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SUBSIDIZING RISK: THE REGRESSIVE AND COUNTERPRODUCTIVE NATURE OF NATIONAL FLOOD INSURANCE RATE SETTING IN MASSACHUSETTS

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ABSTRACT

In order to evaluate the progressivity of National Flood Insurance Program (NFIP) premiums in a coastal US state that is directly exposed to the impact of climate change-induced sea level rise, this study examines the relationship between the average NFIP premium and the average property values of NFIP insured properties in 331 Massachusetts municipalities. We utilize community level average premium to property value ratio as a measure for comparison. Findings reveal an inverse relationship between insurance premiums paid (as a percentage of property value) and total property value. The greater the average property value, the lower the average premium paid. Conversely, the lower the average property value, the greater the average premium paid. In addition, the study analyzes subsets of municipalities that had certain thresholds of total property in flood prone areas. The strength of the inverse relationship between insurance premiums paid and total property value increases when subsets of municipalities with greater total property value at-risk are analyzed independently. Results suggest current policies in setting flood insurance rates in Massachusetts result in regressive premiums and, as a result, can increase incentives for risk taking.

Keywords:

Environmental policy; flood insurance; public policy; regressive policies; sea level rise

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Overview of Study

In October 2014 the National Flood Insurance Program (NFIP) provided flood insurance to eligible property owners in 331 Massachusetts municipalities, and insured a total of 57,972 properties.[1] Collectively, the stated value of these properties was approximately $15.3 billion. Annual premiums collected on the $15.3 billion of insured property equaled $77.2 million. The ratio of total premium to total property value insured by the NFIP in the Commonwealth is 0.51percent. The average value of a Bay State property insured through the NFIP is $263,179.[2]

This study examined the relationship between NFIP premiums paid and the value of the property being insured. The 331 NFIP participating communities in Massachusetts were ranked based on the ratio of the average NFIP premium for each municipality to the average value of the property covered in that same municipality. For example, a community with an average property value of $250,000 paying an average insurance premium of $1,250 would have a ratio of insurance to property value of 0.50 percent ($1,250 / $250,000). Municipalities were first ranked by the value of this ratio and the results were then analyzed using a linear regression approach. The goal of this analysis was to determine whether there were consistent statistical relationships between average premium-to-property ratios across participating Massachusetts municipalities. In other words, did NFIP eligible municipalities with similar average property values pay similar

[1] The terms "properties" and "property" used in this paper refers to all developed property covered by NFIP policies. These properties could be residential, commercial, industrial, etc. Data relied upon for the analysis in this paper did not distinguish between different types of developed property.
[2] Average insured property calculated by dividing the total value of property insured in the Commonwealth ($15.3 billion) by the total number of policies in-effect (57,972).

average NFIP premiums? Furthermore, were average NFIP premiums progressive (did higher value properties pay higher premiums) or regressive (did higher value properties pay lower premiums)?

Subsets of municipalities based on their total property value covered by the NFIP were also examined. For this component of the analysis, municipalities were organized into the following subsets: greater than $25 million in value, greater than $50 million in value, greater than $100 million in value, greater than $200 million in value, and over $300 million in value. These thresholds are meant to represent increasing levels of risk with higher values implying greater levels of risk. In order to use total property value in a municipality as a metric for risk differentiation between communities, this study assumes that the background rate of flood risk is constant across municipalities where national flood insurance is required.[3] By holding background risk of flooding constant between municipalities, total property value at-stake in a municipality can then act as a measure of risk since more stands to be lost in the event of a flood. This approach allowed for examination of subsets of municipalities in Massachusetts that vary by the degree of risk they experience, measured as the total amount of property value under insurance in that municipality.

[3] There are numerous factors that influence the risk of flooding between communities in Massachusetts. For example, NFIP contains a rating system with incentives for communities to develop flood resiliency. Furthermore, some communities may be located in less risk prone areas, and others may have land use planning measures that are more protective and forward-looking. However, this study assumes that, on average, the risk to areas that have national flood insurance requirements is spread relatively evenly and is, for interpretive purposes, essentially equal.

Methods

The data set used to support the analysis comes from the NFIP's Policy Statistics as of October 2014.[4] The raw data made available by NFIP includes the following information: State, municipality by county, number of flood insurance policies in-force, whole dollar value of insurance in-force (total property value insured), written premium in-force (total value of premiums assessed).

The information is provided for the Commonwealth of Massachusetts and for each municipality by county. These data were used to calculate average insurance premiums using average property values for Massachusetts as a whole and for each of the 331 participating municipalities. The average insurance premium for the municipality was then divided by the average property value for that same municipality to arrive at a ratio of flood insurance to property value. These municipal level ratios were then examined using scatter plots, where the average property value (independent or explanatory variable) of each municipality was placed on the x-axis and the average insurance ratio of each municipality (dependent or outcome variable) was placed on the y-axis. A simple linear regression was then conducted to determine the best fit of the data and to assess the relationship between these two variables. R squared values were calculated to assess the "goodness of fit" between the data points and the regression line and the explanatory power of this straightforward regression model.

This general approach was used to analyze both municipal level data for all 331 participating Massachusetts communities and subsets of communities organized by the value of property with NFIP insurance coverage. As noted earlier, subsets were defined

[4] Data (updated regularly) are available at: http://bsa.nfipstat.fema.gov/reports/1011.htm. The October 2014 data set used for this analysis is available upon request.

using a series of aggregate property value thresholds being insured in order to assess the relationship between community risk and NFIP premium. For the purposes of this analysis, risk was defined in terms of the total value of property being insured in a given community with more property value under insurance indicating greater risk. Five subsets of communities were examined: those with over $25 million in value under insurance, over $50 million in value, over $100 million in value, over $200 million in value, and over $300 million. R squared values were used to assess each of the 331 individual municipalities as well as the five subsets of municipalities organized by aggregate property value.

Results

A summary of the relevant data yielded from the analysis for all municipalities requiring flood insurance ("All Cases") and the subsets of communities with threshold total property under insurance is provided in **Table 1**.

Table 1: Summary Information of Flood Insurance Analysis

	All Cases	Over $25 Million	Over $50 Million	Over $100 Million	Over $200 Million	Over $300 Million
Total Communities	331	105	72	40	18	12
Total NFIP Policies in force	57,972	51,269	47,345	37,917	26,460	20,825
Correlation	-0.513	-0.547	-0.507	-0.568	-0.651	-0.616
R squared Value	0.263	0.280	0.257	0.323	0.423	0.380

As of October 2014, the 331 municipalities in Massachusetts that participate in the NFIP were home to 57,972 discrete properties that were covered by national flood insurance. The correlation between the premium paid and the aggregate property value

covered by NFIP insurance for each subset of data is presented in Table 1. Notably, all subsets show a negative correlation value, indicating an inverse relationship between the average insurance ratio and average property value: The higher the total value of the property in a given community or subset of communities that is being insured, the lower the ratio between property value and premium paid. The R square values for each of the scenarios evaluated are revealing and can be found in Table 1. On average, the "goodness of fit", as measured by the R squared value, between the data points and the regression line increases as the aggregate property insured in a municipality increases. The regressive nature of these relationships can be most clearly seen in **Figures 1-6**.

Figure 1: Average Insurance Ratio and Average Policy Value for All Municipalities in Massachusetts

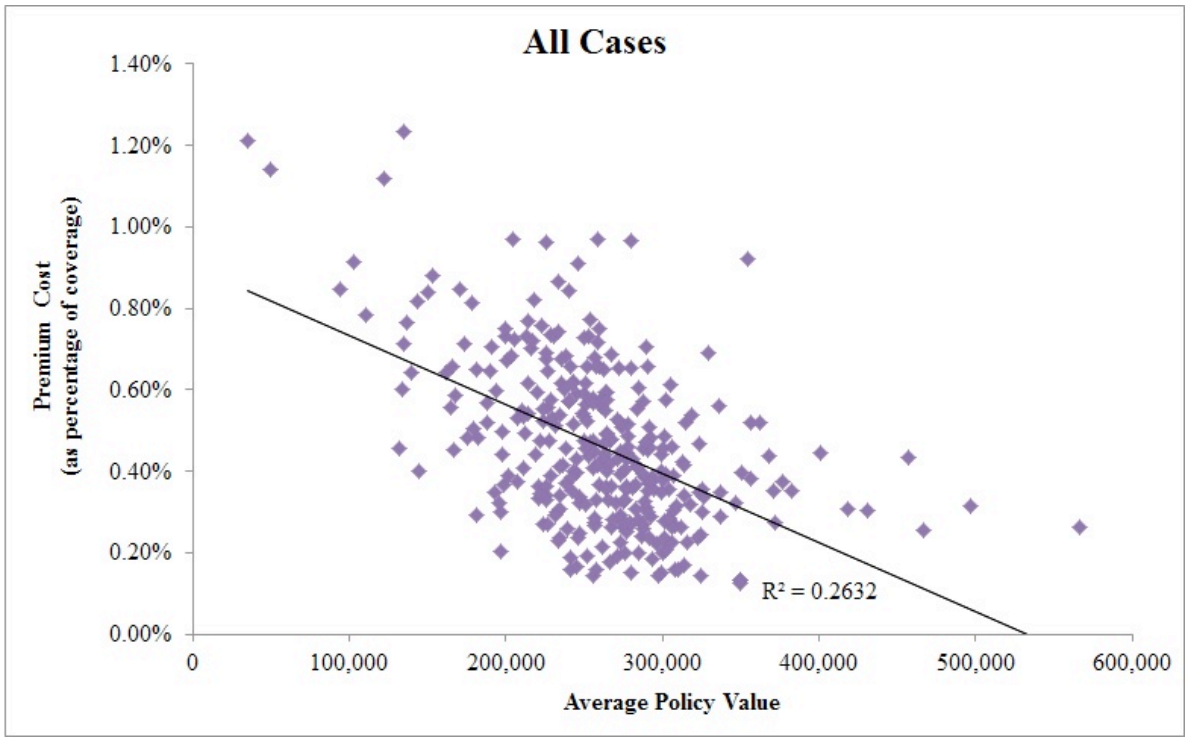


Figure 2: Average Insurance Ratio and Average Policy Value for Municipalities in Massachusetts with At Least $25 Million in Property Insured For Flood Loss

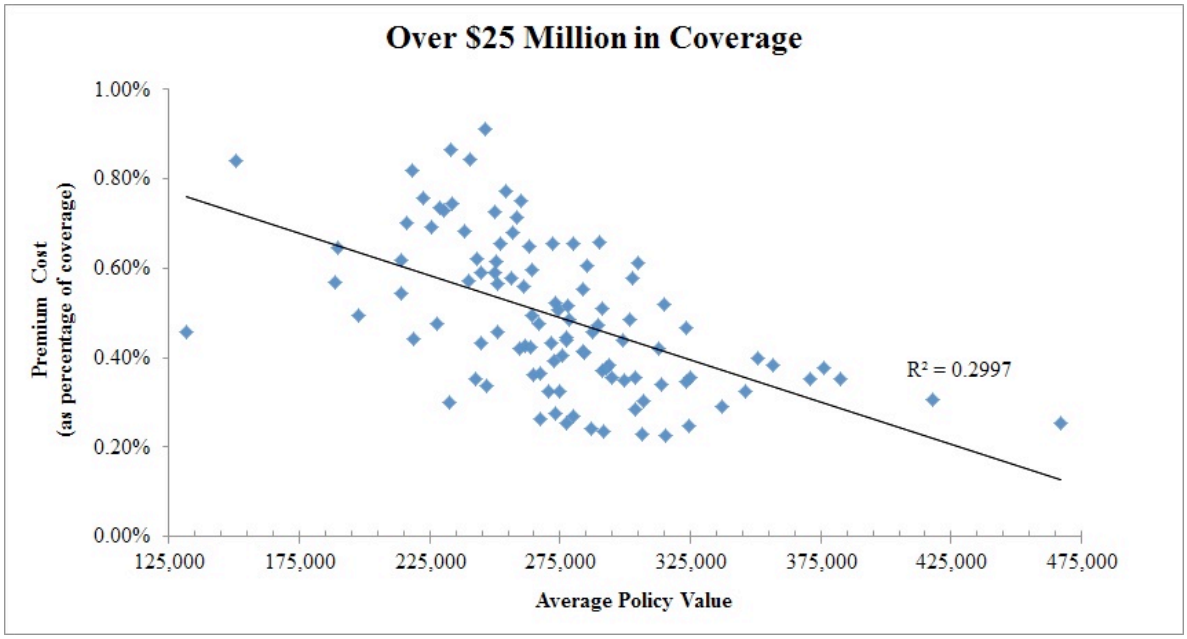


Figure 3: Average Insurance Ratio and Average Policy Value for Municipalities in Massachusetts with At Least $50 Million in Property Insured For Flood Loss

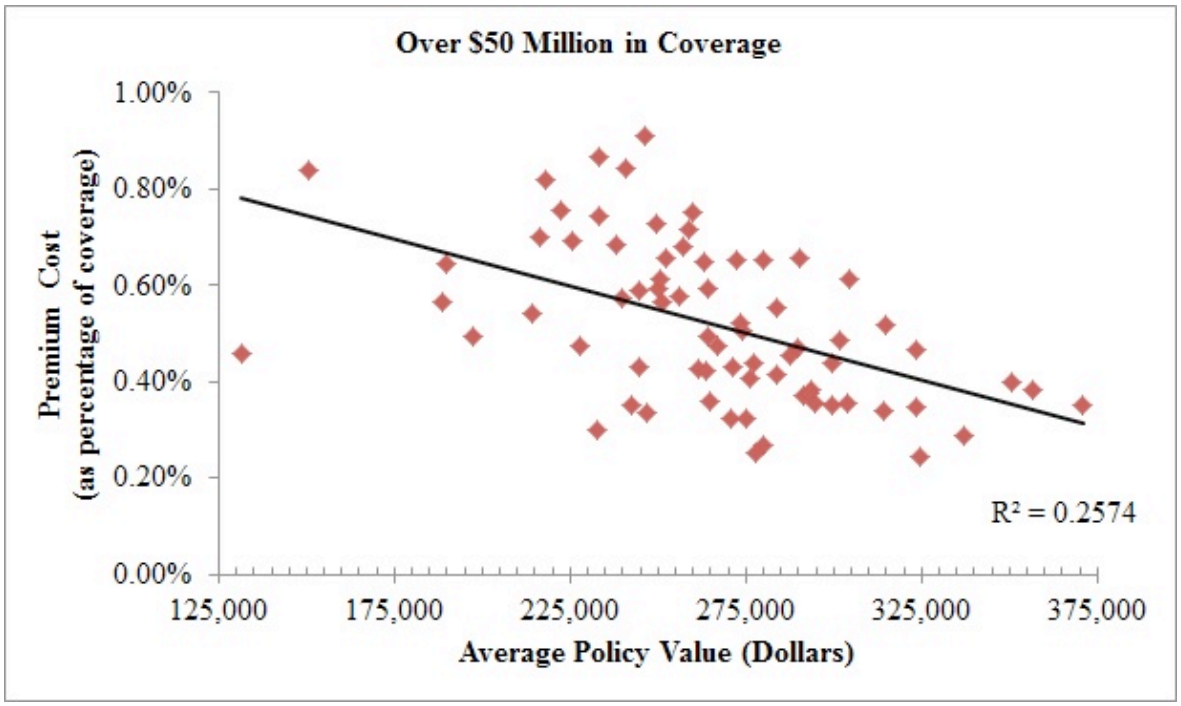


Figure 4: Average Insurance Ratio and Average Policy Value for Municipalities in Massachusetts with At Least $100 Million in Property Insured For Flood Loss

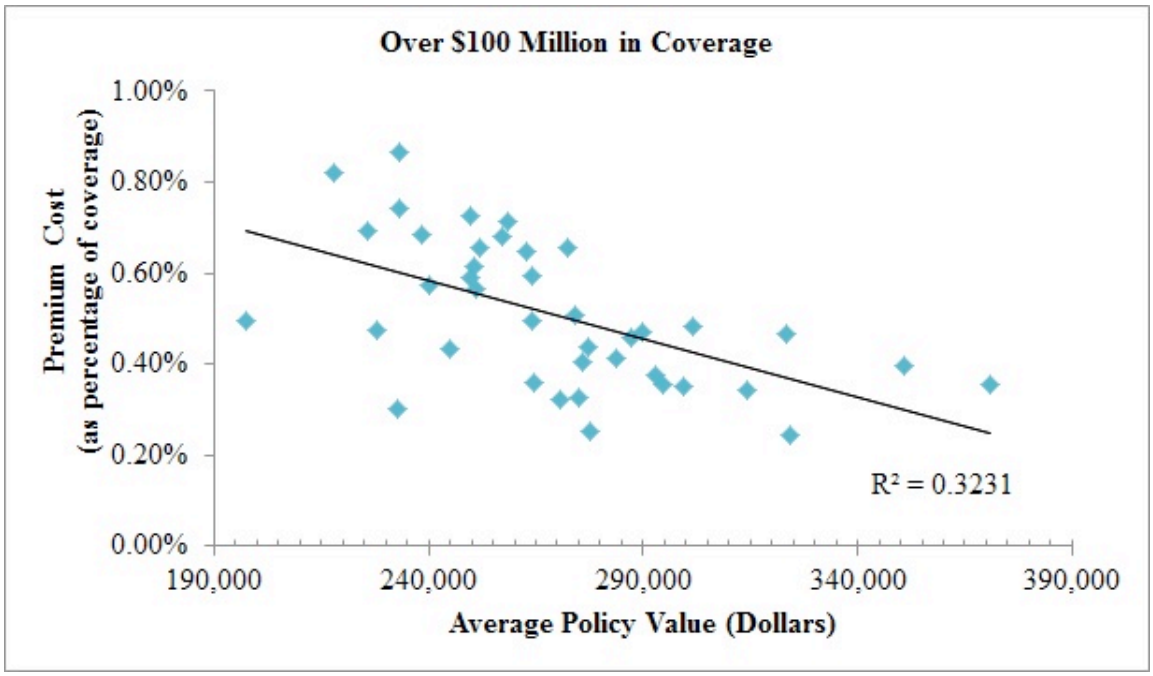


Figure 5: Average Insurance Ratio and Average Policy Value for Municipalities in Massachusetts with At Least $200 Million in Property Insured For Flood Loss

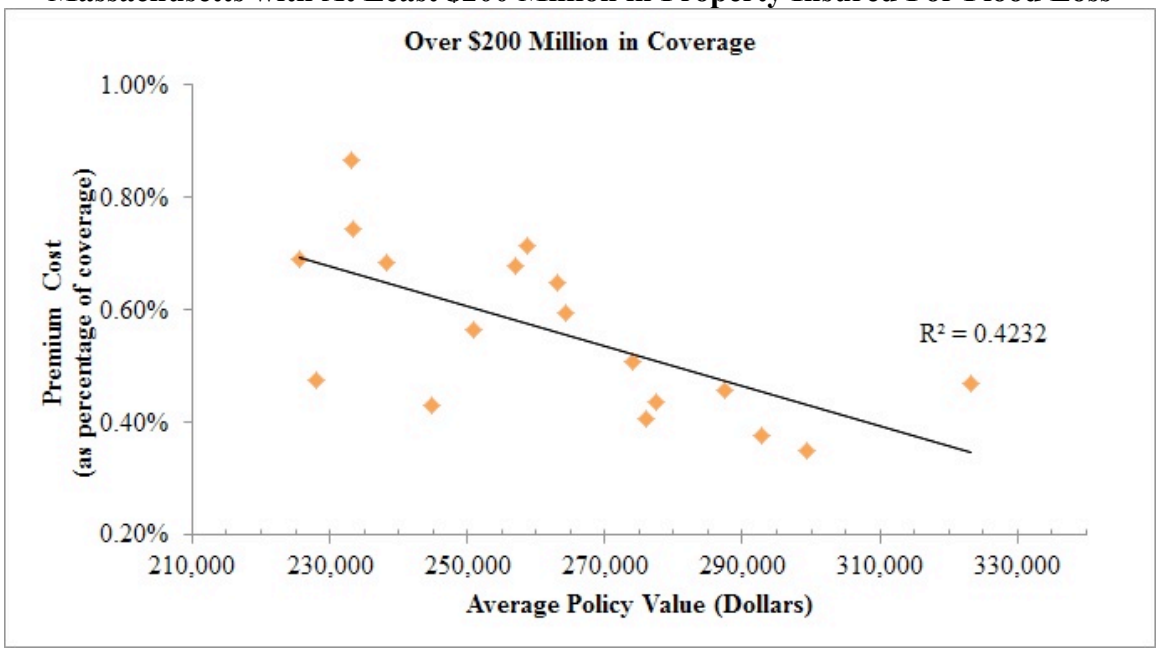
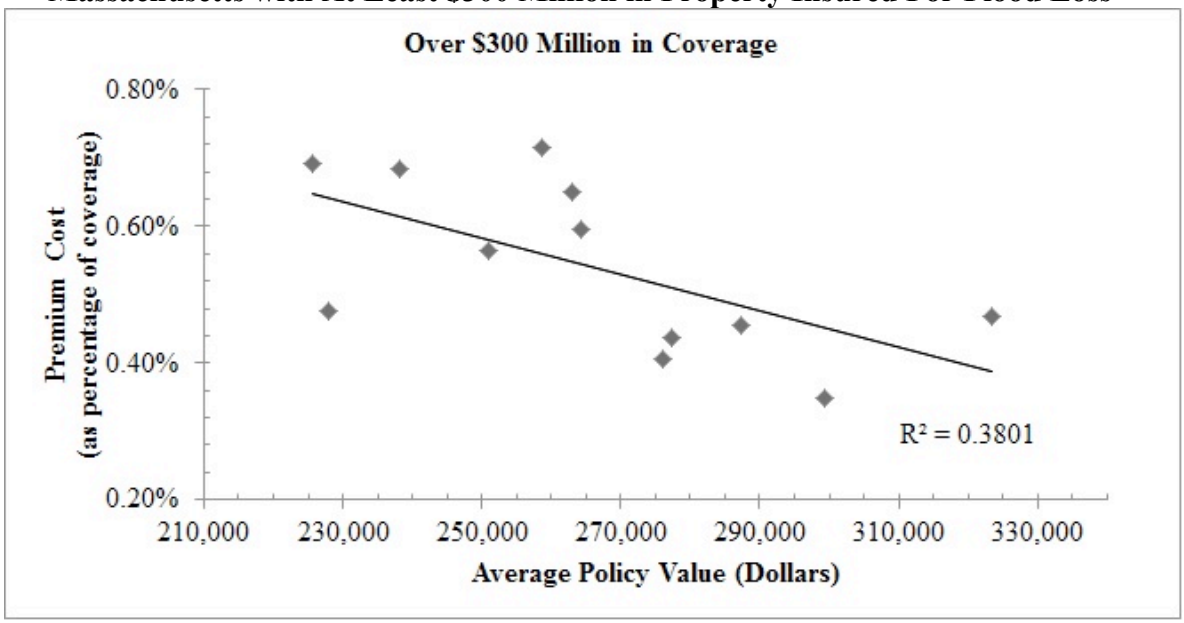


Figure 6: Average Insurance Ratio and Average Policy Value for Municipalities in Massachusetts with At Least $300 Million in Property Insured For Flood Loss



Figures 1-6 all show a negative or inverse relationship between NFIP insurance premiums and property values. As the average property value increases for a community, the amount of insurance paid as a share of that property value decreases. This finding holds true for all 331 municipalities in Massachusetts (Figure 1). Further, when municipalities with relatively lower total property values are excluded from the analysis, the overall fit between average property values and cost of insurance improves (Figures 2-6) as reflected in the increasing R squared values for subsets of communities with higher insured property values. As Figures 2-6 show, the negative correlation strengthens with higher value thresholds signaling a more regressive relationship between premium cost and average property value as total property value at-risk of flooding increases.

Discussion

The results of this study reveal an inverse and regressive relationship between

property values and flood insurance premiums in Massachusetts under the National Flood Insurance Program (NFIP). On average, municipalities in Massachusetts with higher value properties pay proportionately less for national flood insurance than municipalities with lower value properties. This relationship remains even when we control for risk, measured as the total amount of property insured in a particular municipality. In fact, municipalities with greater amounts of total property under insurance (and thus greater risk) have a stronger negative relationship between property value and flood insurance premiums than communities with lower values.

These results clearly demonstrate the regressive nature of the NFIP rate setting process in Massachusetts. Owners of lower value (and by extension less risky) properties pay disproportionately more for their NFIP flood insurance than their neighbors in communities with higher value properties. This pattern holds true in all 331 participating municipalities despite the fact that these communities otherwise share similar flood risk characteristics. In traditional insurance underwriting, premiums are set based on numerous factors, but two critical factors are the probability of loss and the total amount of value at-risk from loss (AAA, 2011). Assuming probability of loss due to flooding is relatively constant across NFIP eligible communities in Massachusetts, in a traditional insurance environment, one would expect the opposite outcome (i.e., higher property value is associated with higher premiums).

There are a number of reasons why higher value properties in Massachusetts might be paying proportionately less for flood insurance. For instance, the NFIP has a rating system that provides potential discounts to certain communities that engage in best

practices to mitigate flood risk.[5] In addition, NFIP insurance is capped at a specific dollar amount of exposure per property.[6] Thus the cap may act as a ceiling for flood insurance premiums. In such a case higher value properties would appear to be paying proportionately less for flood insurance because the property values exceed the amount covered under national flood insurance and the premium charged is capped at the payout maximum.[7] While these are plausible rationales for the differences observed, specific reasons for the counterintuitive findings are beyond the scope of this paper and necessitate further study.

Regardless of the reasons for the regressive nature of the NFIP as currently operating in Massachusetts, the influence of lower premiums on ratepayers can be substantial. This has to do with *risk perception*, or how the public develops, understands, and internalizes the concept of *risk*, and the role that flood insurance premiums play in risk perception. Risk perception is a term often used to describe a measure of risk that incorporates both objective and subjective factors (Slovic, 1987; Sjoberg, 1999; Sjoberg, 2000). Insurance premiums provide an important signal of risk to the insured: the higher the premium paid, the greater the perception of risk associated with the activity being insured and vice-versa (Browne and Hoyt, 2000; Siegrist and Gutscher, 2006; Petrolia et al., 2013).

[5] Details on the NFIP Community Rating System are available here: https://www.fema.gov/national-flood-insurance-program-community-rating-system

[6] A summary of flood insurance coverage through the NFIP as of March 2015 is available here: https://www.floodsmart.gov/toolkits/flood/downloads/NFIP-SummaryCoverage.pdf

[7] For example, the NFIP might cap flood insurance payments at $250,000 of loss. Properties that are up to $250,000 in value, but not higher, might pay a "full" premium for flood insurance. Properties valued at more than $250,000 might pay a premium that is capped at the first $250,000 of value.

The passage of a national flood insurance program in 1968 was necessitated in large part by the federal government recognizing that a lack of mandatory flood insurance created a moral hazard that incentivized coastal development, even in very dangerous areas (Knowles and Kunreuther, 2014). A moral hazard existed because federal disaster relief was regularly made available after a natural disaster, essentially providing a de facto zero premium insurance backstop for coastal development (Michel-Kerjan, 2010). The NFIP was created to begin sharing flooding risks with flood-prone communities, thus creating incentives for less risky behavior through insurance price signaling (Anderson, 1974). Moral hazard would be diminished through a mix of risk shifting behavior (brought on by flood insurance requirements) and penalties for non-compliance as failure to carry insurance could result in loss of federal disaster assistance eligibility (Anderson, 1974; CRS, 2013). It may be that factors such as political shaping has limited the influence of the NFIP, importantly the subsidies inherent in current flood insurance policies (PCI, 2011).

Even with existing subsidies across the board, the findings in this paper suggest additional hidden subsidies that further frustrate risk internalization. Massachusetts properties currently covered under the NFIP enjoy federally subsidized flood insurance backed up by federal disaster relief funding. But higher value properties that require flood insurance (i.e., exist in flood prone areas) pay proportionately less for their flood insurance then lower valued properties. This does little to protect against speculation in coastal property development by creating an additional subsidy for high value properties. One effect is that housing stock may be pricier than it may otherwise be if flood insurance premiums more accurately reflected the actual risks of flood related losses.

Conclusion

The findings in this study demonstrate that current federal policy in setting national flood insurance premiums disproportionately favors higher value property owners in Massachusetts. To the extent the outcomes of current federal flood insurance policy engender the regressive relationship shown in this study, such outcomes are counterproductive in aiding property owners and communities to recognize current and future risks associated with living in coastal areas, particularly through insurance premium price signaling. Subsidized rate setting can encourage risky property owner behavior, potentially exposing the American taxpayer to avoidable and substantial financial liabilities. Subsidies also encourage discounting of risks, making it harder for communities and property owners to take appropriate action to mitigate the increasing risks associated with living in flood prone areas.

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