehensive flood management. HFIAA requires FEMA to recognize the effectiveness of community- and areawide mitigation in setting premium rates and to maintain updated maps that reflect communities' mitigation efforts.

FEMA could perhaps advance its goals of actuarial soundness and reduced cost to policyholders if it could more accurately identify and quantify the effectiveness of additional mitigation efforts. However, doing so would be challenging. If FEMA's premium adjustments for mitigation were inaccurate—for example, because the adjustments did not account for how well certain measures were maintained—they could increase the NFIP's expected shortfall or expand the extent of cross-subsidies.

Adjusting Premium Rates for Property Value. Lawmakers could direct FEMA to modify premium rates to account for the fraction of the value of a structure that a policy covers. NFIP premiums do not currently reflect differences in the amount of coverage relative to the replacement value of insured structures.

Consider the case of a pair of two-story, single-family homes in Zone A at the same elevation relative to the base flood with replacement values of $1 million and $100,000. Those properties' policyholders would pay the same premium for $100,000 worth of coverage, even though a flood that resulted in 10 percent damage would require FEMA to pay a $100,000 claim on one but only a $10,000 claim on the other. Charging the same premium for both homes results in a cross-subsidy.

Modifying rates to account for property values would increase premiums for higher-value homes and decrease them for lower-value homes. To the extent that lower-value homes are owned by lower-income households, that change could make flood insurance more affordable, although it would add to the complexity of the program's rates.

37. See Lloyd Dixon and others, *The Cost and Affordability of Flood Insurance in New York City: Economic Impacts of Rising Premiums and Policy Options for One- to Four-Family Homes* (RAND Corporation, 2017), pp. 107–109, www.rand.org/pubs/research_reports/RR1776.html.

APPENDIX

A

CBO's Method for Estimating Expected Claims

The Congressional Budget Office examined the financial soundness of the National Flood Insurance Program (NFIP) by constructing estimates of the difference between the amount of receipts from premiums and the expected costs of the program nationally and at the county level. The agency analyzed data for 5 million policies that were in effect in the contiguous 48 United States and the District of Columbia on August 31, 2016. The largest component of expected costs is expected claims, consisting of gross losses (the total expected damage for which policyholders would be eligible to make claims under their NFIP policies) and loss adjustment expenses (associated with investigating and settling the claims filed by policyholders). CBO estimated gross losses at the county level, converted those amounts to expected claims, and aggregated those data to arrive at figures for expected claims nationwide.

Aggregated County-Level Gross Losses

CBO constructed an estimate of annual gross losses for each of the 2,984 counties considered in the analysis. Annual gross losses indicate claims payments (before loss adjustment expenses) and account for the wide range of types of flooding events that could occur in any given year and their probability of occurring. CBO accounted for four types of flood risk that could lead to claims payments in each county j, as follows:

$$L_j = S_j + I_j + P_j + T_j \qquad (1)$$

In that equation, L_j—the county's annual gross losses from all types of flooding—is the sum of the county's annual gross losses from storm surges (the abnormal increases in seawater level caused by storms) S_j, from inland flooding I_j, from hurricane related-precipitation P_j and from tropical storms T_j.

CBO used estimates of annual gross losses from storm surges and inland flooding that were commissioned by the Federal Emergency Management Agency (FEMA) in preparation for its purchase of reinsurance. Those estimates were generated on the basis of thousands of simulations of flooding events (reflecting the many possible outcomes in any given year) and their effects on all individual properties covered by an NFIP policy on a specific day, August 31, 2016. To date, no models project expected damage attributable to precipitation associated with hurricanes or tropical storms. An examination of 35 years' worth of NFIP claims indicated that such damage accounted for about 23 percent of claims payments over the period: roughly 16 percent from hurricane-related precipitation, 5 percent from tropical storms, and the rest from other sources of flooding, including nor'easters (coastal storms that typically affect the northeastern and mid-Atlantic states).[1] CBO used the methods described below to estimate the distribution of gross losses attributable to various types of flooding.

County-Level Gross Losses From Storm Surges

For each county, CBO obtained two estimates of gross losses attributable to storm surges. The data came from FEMA and were constructed by Guy Carpenter and Company, a reinsurance intermediary that advises businesses and governments. Guy Carpenter generated the estimates using hurricane storm surge models developed by Risk Management Solutions (RMS) and AIR Worldwide (AIR). Specifically, Guy Carpenter applied data about the NFIP's insurance policies to location-specific damage estimates from thousands of potential hurricane surge events simulated by AIR's and RMS's models. Each simulation yielded a set of gross losses for each policy, based on geographic location, physical characteristics (such as whether the insured property had a basement or what its elevation was relative to the base flood elevation, the expected elevation of water during a 100-year flood), and policy details (such as coverage amounts and deductibles). Guy Carpenter reported those losses, aggregated to the county level, to FEMA, which then shared them

1. See John Kulik and Andy Neal, "C-8: NFIP Update: Initial Steps Toward Sharing U.S. Flood Risk With the Private Sector, Presentation 1" (Casualty Actuarial Society, Seminar on Reinsurance, Boston, Mass., June 7, 2016), p. 4, http://tinyurl.com/yah7hf5o.

with CBO. Because RMS's and AIR's county-level estimates were similar, CBO averaged the two estimates of gross losses attributable to a storm surge to obtain a single estimate for each county.[2]

County-Level Gross Losses From Inland Flooding

FEMA also supplied CBO with estimates of county-specific gross losses from inland flooding, which typically is associated with rivers but also can involve streams, lakes, ponds, or flash floods. Those estimates were generated by Guy Carpenter using AIR's inland flood model to calculate property-specific gross losses to the NFIP associated with thousands of simulated events. The gross loss estimates were aggregated to the county level before they were shared with CBO. CBO reduced the county-level estimates by 50 percent, after Guy Carpenter advised CBO that its analysis of the model results showed that such a reduction could be justified.

Unadjusted County-Level Gross Losses From Hurricane-Related Precipitation

In addition to creating storm surges, precipitation from hurricanes can cause rivers, lakes, streams, and ponds to overflow. Although CBO had estimates (from the model simulations) of gross losses from storm surge and inland flooding not associated with hurricanes, the agency did not have access to modeled estimates of gross losses at the county level from hurricane-related precipitation. Therefore, the agency developed a method to estimate those losses.

CBO first estimated each state's annual gross losses arising from hurricane-related precipitation and then allocated the state-level losses to counties on the basis of factors that indicated each county's vulnerability to associated flooding.[3] State- and county-level estimates were adjusted so that, when aggregated, they yielded national estimates of hurricane-related precipitation that were consistent with ratios of aggregated hurricane-related precipitation to modeled losses (attributable to storm surge and inland flooding) identified by Guy Carpenter in its analysis of historical data and model simulations. Unadjusted estimates are described here and indicated by a "^"; the adjustment process is described below.

Estimating State-Level Gross Losses From Hurricane-Related Precipitation

The first step in developing estimates of county-level gross losses attributable to hurricane-related precipitation was to start at the state level. For each state i, CBO estimated gross losses from hurricane-related precipitation on the basis of the state's estimated total gross losses from storm surges (county-level losses, S_j, summed across each county J for all counties J_i in state i) and a state-specific scaling factor, which indicates the relationship between gross losses from storm surges and gross losses from hurricane-related precipitation within the state:

$$\hat{P}_i = \beta_i \Sigma_j^{J_i} S_j \qquad (2)$$

where $\hat{P}_i$ is the state's estimated annual gross losses from hurricane-related precipitation and β_i is the ratio of gross losses from hurricane-related precipitation in the state to gross losses from storm surges in that state.

The estimates of β_i (see Table A-1) were provided to CBO by Guy Carpenter, which constructed the scaling factors from historical data on NFIP claims and simulations of the effects of storm surges on properties covered by NFIP policies in effect in 2012.[4] Estimates of gross losses in a state that are attributable to hurricane-related precipitation can be low if the state's gross losses from storm surges are low or if the state's scaling factor (β_i) is low. A six-step process was used to develop the state-specific scaling factors.

First, AIR Worldwide (a Guy Carpenter subcontractor) examined 35 years' worth of NFIP claims payments, categorizing each claim as arising from a storm surge,

2. The Pearson correlation coefficient (a measure of the linear correlation between two variables) was .84 for the two models' county-level estimates of expected claims attributable to a storm surge.

3. CBO's methods for this analysis were informed by personal communications as follows: for determining the relationship between modeled losses (from hurricane-related storm surges and from inland flooding) and nonmodeled losses (from hurricane-related precipitation and tropical storms) at the national level (Andy Neal, Federal Emergency Management Agency, June 15, 2016, and November 23, 2016); for allocating national totals of hurricane-related precipitation among states (Elizabeth Cleary and John Kulik, Guy Carpenter and Company, June 28, 2016); and for assigning losses from tropical storms to states and a method of distributing state-level losses from hurricane-related precipitation and from tropical storms among counties (Paul Wilson, Risk Management Solutions, August 24, 2016).

4. Guy Carpenter's analyses were commissioned by FEMA. The company provided data directly to CBO only as requested by FEMA.

Table A-1.

Estimates of Gross Losses From Storm Surges and Hurricane-Related Precipitation, by State

	Gross Losses From Storm Surges, Millions of Dollars (S_i)	Scaling Factor (β_i)	Unadjusted Gross Losses From Hurricane-Related Precipitation, Millions of Dollars ($S_i \times \beta_i$)
Alabama	10.81	2.99	32.34
Connecticut	4.98	0.33	1.64
Delaware	3.26	0.57	1.86
District of Columbia	0.03	2.13 [a]	0.07
Florida	1,026.71	0.05	51.34
Georgia	16.71	0.27	4.51
Louisiana	300.59	0.57	171.34
Maine	1.26	1.18	1.48
Maryland	3.57	2.47	8.83
Massachusetts	4.25	1.79	7.60
Mississippi	20.6	7.74	159.47
New Hampshire	0.06	32.22	2.08
New Jersey	27.45	2.20	60.38
New York	38.36	0.46	17.64
North Carolina	31.63	1.71	54.09
Pennsylvania	0.02	1,024.67	20.60
Rhode Island	1.35	0.29	0.39
South Carolina	61.57	1.52	93.59
Texas	72.87	0.91	66.31
Virginia	13.88	1.78	24.70

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency and Guy Carpenter and Company.

S_i = gross losses from storm surges summed across all counties in state *i*; β_i = ratio of gross losses from hurricane-related precipitation in state *i* to gross losses from storm surges in that state.

a. Guy Carpenter did not provide a scaling factor for the District of Columbia. CBO estimated that factor using the average for Maryland and Virginia.

inland flooding, hurricane-related precipitation, or a tropical storm.

Second, a statistical relationship was estimated for the relationship between gross losses from storm surges and from hurricane-related precipitation, according to the following process:[5]

- For each storm event, calculate a ratio of total losses from storm surges to total losses from hurricane-related precipitation.
- Determine a piecewise linear relationship between those event-specific ratios.
- Generate random noise around the piecewise linear result using a lognormal distribution with variance approximated by the data to reflect underlying variability.
- Construct a random component that applies a multiple to the result, with a probability estimated from the data for events with total surge losses below $5 billion. The reason for this step was that roughly 5 percent to 10 percent of the ratios from past events were not represented well by the linearized relationship; those ratios were substantially higher than the predicted values.

Third, historical claims data were examined to identify a distribution of state-specific, hurricane-related precipitation losses when a hurricane landed in a particular state. For hurricanes that had come ashore in Florida,

5. This method accurately approximated NFIP hurricane precipitation losses for the nation as a whole, but the accuracy weakens when the method is applied to increasingly smaller subregions of the United States.

for example, the data showed that the vast majority of associated losses were recorded not in Florida but in neighboring states.

Fourth, a large number of hurricane simulations generated estimates of state-level gross losses from storm surges for each. The statistical relationship established in the second step above was used to estimate gross losses from hurricane-related precipitation for each simulation.

Fifth, on the basis of the location of each simulated hurricane's landfall, total gross losses from hurricane-related precipitation were apportioned to individual states using the geographic distributions established in step three.

Sixth, state-specific ratios were determined by comparing each state's total gross losses from hurricane-related precipitation to its total gross losses from damage caused by storm surges, aggregated for all of the simulations.

Assigning County Shares of States' Gross Losses From Hurricane-Related Precipitation

For each county j within state i, losses from hurricane-related precipitation, $\hat{P}_j$, were estimated as a share of its state's gross flood losses from hurricane-related precipitation. That estimate was prepared on the basis of the county-level estimate of gross losses from inland flooding I_j, which served as a measure of the county's insured properties' vulnerability to flooding from precipitation, and on a measure of the county's likely exposure to hurricane-related precipitation, γ_j. Specifically, within state i, the estimate of hurricane-related precipitation for each county j was based on the county's vulnerability-weighted gross losses from inland flooding, measured as a share of the total of those vulnerability-weighted losses aggregated across all counties in the state:

$$\hat{P}_j = \hat{P}_i \frac{I_j \gamma_j}{\sum_j^{J_i} I_j \gamma_j} \quad (3)$$

Each county's vulnerability weight consisted of a weighted average of that county's share of the state's "ground-up damage" from storm surges and wind damage:

$$\gamma_j = 0.25 v_j + 0.75 w_j \quad (4)$$

where v_j is the county's share of annual expected ground-up damage from storm surges and w_j is the county's share of annual expected ground-up damage from hurricane winds. Ground-up damage includes all potentially insurable losses, regardless of whether properties actually have flood insurance. Thus, expected claims from storm surges would be a subset of ground-up damage from storm surges.

CBO used estimates of each county's share of ground-up damage from storm surges and from wind (both of which were obtained from RMS) as proxies for each county's exposure to hurricane-related precipitation. The agency gave wind damage three times more weight than it gave surge damage because of its judgment that, in areas that are vulnerable to storm surges, flooding from hurricanes is more likely to result from the surges themselves than to be caused by hurricane-related precipitation. Thus, exposure to hurricanes as indicated by wind damage is a better indicator of flood losses attributable to hurricane-related precipitation.

That method of distributing each state's gross losses from hurricane-related precipitation among the state's counties is based on CBO's assessment that the conditions that increase expected payments for claims from inland flooding in a county (the prevalence of NFIP-insured properties in low-lying areas near rivers, streams, lakes, and ponds) are likely to boost expected payments for claims in the county from hurricane-related precipitation, if such precipitation occurs in the county. Again, ground-up expected damage from storm surges and hurricane winds serves as a proxy for exposure to hurricane-related precipitation.

By that method, a county with gross losses from inland flooding but no expected damage from storm surges or hurricane-related winds is not assigned any of the state's gross losses from hurricane-related precipitation; the county's location makes it unlikely to be affected by hurricanes. Conversely, a county with significant expected damage from winds, storm surges, or both, but no gross losses from inland flooding, is not assigned any of the state's gross losses from hurricane-related precipitation. Such a county could be exposed to hurricane-related precipitation but is unlikely to have NFIP-insured, low-lying properties along bodies of water that might be flooded by such precipitation.

Unadjusted County-Level Gross Losses From Tropical Storms

On the basis of its analysis of historical claims and associated modeling, Guy Carpenter estimated that gross losses from tropical storms amount to roughly

11 percent of aggregated gross losses from storm surges and hurricane-related precipitation.[6] CBO distributed that additional 11 percent of gross losses among counties in proportion to their gross losses from hurricane-related precipitation.[7] Specifically, for each county j of the J_i counties in state i, CBO estimated expected claims payments from tropical storms, $\hat{T}_j$ as follows:

$$\hat{T}_j = 0.11\,(\hat{P}_i + S_i)\frac{I_j \gamma_j}{\sum_j^{J_i} I_j \gamma_j} \qquad (5)$$

Equation 5 includes the unadjusted estimate of state-level gross losses from hurricane-related precipitation and thus yields unadjusted estimates of tropical storm losses. The adjustment process is described next.

Adjusted County-Level Gross Losses From Hurricane-Related Precipitation and Tropical Storms

The Guy Carpenter analysis of historical claims and associated modeling indicated that—for the nation as whole—gross losses from tropical storms amounted to 11 percent of total hurricane losses (gross losses from storm surges and hurricane-related precipitation) and that nonmodeled losses (gross losses attributable to hurricane precipitation and tropical storms) amounted to 37 percent of modeled losses (gross losses arising from storm surges and inland flooding).[8] CBO adjusted the county-level estimates to ensure that the nonmodeled losses that were estimated for each county summed to totals that were consistent with the national findings from Guy Carpenter.

Specifically, CBO reduced each of the 2,984 counties' unadjusted estimates of gross losses from hurricane-related precipitation ($\hat{P}_j$) by 11 percent and each county's unadjusted estimate of gross losses from tropical storms ($\hat{T}_j$) by 3 percent. Those reductions yielded adjusted estimates of losses from hurricane related precipitation, P_j, and adjusted estimates of losses from tropical storms, T_j, that simultaneously satisfied the following constraints:

$$\sum_{j=1}^{2,984}(P_j + T_j) = 0.37\sum_{j=1}^{2,984}(S_j + I_j) \qquad (6)$$

and

$$\sum_{j=1}^{2,984} T_j = 0.11\sum_{j=1}^{2,984}(S_j + P_j) \qquad (7)$$

Total Expected Claims for the NFIP

The costs of claims under the NFIP include not only the property damage but the expenses related to investigating and adjusting the claims filed by policyholders. Those expenses were not included in the estimates of gross losses provided by FEMA. On the basis of rate-setting information and historical analyses provided by FEMA, CBO estimated that loss adjustment expenses amount to 5.4 percent of gross losses. Consequently, CBO constructed estimates of expected claims by increasing all annual gross county-level losses (S_j, I_j, P_j, and T_j) by that percentage and then aggregated the expected claims to obtain the estimate for the NFIP as a whole.

6. In contrast to the historical percentages described earlier, the 11 percent share is based on a combination of historical data and modeling. Guy Carpenter used that method to estimate that hurricane storm surges, hurricane-related precipitation, and tropical storms would constitute 38.2 percent, 19.4 percent, and 6.5 percent of total modeled losses, respectively. Thus, tropical storms account for 11 percent of combined losses from storm surges and hurricane-related precipitation. See John Kulik and Andy Neal, "C-8: NFIP Update: Initial Steps Toward Sharing U.S. Flood Risk With the Private Sector, Presentation 1" (Casualty Actuarial Society, Seminar on Reinsurance, Boston, Mass., June 7, 2016), p. 9, http://tinyurl.com/yah7hf5o.

7. The decision to distribute losses from tropical storms in the same manner as losses from hurricane-related precipitation was made because the bulk of damage from tropical storms results from precipitation rather than from storm surges (Paul Wilson, Risk Management Solutions, personal communication, October 25, 2016).

8. Specifically, modeled losses (from storm surges and inland flooding) totaled 69.3 percent of gross losses, and nonmodeled losses (from hurricane-related precipitation and tropical storms) totaled 25.9 percent of gross losses. Combined gross losses from hurricane-related precipitation and from tropical storms amounted to 37 percent of combined gross losses from storm surges and from inland flooding. See John Kulik and Andy Neal, "C-8: NFIP Update: Initial Steps Toward Sharing U.S. Flood Risk With the Private Sector, Presentation 1" (Casualty Actuarial Society, Seminar on Reinsurance, Boston, Mass., June 7, 2016), p. 9, http://tinyurl.com/yah7hf5o.

APPENDIX

B

Details of the NFIP Subsidies

Many policies issued under the National Flood Insurance Program (NFIP) carry subsidized coverage-based rates. That is, for such policies the portion of the premium charged for coverage, as opposed to the separate fees and surcharges, is less than the amount that the Federal Emergency Management Agency (FEMA) estimates would cover the average expected costs of claims and associated administrative expenses.

Subsidized insurance policies are available for buildings and their contents in four categories (see Table B-1):

- Properties constructed either before their communities' first flood insurance rate map (FIRM) was created or, for certain coastal properties, before 1981;
- Properties for which the estimated risk of flooding increased after remapping;
- Properties that, although not covered previously by flood insurance, had received federal disaster assistance as a result of flood damage; and
- Properties in areas that will be protected by levees or other flood-control structures that are under construction or repair.[1]

Two types of subsidies have been established, in law or by FEMA, with different effects on the program's finances: explicit subsidies—for this report termed discounted rates—and intentional cross-subsidies. Discounted rates contribute to the NFIP's financial shortfall by enlarging the gap between the program's income from premiums and its expected costs. FEMA estimates that the discounts for policies that were in effect on September 30, 2016, on average, covered 60 percent of the expected claims from those policies. The Congressional Budget Office estimates that discounts reduced FEMA's net income from the policies analyzed in this study by $0.7 billion.

Unlike discounted rates, intentional cross-subsidies are designed not to result in a gap between expected claims and rate receipts. If FEMA's calculations of full-risk rates are accurate, intentional cross-subsidies—which reduce rates for some policyholders while raising them for others—need not contribute to the financial shortfall. (Not discussed here are the unintentional cross-subsidies that result from FEMA's broad rate classifications, which set premiums at the same rates within a given flood zone to cover properties whether they are on expansive plains or in narrow valleys, for example.)

This appendix focuses on FEMA's coverage-based rates, so the surcharges added to all NFIP policies by the Homeowner Flood Insurance Affordability Act of 2014 are not considered either as offsets to the discounts or as sources of cross-subsidies. (For policies in effect on August 31, 2016, the NFIP's receipts from those surcharges, $25 per year for policies covering primary residences and $250 per year for all others, totaled $412 million.)

The eligibility rules for the various subsidies refer to the zones in FEMA's flood classification system:

- Zone V designates a coastal area in which "velocity" wave action adds at least 3 feet to the water level that is reached in a 100-year flood (a flood with a water level that has a 1 percent annual probability of being reached);

1. In addition, in communities that participate in the voluntary Community Rating System (CRS) program, FEMA discounts its coverage rates by 5 percent to 45 percent, depending on which of the approved measures to mitigate flood risk the community has undertaken. (Those measures are additional to the minimum requirements to reduce flood damage and support comprehensive flood management that apply to all communities in the NFIP program.) The discounts apply to policies for all insured properties other than those that are covered at preferred risk policy rates (described later). This analysis does not classify the CRS discounts as subsidies because the extent to which community-sponsored mitigation results in fewer or smaller claims, and hence the extent to which the discounts are not subsidies, has not been estimated. The CRS program is at least financially neutral, if not positive, for the NFIP: FEMA adjusts all premium rates upward to offset income lost as a result of the discounts. If community mitigation efforts reduce claims, then the premium adjustment is larger than needed and yields additional income to the NFIP.

Table B-1.

Subsidies Under the NFIP

Subsidy (Discount or Intentional Cross-Subsidy)[a]	Applicability[b]	Estimated Percentage of Policies in Effect on August 31, 2016	Rate	Eligibility Requirements		Phaseout or Time Limit
				Continuous Coverage	Acceptance of Mitigation Offer	
Subsidies for Properties That Predate Flood Maps or 1981 Construction Standards						
Pre-FIRM (Discount)	Zone A or V, built before creation of the community's FIRM, or before 1975	16.3	FEMA estimated an average subsidy of 40 percent as of September 30, 2016	If coverage is required by a lender under the mandatory purchase requirement[c]	Yes	Until the full-risk rate is reached, annual rates increase by as much as 18 percent for most primary residences and by 25 percent for nonprimary residences, businesses, and certain other properties[d]
Pre-1981 Zone V (Discount)	Zone V, built before 1981	0.1	FEMA estimated an average subsidy of 40 percent as of September 30, 2016	No	No	Until the full-risk rate is reached, annual rates increase by as much as 18 percent
Subsidies for Properties Remapped at Greater Flood Risk						
Newly Mapped Zone X (Discount)	Remapped after September 30, 2008, from Zone X to Zone A or V; covered by April 1, 2016, or within 12 months of the map revision date; and with favorable flood loss history[e]	3.9	Initial rate is the PRP rate[e,f]	Yes	No	Annual rate increases of up to 18 percent until the Zone X standard rate is reached
Other Grandfathered Zone X (Cross-Subsidy)[g]	Properties remapped from Zone X to Zone A or V but not eligible for newly mapped status	At Least 3.5[h]	Zone X standard[e]	Yes, for pre-FIRM properties	No	None
Grandfathered Zone A (Cross-Subsidy)[i]	Properties remapped from Zone A to Zone V	At Least 1.2[h]	Zone A	Generally no[j]	No	None
Grandfathered Elevation (Cross-Subsidy)[i]	Properties remapped to the same Zone A or V but at a higher base flood elevation[k]	No estimate available	Rate for the former base flood elevation	Generally no[j]	No	None
Subsidies for Previously Uninsured Properties That Received Disaster Assistance for Flood Damage						
Group Flood Insurance Policy (Discount)	Properties that did not have NFIP coverage before receiving federal disaster assistance for flood damage	0.1	$600 for three years (coverage limits are lower)	n.a.	No	Policy term is three years; no renewals

Continued

Table B-1. Continued

Subsidies Under the NFIP

Subsidy (Discount or Intentional Cross-Subsidy)[a]	Applicability[b]	Estimated Percentage of Policies in Effect on August 31, 2016	Rate	Eligibility Requirements		Phaseout or Time Limit
				Continuous Coverage	Acceptance of Mitigation Offer	
Subsidies for Properties That Will Be Protected by Levees						
AR, A99 (Discount)	Zone A properties that will be protected from a base flood event by a levee under construction or reconstruction and meeting certain other requirements	0.3	Rate charged as if the levee was fully operational	No	No	Subsidized until the levee is fully operational

Source: Congressional Budget Office, using data from the Federal Emergency Management Agency.

The subsidies included in this table are the discounts that contribute to a financial shortfall for the NFIP and the cross-subsidies that FEMA has established as a matter of policy to reduce premiums for certain policyholders. Not included are the discounts on policies associated with the Community Rating System (described in the text of Appendix B), which FEMA offsets by an upward adjustment to all premium rates. Also excluded are the unintentional cross-subsidies that result simply from FEMA's broad rate classifications.

FEMA = Federal Emergency Management Agency; FIRM = flood insurance rate map; NFIP = National Flood Insurance Program; PRP = preferred risk policy.

a. FEMA's estimates of the premium rates required to provide the funds used to cross-subsidize other policies may be too high or too low. To the extent that the estimates are too low, the cross-subsidies contribute to a financial shortfall for the NFIP.

b. Some entries refer to one of FEMA's three main classifications for its flood risk maps: Zone A, V, or X. In Zones A and V, there is at least a 1 percent annual probability of flooding. Zone V areas are coastal areas in which wave action adds at least 3 feet to the water level reached in the 1 percent flood. The annual probability of flooding in Zone X areas is below 1 percent.

c. The requirement that owners of property in Zones A and V with federally supported mortgages carry flood insurance.

d. Annual increases of up to 18 percent apply to individual rates; average increases within each rate class (for example, pre-FIRM Zone A) are limited to 15 percent. Policies for which the annual increase is 25 percent include those for which property damage or improvement after July 6, 2012, decreased or increased the structure's fair market value by more than 50 percent; those for which total NFIP payments have exceeded the fair market value of the property; and those for which four or more payments of at least $5,000 each have been made.

e. PRP and standard rates are the two that apply to Zone X properties; standard rates are higher. To be eligible for "newly mapped" status, a property's loss history must meet the requirements of a PRP property: In any 10-year period, flood losses must not have led to more than three payments under the NFIP, more than three federal disaster relief payments, or any combination of three such payments of $1,000 or more each from either of those sources.

f. As of October 1, 2016, policyholders paid an annual federal policy fee of $50 for a "newly mapped" property, higher than the $25 fee for a PRP property that did not qualify for the PRP rate on the basis of being newly mapped.

g. NFIP officials take the program's loss experience on grandfathered Zone X properties into account in setting Zone X standard rates. Over time, nongrandfathered properties should provide most or all of the subsidy for the grandfathered properties.

h. Lower-bound estimate based on 79 percent of NFIP policies. CBO could not identify grandfathered status for the 21 percent of policies because the properties were not included in FEMA's digital flood maps or because the policies covering them lacked precise location information.

i. NFIP officials increase the full-risk rates for Zones A and V to compensate for an estimated 20 percent of exposure in those rate classes arising from grandfathered properties. Those properties could contribute to a financial shortfall if actual grandfathering exceeds 20 percent.

j. A property that conformed to the building codes for the relevant flood map zone in effect at the time of construction need not be continuously covered to be eligible for grandfathering. Properties built in Zones A and V generally satisfy that condition.

k. Base flood elevation is the water height that FEMA estimates has a 1 percent annual probability of being reached.

- Zone A designates a 100-year floodplain (in which there is at least a 1 percent annual probability of flooding) not in Zone V; and

- Zone X designates any mapped area that is not inside a 100-year floodplain.

Zone X properties are assigned one of two rate schedules: standard or preferred risk policy (PRP). Properties with little or no history of NFIP claims or federal disaster relief payments for flood losses are assigned the lower PRP rate.

FEMA sets full-risk rates for properties in Zones V and A on the basis of its analyses of expected flood losses. The standard rates for Zone X are set on the basis of historical claims experience, as informed by the professional judgment of FEMA's actuaries. In the absence of significant claims experience for the PRP properties, FEMA relies on the actuaries' judgment in setting those rates.

FEMA has raised particular rates to offset the income losses from some cross-subsidies. Specifically, FEMA adds 20 percent to its full-risk rates for Zone V and A properties to offset the income losses from the cross-subsidies to properties in those zones. Two groups of Zone V or A properties receive cross-subsidies, paying lower, grandfathered rates after remapping has shown increased risk of flooding: Those for which remapping has identified a higher base flood elevation continue to be charged according to their previous elevation, and those that have been remapped from Zone A to Zone V continue to be charged Zone A rates.[2]

In contrast, FEMA need not make any specific adjustment to offset the income loss resulting from the cross-subsidy to properties grandfathered at the Zone X standard rate after they have been remapped into Zone A or V. Because Zone X standard rates are set on the basis of claims experience of properties located in Zone X or grandfathered at Zone X rates, those rates rise if properties whose estimated risk has increased (as shown by their remapping from Zone X into Zone A or Zone V) experience more frequent or costlier claims. The result is a cross-subsidy from policyholders whose properties remain located in Zone X.

The other subsidies, which are not offset by higher premium rates on other policies, contribute to a shortfall in the NFIP's finances. However, each subsidy is available for only a limited time:

- Premiums for properties receiving pre-FIRM and pre-1981 Zone V subsidies are subject to annual increases of up to 18 percent (for some pre-FIRM properties, the annual increase is 25 percent) until the full-risk rate is reached.

- Premiums with PRP rates under FEMA's "newly mapped" designation are subject to increases of up to 18 percent per year until the Zone X standard rate is reached. Qualifying policies cover properties that were newly mapped from Zone X to Zone A or Zone V and have favorable loss histories.

- Group flood policies, which are sold to previously uninsured property owners who received federal disaster assistance for flood damage, are limited to three years and cannot be renewed.

- Premiums for properties that will be protected from a base flood event when construction or repair of a levee or other flood-control structure is completed are no longer subsidized when the work is completed.

2. The base flood elevation is the water height that FEMA estimates has a 1 percent annual probability of being reached.

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About This Document

This Congressional Budget Office report was prepared at the request of the Chairman of the House Committee on Financial Services. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

The analysis was prepared by Terry Dinan, Perry Beider, and David Wylie with assistance from Jon Sperl and with guidance from Joseph Kile and Chad Shirley. Kim Cawley, Molly Dahl, Damien Moore (formerly of CBO), David Torregrosa, and Robert Reese provided comments.

Lloyd Dixon of the RAND Corporation, Carolyn Kousky of the University of Pennsylvania, and Rade Musulin of FBAlliance Insurance also commented. The Federal Emergency Management Agency; Guy Carpenter and Company, LLC; and Risk Management Solutions provided data. (The assistance of external reviewers, companies, and agencies implies no responsibility for the final product, which rests solely with CBO.)

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Director
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