DISCUSSION PAPER

March 2011 ■ RFF DP 11-14

Redistributional Effects of the National Flood Insurance Program

Okmyung Bin, John A. Bishop, and Carolyn Kousky

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org

RESOURCES FOR THE FUTURE

Redistributional Effects of the National Flood Insurance Program

Okmyung Bin, John A. Bishop, and Carolyn Kousky

Abstract

This study examines the redistributional effects of the National Flood Insurance Program (NFIP) using a national database of premium, coverage, and claim payments at the county level between 1980 and 2006. Measuring progressivity as the departure from per capita county income proportionality, we find that NFIP premiums are typically proportional if the time horizon is extended beyond a single year, while claim payments are moderately progressive over all time horizons studied. The net effect of the NFIP program, defined as indemnity payments net of premiums, indicates that NFIP is proportional or at most mildly progressive, while the effect is modest. In sum, we find no evidence that the NFIP disproportionally advantages richer counties.

Key Words: NFIP, progressivity, departure from proportionality

JEL Classification Numbers: D31, G22, Q54, R38

Contents

Redistributional Effects of the National Flood Insurance Program

Okmyung Bin, John A. Bishop, and Carolyn Kousky*

1. Introduction

Damage from flood events is not covered by homeowners insurance policies and flood insurance is not widely available on the private market. Flood coverage is offered federally, however, through the National Flood Insurance Program (NFIP), established by the National Flood Insurance Act of 1968. Under current provisions, if communities choose to adopt minimum floodplain management policies, their residents become eligible for this insurance backed by the federal government. The goal of the NFIP is to contain the rising costs of flood events and to provide economically feasible relief to victims to help fuel recovery (Pasterick 1998). The NFIP is currently managed by the Federal Emergency Management Agency (FEMA) within the Department of Homeland Security. As of June, 2011, there were just over 5.5 million policies-in-force nationwide.

The NFIP has been the subject of renewed interest in recent years. Unprecedented losses associated with Hurricane Katrina and the other storms of the 2005 hurricane season sent the program deeply into debt, drawing the attention of people living in floodplains, insurance companies, and lawmakers. The NFIP was not designed to cover catastrophic loss years and its current debt to the U.S. Treasury from the 2005 claims—almost $19 billion—has raised concerns about the program's long-term financial solvency.[1] The NFIP will be unable to repay its debt given the current structure of premiums. Should Congress forgive it, taxpayers will bear the costs of returning the NFIP to solvency. In addition to debating debt forgiveness, lawmakers are also considering a wide range of other reforms to the program to address both financial soundness and concerns about who is and who should bear the burden of flood and hurricane costs.[2]

Debate has emerged regarding the redistributional effects of the program. Little is known about whether some groups benefit disproportionately from the way the rates are currently

* Okmyung Bin, Department of Economics, East Carolina University, Greenville, NC 27858; (Phone) 252-328-6820, (Fax) 252-328-6743, bino@ecu.edu. John A. Bishop, Department of Economics, East Carolina University, Greenville, NC 27858; (Phone) 252-328- 6756, (Fax) 252-328-6743, bishopj@ecu.edu. Carolyn Kousky, Resources for the Future, 1616 P St., NW, Washington, D.C. 20036; (Phone) 202-328-5188, (Fax) 202-939-3460, kousky@rff.org. Kousky's work on this project was supported by National Science Foundation grant #1062039.

structured or the program is administered. Some media accounts and advocacy groups have argued that the NFIP routinely subsidizes some of the wealthiest and most irresponsible property owners (Brannon and Lowell 2011; Holladay and Schwartz 2010; Kearns and Fontana 2007). Holladay and Schwartz state that "the benefits of the NFIP…are enjoyed by the wealthy counties." They suggest that the program disproportionately benefits wealthy households and owners of vacation homes, many of which are expensive waterfront properties. Others have suggested that the program is a form of assistance for the poor who could not afford to purchase flood insurance at private market rates. There are concerns that the flood insurance reforms enhancing the program's actuarial soundness could have unintended impacts on home ownership, including property values and the cost of mortgage credit (King 2006). In this study we provide, as far as we are aware, the first empirical evidence on the overall redistributional effects of the NFIP.

Our analysis of the redistributive effects of the NFIP is based on a unique national database of the total dollars of premium, coverage, and claims paid per county per year from 1980 to 2006. We measure progressivity as the departure of total county premiums and program payouts from per capita county income proportionality. We find that NFIP premiums are typically proportional as the time horizon is extended beyond a single year, while claim payments are moderately progressive over all time horizons studied. The combined or net effect of the NFIP program, defined as indemnity payments minus premiums, shows that the NFIP is proportional or at most mildly progressive while the effect is modest. In sum, we find no evidence that the NFIP disproportionally advantages richer counties.

The next section of the paper offers background on the NFIP relevant to understanding its redistributional effects. Section three discusses our data while the fourth section presents our methods. The fifth section summarizes the results, and the sixth section concludes with a discussion of our findings and some important caveats to our conclusions.

2. Background on the NFIP

The NFIP was created in 1968 out of a concern that private companies were not willing or able to cover flood risk due to the catastrophic nature of losses, spatial correlation, and adverse selection. It was thought a government program could overcome these challenges. The NFIP was designed as a partnership between the federal government and local communities. FEMA maps the flood hazard in participating communities on Flood Insurance Rate Maps (FIRMs). Participating local governments then adopt baseline regulations in high-hazard areas and, in exchange, the federal government provides insurance to homeowners and businesses.

Homeowners can purchase up to $250,000 of building coverage and up to $100,000 of contents coverage. Business-owners can purchase up to $500,000 each of both building and contents coverage.[3]

Concerns about the costs of flooding and low take-up rates led Congress in 1973 to make the purchase of flood insurance mandatory for property-owners in 100-year floodplains with a mortgage from a federally backed lender. Take-up rates remained low in the early years of the program, but they have grown steadily over the decades. Still, following major flood events, concern is often expressed that many at-risk homeowners remain without coverage. An estimate of take-up rates in 100-year floodplains by RAND Corporation found high regional variation, with the South and West having the highest take-up rates of around 60 percent, while in the Midwest, take-up rates are only around 20-30 percent (Dixon et al. 2006). The NFIP is also highly concentrated geographically, with 40 percent of all policies-in-force nationwide located in Florida and close to 70 percent of all policies located in just five states: Florida, Texas, Louisiana, California, and New Jersey (Michel-Kerjan and Kousky 2010).

There are two types of policies in the NFIP: actuarial policies and discounted policies. For both types of policies, rates for flood insurance vary by the flood zone indicated on the FIRM and structural characteristics of the property. Currently 78 percent of all policies-in-force are what FEMA calls "actuarial," meaning they are priced using hydrologic models that include catastrophic loss year scenarios.[4] The remaining 22 percent of policies are discounted. These are sometimes referred to as subsidized policies, but it is important to note that these are not subsidized by the general taxpayer. Rather, the discounted policies prevent the program from developing a catastrophe reserve. In 1981 it was decided that the combined revenue from the actuarial and the discounted policies should be enough to cover losses from the "average historical loss year." After a series of rate increases on the discounted policies, this was achieved in 1986. Due to the discounted policies, therefore, the program does not build up a capital reserve to cover high loss years, such as 2005. If Congress forgives the debt incurred from the 2005 season, however, the general taxpayer will be subsidizing these policyholders.

The largest portion of the discounted policies is referred to as "pre-FIRM." These structures were built before the FIRM for a community was available and were offered at discounted rates to encourage communities to join the program, to have homeowners cover at least some of the costs of flood losses (on the supposition that full rates would be so high that individuals would not insure and thus require more disaster aid), and to prevent the abandonment of otherwise economically viable structures through high premiums (Hayes and Neal 2009). Post-FIRM, new construction is charged actuarial rates. The subsidy applies only to the first

$35,000 of coverage on the building and $10,000 on contents, although the mean and median claims in 2004 were below these limits (CBO 2007). Subsidized properties become required to pay actuarial rates when they are damaged at half the property value or when improvements increase their value by 50 percent or more (CBO 2007). It was, therefore, thought the subsidy would phase out quickly as structures were damaged or improved, but modern construction techniques have extended the life of buildings (Pasterick 1998; CBO 2007).

After Hurricane Katrina, the NFIP paid out more in claims than had previously been paid over the entire life of the program (Hayes and Neal 2009).[5] The NFIP had to borrow heavily from the Treasury and its debt currently exceeds $19 billion. While the NFIP had borrowed from the Treasury in previous years, it was always a small enough amount that it could subsequently be repaid. The program is unlikely, though, to be able to repay the current debt from Katrina. Forgiveness of the debt by Congress would create a subsidy from the general taxpayer to the program, particularly to those policyholders with discounted premiums.

Partially in response to the high debt, the program is currently the target of a reform effort by FEMA and proposed legislation in Congress. This policy debate has raised questions concerning the distributional impacts of the program. Some advocacy groups are concerned that the NFIP is regressive. For example, The American Action Forum released a report arguing that subsidies in the NFIP "benefit upper-income households, particularly in Gulf States" (Brennon and Lowell 2011). This was echoed in a 2010 report from the Institute for Policy Integrity at New York University School of Law that the financial risks and ecological damage the NFIP induces are born by all taxpayers but the benefits primarily go to wealthy counties and vacation homeowners. Such reports often reference the fact that there have been large claims payments to higher income areas or that many expensive beachfront homes have policies and receive claims. This neglects the fact that these areas also pay more in premiums. Indeed, an accurately priced insurance program should be neither progressive nor regressive. Of course, the concern with the NFIP is that its rates are not risk-based, potentially introducing cross-subsidization into the program.

Distributional consequences could arise from two NFIP pricing policies. First is the discounted rates.[6] In general, discounts for pre-FIRM properties are discounts to older structures. If this is correlated with income, there would be distributional consequences. We, unfortunately, do not have data on which policies are subsidized and which are not and also do not have data on homeowner income or home value and so cannot comment on whether the subsidies currently built into the NFIP inherently go more to higher-income households. A CBO report found, out of a sample of 10,000 households in the NFIP, subsidized coastal properties tend to be higher

valued, although this is largely because the land is more valuable, not the structure, and that inland subsidized properties are generally less valuable than inland unsubsidized properties (CBO 2007). The CBO report also found that just under a quarter of subsidized coastal properties are for second homes, vacation homes, or homes rented out year round (CBO 2007).

Second, as rates are now set to cover the average loss year, the program cannot handle catastrophic years. If taxpayer funds are required to cover high loss years (like 2005), this could also have distributional consequences. It would mean the general taxpayer was covering some of the costs of floodplain residents. No taxpayer money has yet been put into the program and we do not consider the distributional consequences of doing so, although this is worthy of further study.

In this paper, we are able to look at total premiums and claims at the county level. We can thus analyze at the county level whether the program has been regressive or progressive overall. This offers initial empirical guidance to policymakers on an area of interest to the reform effort that is currently very data scarce. It should also suggest areas of more detailed study on this topic, which is unfortunately limited by the fact that the NFIP does not collect income data for policyholders.

3. Data

This study utilizes data on total claims paid, the number of policies-in-force, and the total premium intake at the U.S. county level from 1980 to 2006,[7] which allows for a county-level analysis of how claims compare to premiums. Table 1 shows the descriptive statistics of the variables by states. Total premium intake during the period was about $38 billion while the total claims payments were about $37.4 billion.[8] The top five states in terms of total paid claims – Louisiana, Florida, Texas, Mississippi, and Alabama – represent about 75 percent of the total claim payments for the nation as a whole. Louisiana has the highest claim payments which total $16.5 billion or 44.2 percent of the total claim payments, followed by Florida ($4 billion or 10.8 percent of the total payments) and Texas ($3.5 billion or 9.4 percent of the total payments). This finding is largely driven by the unprecedented loss of the 2005 hurricane season on the Gulf Coast.[9] When we exclude the year 2005, the ranking changes to Texas (17.8 percent), Florida (17.6 percent), Louisiana (13.0 percent), North Carolina (4.6 percent), and New Jersey (4.5 percent). The top five states in terms of the premium payment – Florida (34.6 percent), Texas (9.4 percent), Louisiana (9.1 percent), California (7.6 percent) and New Jersey (5.8 percent) – represent about 67 percent of the total amount.

Table 2 shows the summary statistics by year. The number of NFIP policies has increased by about 170 percent between 1980 and 2006, an average increase of 6.5 percent per year. The premium intake has steadily increased over time, from rising prices and more policies-in-force, while the claim payments appear to be highly correlated with the occurrence of historical hurricanes.[10] Hurricanes Charley and Ivan each made a landfall in Florida and Alabama in 2004, followed by Hurricanes Katrina and Rita along the Gulf Coast in 2005. The claim payments in 2004 and 2005 and represent 6.3 percent and 48.2 percent and of the total claims paid from 1980 to 2006, respectively. The average premium paid in 2006 was $472. The average premium per policy between 1980 and 2006 is about $432, and the average claim per policy during the period is approximately $368.

Per capita personal income by year for each county is used in the analysis of the redistributive effect of the NFIP.[11] Between 1980 and 2006, about 94 percent of U.S. counties had at least one NFIP policy-in-force and 80 percent of the counties filed at least one claim. Counties with at least one policy had on average per capita personal income of $24,543 whereas counties without a policy had per capita personal income of $24,923. Counties that filed claims had on average per capita personal income of $24,846 and counties that did not file claims had, on average, per capita personal income of $23,371. Per capita claim payment exhibited high variation—the standard deviation was about $37.76, while the standard deviation of per capita premium was $12.58. The highest per capita premium and per capita claim payment was $251.62 and $1,309.48, respectively.

4. The Measurement of NFIP Progressivity

In this study, we adapt the well-established tools of tax progressivity to evaluate the equity implications of the NFIP. Modern tax progressivity theory has at its roots Musgrave and Thin (1948), who were attempting to quantify an equitable approach to reducing taxes in the early post-war period. More recent developments in measurement of progressivity are well-summarized by Lambert (2002). In their most general form, tax progressivity measures are based on the familiar Lorenz curve measure of inequality and its associated concentration curve.

The most commonly used measure of progressivity focuses on the net redistributive effect of a fiscal action such as taxes, transfers, and other government programs. This net redistributive effect, which is often referred to as residual progression, measures the equalizing effect of the fiscal action. A fiscal action that improves upon the underlying income distribution is progressive, while a fiscal action that results in greater inequality is regressive. Alternatively, there are well-established measures of the departure from proportionality, also based on the

Lorenz curve. This departure from proportionality, also known as liability progression, measures the share distribution of the policy effect across units with varying pre-policy income. Thus increases in progressivity are associated with enhanced departure from proportionality for pre-policy income distribution.

In the case of taxes, the crucial difference in these classes of measures is that the net redistributive effect is influenced by the magnitude of taxes relative to income (tax height), while departure from proportionality is scale invariant. When the level of tax height varies across time, these two measures can tell very different stories about changes in tax progressivity, but both are valid and offer some insight into changes in tax progressivity. Alternatively, when the tax height are the same the two measures provide identical progressivity rankings. In our case, NFIP premiums are small relative to total county income so we can ignore the "tax height" and focus on the departure from proportionality measure of progressivity.

We begin by defining the Lorenz curve and its related concentration curve. Let $0 \le F^{-1}(p) \le \infty$ be the inverse cumulative distribution function of *x*, and without loss of generality, let $\tau = F^{-1}(p)$. Following Bishop, Chow and Formby (1994), the Lorenz ordinates of *x* (for our analysis, x represents pre-NFIP county income) and the concentration ordinates of *y* (premiums or payments) can be written as follows:

$$L(\tau; x) = \mu_x^{-1} \int_0^{\tau} xf(x)dx = \mu_x^{-1} \int_0^{\infty} xI_{\tau}^{x} dF(x) = E\left[xI_{\tau}^{x}\right] / E[x], \tag{1}$$

where μ_x is the mean of *x*, $I_{\tau}^{x} = 1$ if $x \le \tau$ and $I_{\tau}^{x} = 0$ otherwise,

$$C(\tau; y) = \mu_y^{-1} \int_0^{\tau} \int_0^{\infty} yf(x, y)dydx = \mu_y^{-1} \int_0^{\infty} \int_0^{\infty} yI_{\tau}^{x} f(x, y)dydx = E\left[yI_{\tau}^{x}\right] / E[y]. \tag{2}$$

$L(\tau; x)$ represents the proportion of pre-NFIP per capita county income received by counties with incomes *x* less than or equal to τ.[12] $C(\tau; y)$ indicates the proportion of per capita payments received by counties with incomes *x* less than or equal to τ. A payout concentration curve, $C(\tau; z)$, orders payouts (*z*) by county per capita income. Unlike ordinary Lorenz curves a concentration curve can lie above the 45 degree line.

Following Kakwani (1976) and Jakobsson (1976), there is a progressive departure from proportionality of the flood insurance payouts if:

$$C(\tau; z) - L(\tau; x) \geq 0 \tag{3}$$

with one strict inequality prevailing at some τ. We can evaluate NFIP per capita premiums in a similar manner; however, the sign on equation (3) must be reversed. For NFIP premiums to be progressive, counties must have paid premiums in a smaller proportion than their income.

The final issue to be considered in this section relates to which of the many indices of departure from proportionality (*DP*) to use to evaluate the flood insurance program. A frequent choice is the index based on the familiar Gini coefficient of inequality and its associated concentration index.

Given a continuous distribution $F(x)$, the covariance definition of the Gini index is

$$G_X = \frac{2}{\mu_X}\int_0^\infty xF(x)dF(x) - 1 = (2/\mu_X)\,\mathrm{cov}\{x, F(x)\} \tag{4}$$

and the associated concentration index for $y = g(x)$ is

$$C_y = \frac{2}{\mu_y}\int_0^\infty g(x)F(x)dF(x) - 1 = (2/\mu_y)\,\mathrm{cov}\{g(x), F(x)\}\,. \tag{5}$$

The departure from proportionality is measured as twice the area between the Lorenz curve for pre-program income (X) and the concentration curve for payouts (PO) and premiums (PR):

$$\Pi^{PO} = G_X - C_{PO}\,. \tag{6a}$$

$$\Pi^{PR} = C_{PR} - G_X\,. \tag{6b}$$

Using the definitions in (6a) and (6b) results in a positive sign under progressivity and a negative sign for regressivity. Finally, we note that these measures of progressivity are based on sample data. A finding of Π (statistically) equal to zero implies proportionality. Inference tests for *DP* measures are provided by Bishop et al. (1994; 1998).[13]

5. Results

Flooding is a catastrophic risk by nature. Most years, there will be only minimal damage, and yet some years damages will be extremely high, as the program saw in 2005. With a risk such as this, it is not clear over what time period it is optimal to examine distributional impacts.

The years of high claims will have a dominating influence on the analysis. For a flood event that has an annual probability of 1 in 100 or 1 in 500, a few decades is not enough data to accurately assess whether the prices are matching the risk. It just so happened that Katrina hit many low-income communities, leading to high payments in these areas. Should next year bring a devastating storm to West Palm Beach, Florida, the impact of claims payments might look much more regressive.

This might suggest that we are unable to accurately examine the distributional impacts of the program without centuries of data, but we do not believe this to be the case for two reasons. First, there is a distribution of floods—while catastrophic floods occur rarely, smaller-scale flooding occurs much more frequently. The distributional consequences of more frequent, but smaller, flood events is still of policy concern, particularly since this is the most common type of flood event. We can analyze this by looking at progressivity over many years. Here, we look at progressivity in 5 year, 10 year, and a 25 year blocks.[14] Second, while looking at one location over only a short time period would likely not capture the distributional impact of the program, we have data for the entire country. There is some correlation in flood risk around the country due to weather patterns and the spatial distribution of river systems, but having data on the entire country over space compensates for having fewer observations over time.

We begin our analysis of NFIP progressivity by examining the departure from proportionality using Lorenz and concentration curves for two time periods, 1991-1995 (Table 3a) and for the 1980-2006 (Table 3b). Column 1 provides the Lorenz ordinates for per capita county income, column 2 provides the concentration ordinates for per capita premiums, and column 3 provides the concentration ordinates for per capita NFIP payments. All three columns are population weighted.

The first column in Table 3a shows that the bottom 10 percent of counties received 6.5 percent of total income over the period 1991-1995. These counties paid 5.8 percent of the premiums and received 6.8 percent of NFIP payments. A progressive departure from proportionality requires that every premium decile be smaller (no larger) than its corresponding income decile. While for the 1st, 3rd and 4th deciles the share of premiums paid is less than the share of county income, the opposite is true for the remaining deciles. We can summarize this finding by noting that the DP index (-0.018) is not significantly different from zero, implying that premiums are proportional to income. In contrast, the concentration ordinates for payments are all larger than the corresponding Lorenz ordinates for income implying that NFIP payments are progressive. The progressivity of NFIP payments is shown in Figure 1, where the concentration curve of NFIP per capita payments lies everywhere above the Lorenz curve of per

capita county income. As noted above, the concentration curve can (and does in this case) lie above the 45 degree line. The findings in Table 3b for the entire period 1980-2006 are consistent with those from the five year period 1991-1995.

Table 4 provides the departure from proportionality findings for 5 year time periods, the decades of the 1980's and 1990's, and for the overall period 1980-2006. In all time periods considered NFIP payments are progressive—all of the DP indexes are positive and significant. In all cases (except for 1996-2000) the NFIP premiums are proportional to county income.

To assess the combined or net effect of NFIP program, Table 5 provides the net dollar values of the NFIP program (NFIP payments – NFIP premiums). As noted above, DP progressivity indexes are not defined over negative values. So we report simply the net dollar value by county per capita income decile. Like Table 4, our results are for 5 year time periods, decades, and the overall 1980 to 2006 periods. Again, like Table 4, we exclude 2005 (Hurricane Katrina).

The first observation is the modest size of the NFIP. For example, the median (decile 5) county gained $0.85 per capita over the entire time period. Deciles 9 and 10 show net losses of $2.38 and $4.37, respectively. Other than mostly negative values in the top three deciles (recall the program is capped), there appears to be little pattern by income. This supports our notion that NFIP is proportional or at most mildly progressive (See Table 5).

6. Discussion and Caveats

This study offers evidence on the progressivity of the NFIP using county level data from 1980 to 2006. From county level income data we calculate population-weighted per capita income, per capita NFIP premiums, and per capita NFIP payments. Earlier studies have suggested that the benefits of the NFIP "are enjoyed largely by wealthy counties." Our findings indicate that the NFIP premiums are generally proportional while NFIP payments are moderately progressive. This suggests that while NFIP rates are not disproportionally benefitting some income groups, claims tend to be paid in lower income areas. Since rates are a function of the value of the home and there are no income-based discounts in NFIP pricing, it is intuitive that premiums would be proportional. Payments may be slightly progressive because nationally-speaking, riskier areas tend to be lower income despite discussions of mansions on the Florida coast. Sarmiento and Miller (2006) find evidence that both higher and lower income people live in flood hazard areas, the former because of the aesthetics of waterfront property, and the latter because property in risky locations (without high amenities or costly flood mitigation measures)

is cheaper. They also estimate that flood damages are higher to lower income groups, consistent with our findings, as well.

A number of caveats, however, are in order. First, our findings are by no means a complete measure of the redistributional effects of the NFIP as we have no information about the individual income of policyholders. We can thus only make statements about aggregate redistributional effects at the level of the county. Our findings would hold for individuals as well, if the income of those buying insurance was symmetric around the income of the county population. While ours is a useful first-order assessment, the largest redistributional effects in the program are likely between those policyholders paying discounted rates and those paying actuarial rates. Unfortunately, the income of those subsidized homeowners is unavailable. More detailed analysis of the redistributional effects at the individual level is warranted since claims payments are concentrated on a few policies. Around 30 percent of claims payments are made to only about 1 percent of policyholders—these are the so-called repetitive loss properties. FEMA has estimated that around 90 percent of repetitive loss properties were constructed pre-FIRM (King 2005) and thus are also paying subsidized rates for their insurance.[15]

Second, we have examined the redistributional effect of the programs premiums and claims, not any infusion of taxpayer dollars.[16] If Congress chooses to forgive the NFIP's debt, this will create a cross-subsidy from the general taxpayer to policyholders in the program that have been paying rates that did not include a catastrophe loading to cover an event like 2005. Understanding the redistributional effects of this debt forgiveness would require comparing the income of the general taxpayer to policyholders in the program.

If the risks of flooding can be accurately modeled, then an insurance program should not have any redistributional effect. Premiums paid should be proportional to the value of the insured structure and the risk that it faces. The NFIP, however, is a government program and its pricing and policies has been subjected to political pressure. This first-order analysis suggests that this influence has not been directed disproportionally at helping higher income communities, as some critics of the NFIP claim. The slight progressivity we find in payments, however, does suggest that the poor may be more at risk for flood damage, whether this is due to location or less adoption of flood mitigation measures. While economists would argue that insurance prices should be risk-based and any redistribution handled through other channels (and we concur), this analysis does suggest there may be a public role in reducing the vulnerability of lower income households to disaster damages. Finally, it is important to note that this finding of slight progressivity in claims payments is still based on those who purchase insurance. There may be low income households in risky locations who choose to forgo insurance because the funds are

needed for necessities. Vouchers to help such households afford insurance may be socially desirable.

Endnotes

1. Although the NFIP is supposed to be funded with premiums collected from policyholders rather than with tax dollars, the program is, by design, not actuarially sound (see section 2 for more details). The program is not structured to build a capital surplus, is likely unable to purchase reinsurance to cover catastrophic losses, cannot reject high-risk applicants, and is subject to statutory limits on rate increases (GAO 2010).
2. The U.S. Congress is discussing options for NFIP reform, including i) a phase out of the program's rate subsidies, ii) an increase in the amount FEMA can raise rates each year, and iii) the encouragement of private insurer and reinsurer participation in the market (H.R. 1309, The Flood Insurance Reform Act of 2011).
3. Congress has modified the coverage limits several times but they have been unchanged since 1994. They are not indexed to inflation. When the total coverage available is indexed to 2008 prices, the real value of this limit has varied over our time period by up to $200,000 2008 dollars (Michel-Kerjan and Kousky 2010). Most homeowners purchase coverage below the limit (Michel-Kerjan and Kousky 2010).
4. The GAO, however, recently reported that the data used is in some cases out-of-date or inaccurate and thus might be preventing the program from charging appropriate premiums (GAO 2008).
5. These are payments for insured properties. Congress also appropriated over $60 billion in disaster relief for Hurricane Katrina. Some of this money does go to grants for individuals (who may be uninsured) but the amount is limited to just over $30,000.
6. Rates should not vary by value of the property unless property characteristics that drive rates, such as elevation or whether there is a basement, are correlated with value.
7. The authors would like to thank Tim Scoville and Scott Holladay for the data.
8. Premiums, coverage, and claim payments are adjusted to the 2006 level using a consumer price index for the US city average.
9. The Congressional Budget Office estimated the value of capital stock destroyed by Hurricanes Katrina and Rita in the range of $70 billion to $130 billion, and the State of

Louisiana estimated that the economic damage to the state alone could reach $200 billion (US Government Accountability Office 2007).

10. Damage from hurricanes comes from storm surge, wind, and flooding. The NFIP does not cover wind damage, only flood losses from the storm surge and intense rainfall. During Katrina, flooding was also caused by levee failures.
11. Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.
12. It is important to note that in the construction of Lorenz curves and Gini coefficients we weight per capita income by population. Thus major urban counties are counted in proportion to their population size.
13. A natural question to ask is why not to combine NFIP premiums and payments into an overall DP index. The answer is that this can result in negative values and the concentration index is not well defined over negative values. We provide some results on overall program progressivity in Table 5 below.
14. The appendix provides the DP indexes for per capita NFIP premiums and payments on an annual basis for the period 1980 to 2006.
15. Efforts have been made to bring these structures into compliance with floodplain regulations, to remove them completely, and to reduce the amount of the subsidy. Severe repetitive loss properties are being transferred to the NFIP Servicing Agent's Special Direct Facility (SDF). The properties are eligible for special mitigation grants.
16. See Wildasin (2008) for a discussion of federal commitments to insure losses from future disasters.

References

Bishop, J.A., K.V. Chow, and J.P. Formby. 1994. A large sample test for differences between Lorenz and concentration curves. *International Economic Review* 35: 479-488.

Bishop, J.A., J.P. Formby, and B. Zheng. 1998. Inference tests for Gini-based tax progressivity indexes. *Journal of Business and Economic Statistics* 16: 322-330.

Brennon, I. and E. Lowell. 2011. Rebuilding our nation's flood insurance program. American Action Forum. Online at: http://americanactionforum.org/sites/default/files/National%20Flood%20Insurance%20AAF.pdf

CBO. 2007. Value of properties in the National Flood Insurance Program. Washington, D.C., Congressional Budget Office, June.

Dixon, L., N. Clancy, S. A. Seabury, and A. Overton. 2006. The National Flood Insurance Program's market penetration rate: estimates and policy implications. Santa Monica, California, RAND Corporation, February.

Federal Emergency Management Agency. 2002. *After Floyd - North Carolina Progress*.

GAO. 2007. Preliminary information on Gulf coast rebuilding. Washington, D.C., United States Government Accountability Office.

———. 2008. Flood insurance: FEMA's rate-setting process warrants attention. Washington, D.C., United States Government Accountability Office.

———. 2010. National Flood Insurance Program: continued action needed to address financial and operational issues. Washington, D.C., United States Government Accountability Office.

Holladay, J.S. and J. A. Schwartz. 2010. Flooding the market: the distributional consequences of the NFIP. New York, NY, Institute for Policy Integrity, New York University School of Law.

Hayes, T. L. and D. A. Neal. 2009. Actuarial rate review: in support of the recommended May 1, 2009, rate and rule changes. Washington, D.C., Federal Emergency Management Agency.

Jakobsson, U. 1976. On the measurement of the degree of progression. *Journal of Public Economics* 5: 161-168.

Kakwani, N.C. 1976 Measurement of tax progressivity: an international comparison. *Economic Journal* 87: 71-80.

Kearns, M. P. and R.A. Fontana. 2007. The flood insurance dilemma: benefit or burden? Common Council, City of Buffalo, New York. Online at: http://www.ci.buffalo.ny.us/files/1_2_1/common_council/flood_report/Flood_Insurance_Report.pdf

King, R. O. 2005. Federal flood insurance: the repetitive loss problem. Washington D.C., Congressional Research Service.

Lambert, P.J. 2002. *The Distribution and Redistribution of Income*, Manchester University Press.

Michel-Kerjan, E. and C. Kousky. 2010. Come rain or shine: evidence on flood insurance purchases in Florida. *Journal of Risk and Insurance* 77(2): 369-397.

Musgrave, R., and T. Thin. 1948. Income tax progression, 1929-48. *The Journal of Political Economy* 56(6): 498-514

Pasterick, E. T. 1998. The National Flood Insurance Program. In *Paying the Price: the status and role of insurance against natural disasters in the United States* H. Kunreuther and R. J. Roth, Sr. eds. Joseph Henry Press, Washington, D.C.

Sarmiento, C. and T. R. Miller. 2006. Costs and consequences of flooding and the impact of the National Flood Insurance Program. Pacific Institute for Research and Evaluation, October.

Wildasin, D. 2008. Disaster policies: some implications for public finance in the US federation. *Public Finance Review* 36(4): 497-518.

Tables and Figures

Table 1. NFIP Policies-In-Force, Coverage, and Claims by State from 1980 to 2006

State	Policies-in-force as of 2006	Premium ($ million)	Coverage ($ billion)	Number of Paid Claims	Claim Payment ($ million)
ALABAMA	53,573	341.5	95.3	24,706	985.0
ALASKA	2,667	29.6	9.6	248	4.9
ARIZONA	34,766	277.9	90.0	2,167	39.4
ARKANSAS	16,868	120.0	23.2	3,075	49.7
CALIFORNIA	276,099	2,888.2	959.4	28,188	646.5
COLORADO	17,059	167.4	45.4	926	11.8
CONNECTICUT	35,004	417.3	101.4	9,282	160.4
DELAWARE	23,081	163.3	53.1	2,428	60.2
D. OF COLUMBIA	1,511	2.9	1.0	50	1.7
FLORIDA	2,220,841	13,154.5	5,324.5	138,087	4,046.1
GEORGIA	87,478	549.2	187.9	8,776	207.4
HAWAII	55,333	310.6	112.4	2,279	92.3
IDAHO	7,334	44.8	15.3	405	6.1
ILLINOIS	47,890	468.8	100.7	21,368	296.1
INDIANA	28,773	259.1	47.4	7,691	108.6
IOWA	10,591	109.3	18.9	4,729	82.6
KANSAS	10,550	108.9	21.1	3,728	75.4
KENTUCKY	21,827	224.1	42.4	13,217	263.4
LOUISIANA	505,336	3,471.7	1,067.1	288,635	16,525.8
MAINE	8,073	94.3	19.9	1,977	38.7
MARYLAND	64,341	394.4	135.3	9,379	257.1
MASSACHUSETTS	48,833	578.8	128.0	16,370	330.5
MICHIGAN	26,474	263.8	56.7	5,800	61.8
MINNESOTA	8,475	92.1	21.0	5,937	122.0
MISSISSIPPI	78,068	438.6	121.3	41,594	2,946.2
MISSOURI	23,732	266.9	49.0	23,877	495.1
MONTANA	3,541	31.7	7.8	632	5.6
NEBRASKA	11,985	122.6	25.7	2,195	30.6
NEVADA	16,419	118.2	39.9	956	45.4
NEW HAMPSHIRE	7,660	60.3	12.8	1,696	30.7
NEW JERSEY	218,291	2,191.3	619.5	54,411	933.0
NEW MEXICO	15,145	96.7	22.6	478	8.7
NEW YORK	134,331	1,317.1	330.7	44,372	656.7
N. CAROLINA	131,858	841.1	281.6	43,536	918.5
N. DAKOTA	5,183	68.8	15.9	5,642	156.1
OHIO	39,198	343.6	64.0	12,682	216.5
OKLAHOMA	14,454	152.1	36.4	6,724	163.8
OREGON	31,175	202.6	61.1	3,040	75.7
PENNSYLVANIA	66,883	843.8	172.7	37,955	837.6

RHODE ISLAND	14,957	183.9	39.6	1,673	38.7
S. CAROLINA	192,176	1,120.4	467.8	17,236	669.7
SOUTH DAKOTA	2,888	26.5	6.0	1,112	17.3
TENNESSEE	20,366	147.3	36.9	4,753	76.6
TEXAS	628,346	3,589.9	1,411.8	123,044	3,502.3
UTAH	4,195	27.4	8.0	485	9.3
VERMONT	3,263	36.7	6.8	660	9.2
VIRGINIA	102,664	656.2	233.0	22,143	495.5
WASHINGTON	34,127	265.2	77.2	7,111	176.9
WEST VIRGINIA	22,028	216.2	33.7	16,992	330.7
WISCONSIN	13,362	122.0	24.0	2,949	36.1
WYOMING	2,529	21.6	5.7	163	2.1
TOTAL	**5,451,601**	**38,041.0**	**12,888.5**	**1,077,190.0**	**37,358.2**

Note: The column for policies-in-force shows the number of policies as of 2006 while the other columns display cumulative counts between 1980 and 2006. Dollars are measured in 2006 USD.

Table 2. NFIP Policies-In-Force, Coverage, and Claims from 1980 to 2006

Year	Policies-in-force	Premium ($ million)	Coverage ($ billion)	Number of Paid Claims	Claim Payment ($ million)	Average Premium per Policy ($)	Average Claims per Policy ($)
1980	2,022,127	382.8	240.6	41,686	562.4	189.3	278.1
1981	1,896,521	565.8	225.4	22,078	271.4	298.3	143.1
1982	1,883,168	736.9	223.3	32,451	411.6	391.3	218.6
1983	1,964,401	773.5	237.7	51,021	884.3	393.7	450.1
1984	1,913,257	811.8	240.6	27,467	492.5	424.3	257.4
1985	2,001,446	843.1	261.3	35,749	654.2	421.2	326.9
1986	2,100,682	948.0	285.5	12,891	226.9	451.3	108.0
1987	2,102,319	1,000.0	292.1	12,207	173.0	475.7	82.3
1988	2,133,693	999.4	298.6	7,431	84.7	468.4	39.7
1989	2,278,446	1,022.5	430.2	35,498	1,061.8	448.8	466.0
1990	2,461,336	1,031.8	328.3	14,568	257.9	419.2	104.8
1991	2,516,038	1,084.9	329.1	28,444	520.2	431.2	206.7
1992	2,598,402	1,142.0	338.8	44,065	1,010.3	439.5	388.8
1993	2,801,428	1,232.6	371.9	34,288	849.5	440.0	303.3
1994	3,011,990	1,355.1	400.6	20,879	534.5	449.9	177.5
1995	3,444,174	1,497.4	457.2	61,753	1,693.1	434.8	491.6
1996	3,655,774	1,624.2	499.8	50,955	1,028.8	444.3	281.4
1997	4,055,957	1,878.7	577.9	30,251	651.4	463.2	160.6
1998	4,186,084	2,043.0	612.1	54,538	1,057.6	488.1	252.7
1999	4,276,183	2,057.6	642.6	46,916	901.8	481.2	210.9
2000	4,318,008	1,995.5	660.6	16,237	292.6	462.1	67.8
2001	4,409,144	1,958.4	692.5	43,294	1,448.2	444.2	328.4
2002	4,470,700	1,997.3	728.6	25,210	482.9	446.7	108.0
2003	4,511,058	2,055.1	753.5	36,220	832.5	455.6	184.5
2004	4,597,457	2,146.9	811.4	54,930	2,338.7	467.0	508.7
2005	4,891,691	2,281.6	899.6	211,694	18,004.3	466.4	3,680.6
2006	5,451,601	2,575.2	1,048.7	24,469	631.1	472.4	115.8
TOTAL	**3,183,448**	**38,041.0**	**12,888.5**	**1,077,190**	**37,358.2**	**432.15**	**368.23**

Note: All states and the District of Columbia are included in the data. The asterisks denote the average values from 1980 to 2006. Dollars are measured in 2006 USD.

Table 3. Lorenz and Concentration Ordinates for County Income, NFIP Premiums, and NFIP Payouts

Table 3A: 1991–1995

Lorenz		Concentration Ordinates	
Decile	**Income (1)**	**Premiums (2)**	**Payments (3)**
1	0.065	0.058	0.068
2	0.143	0.146	0.196
3	0.226	0.211	0.308
4	0.311	0.278	0.395
5	0.408	0.427	0.591
6	0.507	0.524	0.673
7	0.612	0.637	0.747
8	0.723	0.782	0.860
9	0.844	0.888	0.952
1.0	1.000	1.000	1.000
Gini[2]	0.138	0.115	-0.059
DP Index	--	0.018 #	0.192

Table 3B: 1980–2006 [a]

Lorenz		Concentration Ordinates	
Decile	**Income (1)**	**Premiums (2)**	**Payments (3)**
1	0.065	0.058	0.088
2	0.141	0.144	0.211
3	0.222	0.211	0.362
4	0.312	0.287	0.476
5	0.405	0.419	0.599
6	0.501	0.496	0.670
7	0.610	0.638	0.742
8	0.727	0.779	0.788
9	0.843	0.889	0.948
1.0	1.000	1.000	1.000
Gini[2]	0.133	0.113	-0.087
DP Index	--	0.023 #	0.223

Notes: The pound sign (#) denotes insignificance at the five percent level. Country income, NFIP premiums and payouts are in per capita terms, weighted by population. Strictly speaking, column 1 provides a Gini coefficient and columns 2 and 3 provide corresponding concentration indexes.

[a] Excludes 2005 (Hurricane Katrina).

Table 4. Departures from Proportionality, NFIP Premium and Payouts, Alternative Time Periods

Periods	Premiums	Payouts
1980-1985	Proportional -0.013 (0.019)	Progressive 0.187 (0.40)
1986-1990	Proportional -0.039 (0.20)	Progressive 0.399 (0.069)
1980-1989	Proportional -0.026 (0.019)	Progressive 0.296 (0.045)
1991-1995	Proportional -0.018 (0.018)	Progressive 0.192 (0.034)
1996-2000	Regressive -0.049 (0.018)	Progressive 0.257 (0.036)
1990-1999	Proportional -0.027 (0.018)	Progressive 0.256 (0.027)
2001-2006*	Proportional -0.027 (0.017)	Progressive 0.155 (0.034)
1980-2006*	Proportional -0.023 (0.018)	Progressive 0.223 (0.023)

Notes: The first number is DP index and the second is standard error.

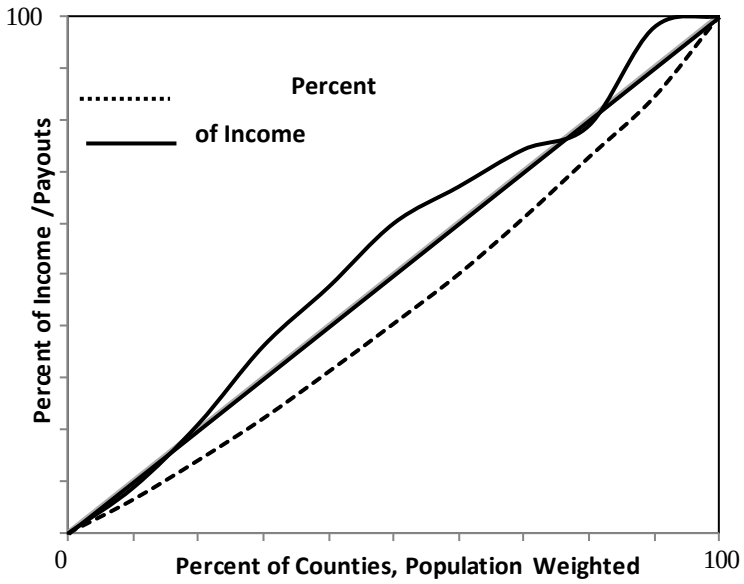
Table 5. Net NFIP by County Per-Capita Income Decile ($)
(selected time periods)

Income Decile[a]	1980-1985	1986-1990	1991-1995	1996-2000	2001-2006[b]	1980-2006[c]
1	2.11	-0.50	0.76	0.28	-0.93	0.68
2	1.30	1.39	0.14	-2.02	-1.02	-0.84
3	1.24	-0.73	0.17	0.58	-1.54	0.15
4	0.45	1.04	0.48	.055	-2.60	-0.42
5	-0.03	-1.04	2.44	-0.01	-0.50	0.85
6	-0.05	-0.23	0.04	1.53	-1.23	-0.36
7	0.78	-1.05	-0.20	1.46	1.28	0.68
8	-0.19	-1.19	-0.22	-2.06	-0.83	-0.39
9	-0.68	-1.80	1.38	-2.64	-2.91	-2.38
10	-1.28	-5.23	-3.26	-6.96	-5.98	-4.37

[a] County per capita income, population weighted.

[b & c] Excludes 2005 (Hurricane Katrina).

Figure 1. Lorenz and Concentration Curves of Income and Payouts, 1980-2006 (excluding 2005)



Appendix. Departure From Proportionality Indexes, NFIP Premiums and Payouts, 1980-2006[a]

Year	Premiums	Payout
1980	-0.0225 #	0.2323
1981	0.0295 #	0.0398 #
1982	0.0159 #	0.1018
1983	-0.0446	0.1450
1984	-0.0368	0.2873
1985	-0.0372	0.2846
1986	-0.0540	0.0950 #
1987	-0.0687	0.2626
1988	-0.0446	0.1416
1989	-0.0962	0.5188
1990	-0.0368 #	0.3432
1991	-0.0548	0.0752 #
1992	0.0003 #	-0.2460
1993	-0.0321	0.4629
1994	-0.0291	0.2170
1995	-0.0615	0.3112
1996	-0.0392	0.2824
1997	-0.0499	0.3776
1998	-0.0519	0.2761
1999	-0.0761	0.1541 #
2000	-0.0594	0.2872
2001	-0.0571	-0.2848
2002	-0.0730	0.3211
2003	-0.0519	0.1094 #
2004	-0.0259 #	0.4102
2005	-0.1332	0.9694
2006	-0.0245	0.1126

[a] Positive number indicates progressive, the pound sign (#) denotes insignificance at the five percent level, implying strict proportionality.