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Market Failure in Information:
The National Flood Insurance Program

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Abstract

The National Flood Insurance Program (NFIP) was established in 1968 and requires mandatory flood insurance for property owners who have federally-backed mortgages. Krutilla (1966) noted that a compulsory national flood insurance program could greatly improve the economic efficiency of flood plain occupancy in the U.S. However in order to realize the efficiency gains suggested by Krutilla, property owners must have sufficient information about flood risk and insurance premiums to make well-informed home purchase decisions. Using survey data from Boulder, Colorado, we find significant evidence of market failure in information in the NFIP program. The majority of survey respondents, all of whom live in a special flood hazard area, report they did not fully understand the degree of flood risk or the cost of insuring against this risk when negotiating the purchase of their property.

I. Economic Efficiency and NFIP

In 1968 the U.S. Congress created the National Flood Insurance Program (NFIP). According to a recent report by the Federal Emergency Management Agency, FEMA (2000), the intent of the NFIP is “to reduce future damage and provide property owners with protection from financial losses through an insurance mechanism that allows a premium to be paid for protection by those most in need of protection.” The NFIP currently provides coverage to millions of property owners throughout the U.S.

Krutilla (1966) outlined the potential for compulsory flood insurance to improve the economic efficiency of the use of the nation’s flood-prone areas. Krutilla made three main points. (1) “Premiums proportional to risk and equal to both the private and social cost of flood plain occupancy will serve as a rationing device, eliminating economically unwarranted uses of flood plain lands on one hand, while not prohibiting uses for which a flood plain location has merit on the other hand.” (2) “In addition, reduction of flood loss insurance premiums can serve as a standard to measure the economic justification of alternative flood control measures and/or discrete increments in scale of protective works or other nonstructural flood control measures.” (3) “A final advantage of flood loss insurance, which no alternative in flood management possesses, is indemnification for

the residual damage potential against which it is not economic to seek protection.”

Krutilla was a member of the President’s Task Force on Federal Flood Control Policy and as Krutilla noted, the work in Krutilla (1966) was an extension of the Task Force’s 1965 draft report.¹ While the Task Force’s recommendations that pertain to the points emphasized by Krutilla (1966) were incorporated into the NFIP, many would argue that the program has not yet achieved the efficiency potential suggested by Krutilla. Despite mandatory NFIP flood insurance for federally-backed mortgages, as suggested by the Task Force, historically NFIP participation has been low.² For many years, mortgage lenders were not required to make sure that flood insurance policies were in force for federally-backed mortgages. Thus home owners could initially purchase flood insurance as required by the law and then fail to renew their policy with no objection from their mortgage lender. The 1994 Reigel Community Development Regulatory Improvement Act required mortgage lenders to ensure that flood insurance policies are in force or face penalties. Thanks to this new requirement and an extensive FEMA advertising program, participation rates are on the rise.

There is considerable evidence that people tend to ignore, or at least fail to act against, small probability, high consequence events such as those faced by property owners and occupants of flood risk areas, Camerer and Kunreuther (1989). A properly functioning system of compulsory insurance should, at least in principle, avoid this problem. That is, even if people do not appreciate the risk they face by locating in the flood plain for whatever reason, compulsory insurance, as noted by Krutilla, will force them to face the social cost of locating in the flood plain.

II. Property Values and the Flood Risk Discount

In an ideal world where people are forced to face the social cost of locating in flood risk areas, basic economic principles suggest that property in flood risk areas should sell at a discount. However, results of property value studies attempting to measure the flood risk discount have been mixed.³ As noted by Tobin and Montz (1997), some studies failed to find statistically significant evidence of a flood risk discount. Muckleston (1983) and Holoway and Burby (1990) reported that

¹The Task Force’s final report, Goddard *et al.* (1966) was issued in August of 1966.

²Beneson (1993) reports that as of 1993, compliance rates were on average less than 20% in NFIP participating communities.

³As a solemn reminder of flood risk, some communities have begun leaving evidence of flood damage such as flood-damaged houses as opposed to complete clean-up.

a flood discount is not evident for residential property, but is for undeveloped properties. Drawing on their earlier work from Tobin and Montz (1986), Tobin and Montz (1997) presented a theory of the relationship between flood exposure and property values. Their theory concerns property that has been exposed to flood, as opposed to simply being exposed to flood risk. According to their theory, the property values of flooded properties fall immediately after the event. For some properties, values recover to the level of properties that were not flooded while other properties never fully recover. In their study areas, whether or not a property is in the former or latter group depends on the depth of flood waters on the property. Of particular relevance for this paper are the findings of Chivers (2001) who, like Tobin and Montz (1997), finds statistically significant evidence of a flood risk discount for Boulder, Colorado homes only in years immediately after the most recent flood event in that flood plain.

There are many features that distinguish the existing property value studies of flood risk including the years of study, methodological details, and the study areas which make direct comparison of these studies difficult if not impossible. However, our overall impression of this literature is that even though a flood discount premium is typically found for properties that have recently been flooded, properties that are merely exposed to flood risk yet require flood insurance under NFIP often do not carry a flood risk discount. The lack of a flood risk discount suggests that compulsory insurance may fail to efficiently ration flood plain occupancy or efficiently incorporate the social cost of flood plain occupancy into the decision calculus of home buyers.

III. Cost and Variability of Flood Insurance

Flood insurance can be quite expensive and premiums for a similar structure can differ considerably depending on location. In order to give a flavor of the potential magnitude of costs and variability, we provide some examples using information from the NFIP Flood Insurance Manual. It is not our intent to completely describe the rate structure for NFIP premiums. FEMA provides lengthy and highly specialized manuals in addition to the standard manual for this purpose. For those wanting more information, the entire flood manual and several accompanying manuals for writing policies are available on the Internet at <http://fema.gov/nfip>. Basically, rates are set depending on whether the structure was built before flood insurance rate maps were established for the area, referred to as Pre-FIRM properties, or after flood insurance rate maps were established for the area, referred to as Post-FIRM properties. Flood insurance rate maps are required of

communities participating in the NFIP. Post-FIRM rates are intended to be actuarially fair while for Pre-FIRM rates, some cross-subsidy occurs within the group. For both of these types of properties, Pre-FIRM and Post-FIRM, premiums are distinguished by zones, which reflect the degree of flood risk, and whether the home has a basement, whether there is an enclosure at the base of the property, whether the building is elevated, and whether the home is a manufactured (mobile) home. In addition for a given structure within a given zone, premiums for Post-FIRM structures in some, but not all, FIRM zones are differentiated by the elevation of the lowest floor elevation in relation to the base flood elevation. Base flood elevation is defined as “the water surface elevation resulting from a flood that has a one percent chance of equaling or exceeding that level in a given year.” Table 1 presents Pre-FIRM annual premium information for \$100,000 coverage for structure and \$20,000 coverage for contents for a home with a base enclosure across three Pre-FIRM zone designation classes. We provide the information in annual and present value terms, the latter providing readers a benchmark for comparing the long-run cost of protection relative to the cost of the structure/contents.

<p align="center">Table 1 Pre-FIRM Premiums Single Family w/Enclosure, \$100,000 Structure, \$20,000 Content</p>						
	Structure		Content		Total	
Zone Designation	Annual Premium	PV Premium	Annual Premium	PV Premium	Annual Premium	PV Premium
1	365.00	5214.29	116.00	1657.14	481.00	6871.43
2	570.00	8142.86	120.00	1714.29	690.00	9857.14
3	1010.00	14428.57	209.00	2985.71	1219.00	17414.29
<p>1 = FIRM zones A99, B, C, X 2 = FIRM zones A, AE, A1-A30, AO, AH, D 3 = FIRM zones V, VE, V1-V30</p>						

Using the Pre-Firm examples in Table 1, the present value of premiums for structure and

content range from approximately \$7,000 to \$17,000. As a percentage of the value of the items covered, the present value of premiums ranges from 6% to 15% of the value, which at the upper end is a large percentage. Table 2 provides information for the same type of structure but built Post-FIRM across three different zones, including one that requires an elevation rating; the elevation examples are +4 ft. and -1 ft relative to the base flood elevation.

<p align="center">Table 2 Post-FIRM Premiums Single Family w/Enclosure, \$100,000 Structure, \$20,000 Content</p>						
	Structure		Content		Total	
Zone Designation	Annual Premium	PV Premium	Annual Premium	PV Premium	Annual Premium	PV Premium
1	365.00	5214.29	116.00	1657.14	481.00	6871.43
2	120.00	1714.29	33.00	471.43	153.00	2185.71
3	1285.00	18357.14	340.00	4857.14	1625.00	2314.29
<p>1 = FIRM zones A99, B, C, X 2 = FIRM zones AE, A1-A30, +4 ft. Elevation 3 = FIRM zones AE, A1-A30, -1 ft. Elevation</p>						

In Table 2, the first row zone designation is the same as the first row in Table 1. In these zones, A99, B, C, and X, premiums are identical to Pre-FIRM premiums for this particular type of structure. Typically rates for Pre-FIRM and Post-FIRM properties are not the same. From these Post-FIRM examples, the present value of total premiums range from \$2,000 to \$23,000. As a percentage of the value of the items covered, the present value of premiums ranges from 2% to 19% of the value. As the examples from Table 1 and Table 2 make evident, the present value of premiums can differ by a factor of ten with premiums differing from 2% to 20% of the value of the items covered. The differences in premiums are primarily due to differences in flood risk which is desirable for the sake of economic efficiency as argued by Krutilla. However conveying information

on flood insurance premiums is difficult since there exists so much variability.

IV. Information and Economic Efficiency

In order to obtain the economic efficiency benefits discussed by Krutilla, potential purchasers of properties subject to flood risk must have information on the cost of compulsory flood insurance, otherwise we have one of the classic forms of market failure, imperfect information for buyers relative to sellers. Our interest in the informational aspects of NFIP began with our consideration of the preliminary results of an hedonic property value study of Boulder, Colorado by Chivers (2001). The study used Multiple Listing Service (MLS) data. Because open space and mountain views are important to home prices in Boulder, Chivers decided that in order to statistically measure a flood risk discount for Boulder, these features needed attention in the analysis. To this end, Chivers augmented the MLS data by using geographical information systems (GIS) overlay for the properties in the MLS data. Though the GIS information improved the fit of the hedonic model, Chivers findings were mixed. In particular, Chivers found a statistically significant flood risk discount for the years 1982 and 1983, but failed to a statistically significant flood discount for any other years. The most recent flood of the Boulder Creek watershed occurred in 1982 and so Chivers findings are qualitatively similar in spirit to those discussed in Tobin and Montz (1997).

Chivers' results led to a discussion with an acquaintance who at the time was the President of the First National Bank of Boulder County, Robert Callis. Callis has been in the banking business for over thirty years and offered us some observations on the results of Chivers' property value study. Callis noted that in his experience, buyers usually did not learn of the actual NFIP premium until closing. At this point, it is difficult to back out of the purchase on account of an unexpectedly high NFIP premium. According to Callis, everyone at the closing is making money with the exception of the buyer. The pressure to close the deal is intense. In Callis' thirty years of banking he observed only two buyers who backed out of a sale on account of an unexpectedly high NFIP premium. After talking with Callis, we contacted a local realtor, Gregg Ashburn, and asked about the type of

information that was usually conveyed when flood-plain property was shown. Ashburn noted that flood risk is disclosed on the MLS listing, though sometimes incorrectly, and that for properties requiring flood insurance under NFIP, potential buyers are supposed to be notified prior to closing that they must purchase flood insurance. Consistent with Callis' observations, Ashburn said that buyers most often learn of the actual premium at closing. Ashburn also noted that real estate agents do not have the precise premium information either and so they are not in a position to provide NFIP premium information to their clients. The property value findings and our discussions with Callis and Ashburn led us to hypothesize that one reason flood discounts are not found in property value studies is that buyers do not have sufficiently complete information when negotiating a purchase and this lack of information leads to a lower negotiated price than would occur under full information.

V. A Survey of Flood Certificate Applicants

In order to investigate our hypothesis, we decided to conduct a survey of flood plain property owners in Boulder. There are many properties subject to flood risk in Boulder. We decided that rather than randomly sample from all flood plain property owners, we would target those who recently applied for a flood rating certificate, which is required for most property transactions, and their property is located in an area for which flood insurance is required. The entire population of rating certificate applicants was accessible through the City of Boulder, facilitating random sampling. A random sample of 320 residents was selected from City records.

The 320 randomly selected households were sent an eight page survey consisting of 26 questions from three groups. The first group of questions asked about the respondent's general knowledge of flood risk in Boulder and the City's participation in the NFIP. The next group of questions concerned the respondent's knowledge of flood risk to the property for which they applied for flood certification. In particular they were asked when they learned about the potential flood risk associated with their home, when they learned the actual cost of flood insurance for their home, and finally questions about their flood insurance purchasing behavior. These questions are the heart of

the survey since they ask about information acquisition in the process of purchasing. The final group of questions asked demographic questions.

Of the 320 households sampled, 130 responded to the survey resulting in a response rate of approximately 60%. The results from the information-related questions were very interesting. One question asked, “How did you learn your home was located in a special flood hazard area?” The response categories and the percentages of responses by category were: (a) flood certification, 68%; (b) MLS information, 23%; (c) FIRM, 2%; and (d) other, 7%. Another question asked, “When did you first learn of the potential flood risk associated with your home?” The response categories and the percentages of responses by category were: (a) prior to offer, 0%; (b) prior to closing 1%; (c) during closing, 74%; (d) after moving, 7%; (e) after being flooded, 7%; and (f) other 5%. Still another question asked, “When did you first learn of the cost of flood insurance associated with this home?” The responses to this question were highly, but not perfectly correlated with the response to the question previously discussed. The response categories and the percentages of responses by category were: (a) prior to offer, 0%; (b) prior to closing 0%; (c) during closing, 61%; (d) after moving, 32%; (e) after being flooded, 7%; and (f) other 1%.

From the responses to these three questions we learn that information is acquired rather late in the negotiating and purchase process. In order for NFIP to efficiently incorporate the social cost of flood plain occupancy, potential buyers would need to understand the nature of flood risk and the cost for insuring against this risk *before* making an offer. The responses to these three questions suggest the opposite. An overwhelming majority of people do not acquire cost information until closing or after.

From an information perspective, it is important to understand how people felt when they learned the cost of flood insurance. To this end respondents were asked, “At the time of the purchase of your home did you find that the cost of insurance was. . . (a) higher than expected?; (b) lower than expected?; (c) as expected?” For this question the respective percentage responses were (a) higher,

84%; (b) lower, 2%; and (c) as expected, 14%. The responses to this question suggest that for most people, their expectation of the cost of flood insurance was biased downward. This bias, combined with sometimes learning of flood risk after negotiating an offer is a plausible explanation for the failure of Chiver's property value study to pick up a flood risk discount.

Obviously we would like to know if knowledge of flood risk and the cost of flood insurance prior to making an offer would have made a difference in the amount offered. Respondents faced the question, "Do you think your decision to purchase or the amount offered would have been different if you had known the exact cost of flood insurance at the time of making an offer?" The percentage of responses to this questions were 69% yes and 31% no.

VI. Discussion and Policy Implications

Our initial hypothesis was that there exists a market failure in information in the NFIP flood insurance market and our survey was designed specifically to test this hypothesis. The information gained from the survey strongly supports this hypothesis. From our results, we do not conclude that NFIP has been a failure since the program provides valuable financial protection from flood losses and is financed through a risk pool of flood plain residents and property owners. However in terms of providing the efficiency benefits discussed by Krutilla we find the current program to be lacking. If our survey is indicative of other areas, then lack of knowledge of flood risk and lack of knowledge of the cost of insuring against flood risk greatly hampers the desired efficiency effect of NFIP premiums.

If the information asymmetry, sellers fully knowing the degree of flood risk and cost of insurance and buyers having less information, found in our survey is widespread, then the NFIP will not serve as a rationing device for the use of flood occupancy as suggested by Krutilla. The observation that undeveloped land subject to flood risk sells at a discount while developed property subject to the same degree of risk does not have a flood risk discount, Muckleston (1983) and Holoway and Burby (1990), is particularly troublesome. When this is true, developers have an added

incentive to develop flood prone property since they will actually reap additional profits from the undeveloped land discount for flood prone areas since they can sell the developed property to less informed buyers who are not fully aware of the costs associated with the property.

Obviously there is a need to bridge the information gap between buyers and sellers. In particular, potential buyers need to be fully informed of the cost of flood insurance prior to negotiating a purchase. A relatively easy and effective solution would be to require sellers to obtain a flood elevation certificate and to get an NFIP flood insurance quote as a condition of listing the property. In the end, a flood elevation certificate will likely be required for the sale. Requiring the information up front would eliminate the information asymmetry and would likely lead to a more economically efficient NFIP as suggested by Krutilla.

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