“The Role of Insurance and Regulation in Reducing Losses from Hurricanes and Other Natural Hazards”

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I. The Natural Disaster Syndrome

The challenges associated with reducing losses from hurricanes and other natural hazards can be attributed to what I shall call the "natural disaster syndrome". It consists of two interrelated components---one before the disaster (ex ante) and the other after it occurs (ex post). Before a disaster, most homeowners, private businesses and the public sector do not voluntarily adopt cost-effective measures to reduce their potential losses from future storms. Furthermore building codes designed to protect the structure against hurricanes are not well enforced (ex ante behavior). This lack of interest in protective measures coupled with the development of coastal areas has increased the probability that when a hurricane moves across land, the losses can be severe. In most cases the insurance industry and federal government has borned a large share of the recovery costs. A significant amount of the damage could have been averted had building codes been enforced and individuals taken protective measures in advance of the disaster. (ex post impact).

A. Lack of Concern

The evidence supporting the natural disaster syndrome is rather convincing. From 1988 to 1993 the total insured coastal property in the United States increased 69 percent from $1.86 trillion to $3.15 trillion. In Florida, the state most vulnerable to hurricanes, insured exposures increased from $565.8 billion to $871.7 billion during this five year period. (Unnewehr in press).

With respect to adoption of loss reduction measures, a 1974
survey of more than 1,400 homeowners in hurricane-prone areas in the United States revealed that only 22 percent of the respondents had voluntarily adopted any protective measures with an average investment of $1600. (Kunreuther et. al. 1978). There is no indication that the situation has changed twenty years later. Studies of the added costs of materials and labor for hurricane-resistant designs have indicated that it will add no more than 4-5 percent to the cost of a new home and that this additional expense is not substantial relative to the added benefits of safety and security (Unnewehr 1994).

Building codes are often not enforced in hazard-prone areas. According to the Insurance Information Institute as much as 25 percent of insured damage due to catastrophic events in some locations was due to not meeting existing building codes (Jobe 1994). One of the lessons learned from Hurricane Andrew, which swept across the southern Florida coastline in August 1992, is that at least one-fourth of the $15.5 billion in insured damage could have been prevented through better building code compliance and enforcement. (Miami Herald 1993).

Many communities have inadequate staffing and training to conduct the necessary inspections in a quality fashion. In Dade County, the area struck by Hurricane Andrew, there were only 60 building inspectors who were required to conduct multiple

2 An even greater reluctance to adopt mitigation measures has been found in earthquake-prone areas. In a 1989 survey of 3,500 homeowners in four California counties, only between 5 and 9 percent of the respondents in each of these four areas reported adopting any LRM (Palm et. al. 1990).
inspections on an average of 20,000 new buildings each year. (Unnewehr in press).

B. Increasing Losses

It thus not surprising that the losses from hurricanes and other natural disasters are on the rise. In the past several years we have had a series of disasters within close proximity of each other which have caused billions of dollars in damage to different regions of the country and created large losses to the insurance industry. The insurance industry’s catastrophic losses from 1989-1992 were over $34 billion in 1992 dollars, more than the combined total for such loss over the previous 21 years (The Standard, 1993).

Hurricane Andrew was the single most costly natural disaster to the insurance industry in its history. Insurers such as State Farm and Allstate suffered financial losses from Andrew of $3.5 and $2.5 billion respectively. (Snyder, 1993) A computer simulation model indicated that if Hurricane Andrew had hit Miami the losses could have exceeded $40 billion and led to many more than the seven insolvencies that resulted from the actual disaster. (Insurance Services Office 1994). Hurricane Hugo which hit South Carolina in September 1989 cost the insurance industry over $4.9 billion in damage. Thirteen of the 24 largest catastrophes since 1970 in terms of real insured losses were from hurricanes or storms with a total insured damage of over $41 billion. (Swiss Re 1994).

Those who suffer losses to property and contents from hurricanes are uncertain as to whether their losses will covered by
insurance until the cause of damage is determined. A standard
homeowners and business insurance policy, normally required as a
condition for a mortgage, provides protection against wind but not
water damage.\(^3\) Insurance firms have experimented in the past with
providing coverage against water damage from floods, hurricanes and
other storms but concluded that the risk was uninsurable. As a
result Congress passed the National Flood Insurance Program (NFIP)
in 1968 whereby homes and businesses can purchase coverage for
water damage if the community in which they are located agrees to
enforce hazard mitigation requirements and land-use regulations.\(^4\)

Most individuals subject to water damage do not purchase flood
insurance voluntarily. Of the approximately 9.6 million households
in flood and hurricane-prone areas of the United States, it has
been estimated that less than 2 million currently have flood
insurance (Kusler and Larson, 1993). As a specific example,
consider the seven Midwest states affected by the Mississippi
floods of August 1993. Less than 42,000 households out of the
803,000 residing in special flood hazard areas had purchased flood

\(^3\)The standard Homeowners Policy and Commercial Program will
not pay for loss or damage caused directly or indirectly by
earthquakes and water. There can be exceptions to the exclusions
listed below through special delux policies offered by some
companies. I am grateful to Eugene LeComte of the Insurance
Institute for Property Loss Reduction who provided me with this
information.

\(^4\)For a more detailed history of flood insurance and how it
influenced the development of the NFIP can be found in Kunreuther
et al. 1978 pp. 24-26. A discussion of the current status of the
NFIP and its potential role in reducing future flood-related losses
appears in the Interagency Floodplain Management Review Committee
insurance as of August 3, 1993. (Karr 1993)

Following catastrophic disasters, such as Hurricane Andrew or the 1993 Mississippi floods, the government will provide some type of disaster assistance to help cover uninsured losses to victims. Although the programs are more stringent than they were 20 years ago, when forgiveness grants of up to $5000 and low interest loans of 1 percent were provided⁶, the Small Business Administration still provides low-interest loans generally at an annual interest rate of 4 percent with terms up to 30 years to cover uninsured losses by homeowners and businesses. (Interagency Floodplain Management Review Committee 1994 p. E-11).

In addition, the federal government normally covers 75% of the costs of damage to public sector structures and infrastructure, but this percentage can increase to 90% or 100% following a major disaster such as Hurricane Andrew, the Mississippi floods or the 1994 Northridge earthquake in California. It is thus not surprising that Burby (1992) found that most local governments have not adopted hazard mitigation measures or purchased insurance against future disasters.

C. Outline of Paper

This paper focuses on understanding the causes of the "natural disaster syndrome" and suggesting a program which may alleviate some of the problems that it creates. The next two sections explores why there is a reluctance by residents of hazard-prone

⁶These were the provisions for disaster assistance following Tropical Storm Agnes which produced $2 billion in damage to the Northeast in June 1972.
areas to invest in protective measures and voluntarily purchase insurance against losses from natural disasters. Section IV explores why both the insurance and reinsurance industry are not excited about offering coverage against these events.

To cope with the constraints on both the demand and supply side, a program is proposed in Section V which advocates private insurance coupled with well enforced regulations and standards and government reinsurance for catastrophic losses to deal with these concerns. The concluding section summarizes the principal points of the paper. Although the paper focuses on hurricanes and other natural hazards, the proposed program may have some relevance for dealing with "human" disasters caused by industrial accidents or exposure to toxic chemicals.

II. Why Individuals Have Limited Interest in Protective Measures

The decision on whether to adopt a protective measure for reducing losses from future hurricanes involves comparing the upfront investment cost (C) with the expected benefits in the form of a reduction in the magnitude of the resulting loss from future hurricanes. A key question that needs to be addressed is: "What is the maximum amount that a person would be willing to pay (WTP) for this protection?" In theory the WTP should depend on the magnitude of the loss reduction and the length of time that the person expects to live in her current residence.

A. An Illustrative Example

"Some portions of the material in this section and the next one are taken from Kunreuther (1994)."
To illustrate how one would determine whether to invest in particular loss reduction measures (LRMs) consider the following hypothetical example. Suppose that scientific experts have estimated that the annual chances of a severe hurricane that will cause damages to homes in Miami, Florida is 1 in 25.7 The Gale family has a one story home in the area. If they reinforced the walls and foundations it would reduce the losses from this hurricane by $10,000. In other words the expected annual benefit from investing in such a measure would be $400 (i.e. 1 in 25 x $10,000). The longer the time period T that the Gales expect to live in their house, the greater is the expected benefit from investing in such measures. More specifically let B represent the expected net present value of the benefit from LRMs over the entire time horizon T.8

Suppose the cost to the Gales of these LRMs was C= $1200. Let T* represent the minimum number of years for the loss-reduction investment to be cost-effective (i.e. B/C > 1). The first column in Table 1 depicts the expected benefit-cost ratio as a function of T associated with such an investment if the Gale’s annual discount rate was 10 percent. It is clear that if the family planned to live

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7To simplify the story here assume that this is the only hurricane that could affect Miami in the future.

8The net present value of the expected benefits are calculated under the assumption that the house will be occupied for the entire T periods and that if a hurricane occurred it would be at the end of each period. In reality the expected benefits in each year t are determined by weighting the reduction in losses by the probability that the house has not been damaged by a hurricane during the first t periods.
in their home for more than 4 years they would want to invest in these protective measures.

INSERT TABLE 1 HERE

Why have individuals not invested in the cost effective LRMGs? There are a combination of factors which appear to explain their behavior which we will explore below.

B. Underestimation of Probability

Individuals may perceive the probability of a hurricane causing damage to their home as being sufficiently low that the investment in the protective measure will not be justified. Suppose that the Gale family perceived the chances of a severe hurricane damaging their home to be 1 in 75 rather than the scientists' estimate of 1 in 25. As shown in Column 2 of Figure 1, the value of T* is now more than six times as long as before, so that the Gales would have to expect to live in their home for at least the next 25 years in order to want to invest in these LRMGs.

Some individuals may relate their perceived probability of a disaster (p) to a threshold level (p*), which they may unconsciously set, below which they do not worry about the consequences at all. If their estimate of p < p* then they assume that the event "will not happen to me" and take no protective actions. This decision to ignore events where p < p* is justified by individuals by claiming that there is a limited amount of time available to worry about protecting oneself against hazards facing us. By setting a threshold level p*, individuals can devote their attention to events that where p is sufficiently that they are a
source of worry and concern.

The contingent weighting model proposed by Tversky, Sattath and Slovic (1989) provides a useful framework for characterizing individual choice processes with respect to this lack of interest in adopting protective measures. In this descriptive model, individuals make tradeoffs between the dimensions associated with alternatives, such as probability and outcomes. The weights they put on these dimensions are contingent, because they may vary depending on the problem context and the way information is presented. People often weight these dimensions differently than would be suggested by normative models of choice such as expected utility theory.  

It is easy to see why the "it will not happen to me" strategy violates the tenets of expected utility theory or benefit-cost analysis. Instead of weighting the outcome from an event by its perceived probability of occurrence, individuals who utilize a threshold model treat low probabilities as having a zero chance of occurrence. They do not even consider the consequences from events which they treat as impossible, when, in fact, they may actually occur. Homeowners who follow this decision process will have no interest in adopting loss reduction measures because they do not think about the consequences of a disaster.

C. High Discount Rates

Persons may have a very high discount rate so that the future

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See Camerer and Kunreuther (1989) for a more detailed discussion of the decision processes of individuals with respect to low probability high consequence events.
benefits are not given much weight when evaluating the protective measure. As shown in Table 1 (Columns 3 and 4) if the Gale family’s annual discount rate is doubled to \( r = 0.20 \) and the family accepts the scientists’ estimate of \( p = \frac{1}{25} \), then the critical time horizon increases from \( T^* = 4 \) to \( T^* = 5 \). However, if the Gales believes that the probability of a hurricane is \( p^* = \frac{1}{75} \) then there is no value of \( T \) where the expected benefit/cost ratio is greater than 1.

Evidence for high annual discount rates for future savings have been observed in studies evaluating the reluctance of consumers to invest in energy saving equipment. (Hausman 1979; Gately 1980; Kempton and Neiman (1987)). A set of experiments by Lowenstein (1987) on willingness to pay for items whose receipt was delayed or speeded up revealed that the implied discount rates are considerably higher than market rates particularly in situations where the expected savings over time are relatively small relative to the upfront expenditure.

Recent controlled experiment by Kunreuther, Slovic and Hastie (1994) attempt to determine whether high discount rates could account for the lack of interest in protective measures. Students were asked their maximum WTP for investing in a dead bolt lock that would reduce the chances of a break-in of their apartment and the theft of $5000 worth of contents. Over half (52%) of the respondents offered the same price when asked the \textbf{maximum} they would be willing to pay if they had a one year lease for the apartment and then if they had a five year lease. This behavior implies an infinite discount rate, suggesting that other factors
may influence the decision on maximum WTP for protective measures.

**Inappropriate Price** People may decide not to invest in a protective measure because they feel that its price is too high, without even focusing on the time that the protective measure has value. In other words, the determination of an appropriate price is likely to be based on arguments having little to do with expected benefit/cost comparisons. Support for this view comes from a study by Hogarth and Kunreuther (in press) in a study of people's decisions on whether to invest in warranties on such appliances as a stereo, computer or VCR.

Similar findings emerged from the study on purchasing a dead bolt lock described above. When subjects indicated the types of arguments they used in determining HOW MUCH they would be willing to pay for the dead bolt lock, few referred to arguments that could be classified as representing cost/benefit forms of reasoning. Instead other concerns, such as an available budget, were determining factors in specifying WTP. For example one subject, who specified a maximum WTP of $20 for investing in the lock, indicated that:

>$20 is all the dollars I have in the short-run to spend on a lock. If I had more, I would spend more—maybe up to $50.

**III. Limited Interest in Voluntary Insurance Purchase**

The rationale for not voluntarily purchasing an insurance policy appears to be very similar to the choice process regarding protective activities. In the case of insurance a premium is paid every year in return for protection against the occurrence of a
disaster. Hence the expected benefits from this form of protection are restricted to the same time period for which the insurance contract is valid.

To return to the earlier example, suppose that without a loss reduction measure, the damage to the Gale’s home from a severe hurricane would be $25,000. If \( p = 1/25 \) and there is was no deductible or coinsurance clauses on the insurance policy\(^{10}\), then the actuarially fair annual premium for covering the $30,000 loss is $1000. If the Gale Family invested in the LRMs described above, then the actuarially fair premium should be reduced by $400 each year.

The underestimation of probability and the "it will not happen to me" attitude are two principal reasons why individuals do not have an interest in voluntarily purchasing insurance coverage. In addition, factors such as budget constraints may play an important role in determining their reluctance to invest in protection against disasters.

There is little empirical evidence suggesting that individuals are not interested in insurance because they expect liberal

\(^{10}\)A deductible refers to the amount of money that the policyholder has to pay from his or her own resources before collecting on insurance. A 10% deductible on a $60,000 policy means that the insured pays the first $6,000 damage out of her own pocket. In property insurance, coinsurance refers to the amount of coverage required for the insurer to pay the entire amount of the damage. An 80 percent coinsurance clause requires the insured to take coverage of at least 80 percent of the value of the property in order to have his losses fully covered. If the coverage is less than 80 percent then the insurer only pays a portion of the damage costs. Thus if the insurance covered 70% of the value of the property then the insurer would pay 7/8 of the losses (after the deductible).
disaster relief following a disaster. In fact, the data we do have suggests that most homeowners, when asked how they expect to finance recovery, expect to rely on their own resources or bank loans. (Kunreuther et. al. 1978). Even though their failure to purchase coverage appears not to be motivated by the possibility of federal disaster assistance, these funds are likely to be made available after a major catastrophe.

Those who do purchase insurance are likely to cancel policies if they have not made a claim over the course of the next few years. Evidence supporting this point comes from the National Flood Insurance Program (NFIP) where approximately 1 in 5 policyholders cancel their coverage each year.\(^{11}\) This lack of interest in continuing to purchase insurance may help explain the rather startling finding of a report by the U.S. General Accounting Office (GAO) on flood victims with insurance protection.

Specifically, the NFIP requires that homes located in Special Flood Hazard Areas purchase insurance as a condition for federally-backed mortgages. A survey conducted in Texas following a major flood in 1989 revealed that 79 percent of the owners of damaged properties required to purchase flood coverage were uninsured at the time of the disaster. (U.S. General Accounting Office 1990). It would not be surprising to learn that many of these individuals

\(^{11}\)Congressional Hearings on the National Flood Insurance Program in May 1989 (Committee on Banking, Finance and Urban Affairs 1989) provided the following testimony for determining this cancellation rate. There were 2.1 million policies in force at the time (p. 14); nearly 400,000 new flood insurance policies are added each year but these are offset by approximately the same number of people dropping their policies. (p. 29).
purchased a policy at the time they took out a mortgage but failed to renew their policy the next year or several years later after not experiencing any flood losses. Of course, the financial institutions issuing the mortgage would have had to look the other way.

IV. Why Insurers Do Not Promote Coverage?

The two principal reasons that private insurers do not offer policies to cover water damage from hurricanes and floods or actively promote earthquake coverage is because of the uncertainty of the risk and a fear of the economic consequences to them of a catastrophic disaster.

A. Uncertainty of Risk

Ideally, the probability distribution of future losses should be accurately estimated in setting insurance premiums. If there is considerable ambiguity associated with the chances of certain events occurring, then underwriters and actuaries will generally reflect this uncertainty by charging a higher premium than for more well-specified risks. (Kunreuther et al. 1993). If the premium is set so high, that there is limited interest by homes and businesses in purchasing coverage, insurers may prefer not to offer any coverage at all rather than having people complain that they are charging exorbitant premiums.\(^{13}\)

\(^{13}\)Another factor influencing the decision on whether to offer coverage is an insurer's available capacity. One of the factors that determines this capacity is the premium/surplus ratio. A standard rule used by insurers is that the ratio not exceed 3 to 1. Since an increase in premium without a corresponding increase in
For frequently occurring disasters, such as fire, it is possible to estimate the risk rather precisely. Low probability-high consequence events, such as hurricanes, floods and earthquakes, present more challenging problems because there is relatively limited past data available. Here one has to rely on risk assessments undertaken by hydrologists and seismologists. These scientists will be the first to admit that there is considerable uncertainty and ambiguity with respect to the estimating the chances of a particular disaster occurring in a specific area.

In the case of hurricanes there have recently been some attempts to forecast the patterns of storms but there is general consensus that it is not possible to pinpoint the location of the hurricane or the magnitude of potential damage. Models for estimating damages from severe hurricanes have been developed by combining the peril being modeled with the vulnerability of the structures affected by the hazard. (Jobe 1994). The occurrence of Hurricanes Hugo and Andrew has stimulated the industry to develop computer-generated simulation models indicating what could happen in hurricane prone areas over periods of 10 years, 100 years or even 1,000 or 10,000 years. However, there is a lack of uniformity in the results since each model relies on different assumptions.

surplus will cause this ratio to rise, insurers may prefer not to offer coverage at all on an uncertain risk rather than charge a higher premium.

For more details on the challenges in forecasting Atlantic hurricanes see the recent article on the meteorologist William Grey (Morgenthaler 1994).
The implied insurance premiums for any given piece of property will thus depend on the model one uses. (Hunter 1994).

In addition to difficulties in estimating the probability of natural disasters, there are potential problems of adverse selection and moral hazard which need to be dealt with for the risk to be insurable. **Adverse selection** refers to the case where the premium is based on the experience of a large population but only those in the highest risk category purchase coverage. It presents special problems in the case of hurricanes and other natural disasters if one sets a uniform premium across a wide area and only those who face the most severe risk purchase coverage.

There are two principal ways of avoiding adverse selection in the case of natural hazards. The first is to require all property owners to purchase insurance. The requirement that homeowners coverage be purchased as a condition for a mortgage is a step in this direction; however, there is no guarantee that rates will be based on risk. Those in less hazard-prone areas could be subsidizing residents subject to greater risk. A second way of coping with adverse selection which addresses the problem of rate setting is to take advantage of scientific studies indicating the risks to structures in different areas coupled with individual inspections prior to issuing an insurance policy. The property owner would bear some or all of the upfront cost of this process.

**Moral hazard** refers to a situation where the insured behaves more carelessly because he knows that future losses are now covered by insurance. Some hazards have a limited degree of moral hazard.
because the risk cannot be controlled by the individual. Natural hazards normally fall into this category, since the events are triggered by external forces. However, even here there is still the possibility of moral hazard. For example, if an insured family is warned about a possible hurricane damaging the basement of their home, they may move old furniture down from the first floor with the intention of collecting on their policy.

One way to avoid such behavior is to impose a reasonably high deductible or coinsurance clause on the policy. Individuals are much less reluctant to behave carelessly if they know that they will have to pay some of the resulting losses out of their own pockets.

On the empirical side, a recent survey of underwriters illustrates how ambiguity affects their premium-setting behavior. A questionnaire was mailed to underwriters employed by primary insurance companies and reinsurance firms asking them to specify the prices which they would charge to insure a factory against property damage from a severe earthquake under the following four different cases: Case 1: well-specified probabilities (p) and known losses (L); Case 2: ambiguous probabilities (Ap) and known losses; Case 3: well-specified probabilities and uncertain losses (UL) and Case 4: ambiguous probabilities and uncertainty losses.¹⁴

¹⁴An ambiguous probability refers to the case where "there is wide disagreement about the estimate of p and a high degree of uncertainty among the experts". A well-specified loss (L) means that all experts agree that if a specific event occurs the loss will equal L. An uncertain loss refers to the situation where the experts' best estimate of a loss is L with estimates ranging from L_{min} to L_{max}.
For the non-ambiguous case, the probability of the earthquake (p) was set at either .01 or .001 and the loss should the event occur (L) was specified at either $1 million or $10 million, yielding four different scenarios.\(^\text{15}\) If one standardizes the premium set by the underwriter at 1 for the non-ambiguous case, then one can examine how ambiguity affects pricing decisions. Table 2 depicts the ratio of the other three cases relative to the non-ambiguous case (p, L) for the four different scenarios which were distributed randomly to underwriters in primary insurance companies.

INSERT TABLE 2 HERE

For the highly ambiguous case (Ap,UL), the premiums were between 1.43 to 1.77 times higher than if underwriters priced a non-ambiguous risk. The ratios for the other two cases were always above 1 but less than the (Ap,UL) case. [Kunreuther, Hogarth and Meszaros (1993)]

B. Fear of Catastrophic Losses

Hurricanes where there is significant damage from the wind will have a severe impact on the surplus of insurers who have provided standard homeowners or commercial coverage to a significant number of residents and businesses in the impacted areas. Nine property-casualty insurance companies became insolvent as a result of losses from Hurricane Andrew forcing other insurers to cover these losses under the industry’s guarantee fund.

\(^{15}\text{These well-specified scenarios were } p=.005 \text{ L}=$1 \text{ million; } p=.005 \text{ L}=$10 \text{ million; } p=.01 \text{ L}=$1 \text{ million and } p=.01 \text{ L}=$10 \text{ million.}\)
(Unnewehr in press). Eight companies announced that they would be cutting back coverage in Florida due to their severe losses. Insurers also reduced availability of homeowners insurance in other hazard-prone areas such as the Massachusetts shoreline (Blanton 1993).

With respect to earthquakes, a recent study suggests that a catastrophic earthquake would have severe consequences on the surplus of private insurers in the United States (Doherty et al. 1991). Data were collected from 18 insurance firms providing earthquake coverage in California, to determine the financial impact to them should there be a reoccurrence of a disaster of the same magnitude and geographic location as the 1906 San Francisco earthquake.

The study found that if such a catastrophic earthquake (CE) occurred, five out of the eleven firms with surpluses less than $2 billion would suffer losses that would exceed their surplus and cause them to be insolvent. The seven larger firms in the survey with surpluses exceeding $2 billion would be less severely affected by the catastrophic earthquake. Though none of these large firms would be insolvent, three of them would have to curtail their current business or raise new capital because their surplus would be sufficiently depleted from the CE that they could not meet current regulatory guidelines.

Medium and small-sized insurers in the United States use the reinsurance market to protect themselves against the possibility of
large losses from events such as a CE. Since reinsurance data is not in the public domain, a questionnaire was distributed to the 18 firms in the sample to determine the amount of catastrophic reinsurance in force. Fourteen companies responded to the survey. Three of the five firms predicted to be insolvent from the CE without reinsurance responded to the survey; all of them would still be insolvent, even if the reinsurers paid all their claims.

The impact of a catastrophic disaster on the private reinsurance market has not been well studied. These firms are likely to face an even greater problem than the primary insurers if such an event occurs. The premiums that the reinsurers believe that they can charge for such an event is relatively small because of its low probability, but the losses to them from a large-scale disaster could be enormous.

If one looks at the catastrophe-related claims that have been paid for all disasters in the United States in the past forty years, 45 percent have been paid since 1990. As a result of the extraordinary trend in both the frequency and severity of natural catastrophes, reinsurance capacity to cover insurers and their policyholders has diminished. The largest United States reinsurance broker reports that that between 1989 to 1993 there was a decrease of 57 percent in the amount of catastrophic reinsurance that they were able to place for its client base (Nutter 1994). In his paper for this Conference Jobe (1994) provides a comprehensive

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Some of the large personal lines insurers do not purchase any reinsurance.
analysis of the current status of reinsurance capacity for catastrophe loss funding.

V. A Program Linking Insurance and Regulation

A. The Current Scene

The above evidence suggests that individuals residing in hazard-prone areas and insurers are reluctant to deal with natural disasters for very different reasons. Many homeowners at risk are not anxious to purchase insurance voluntarily because they feel the disaster will not happen to them; others who have compared costs with potential benefits may feel that insurance and loss reduction measures (LRMs) are not good investments.

Private insurers have been reluctant to promote coverage against hurricanes, floods, and earthquakes because of the uncertainty regarding the risk and a concern with the financial consequences to them of the consequences of a catastrophic disaster. Hence they want to limit their exposure.

The present situation can be costly to all of the interested parties concerned with disasters. First, the potential damage from natural hazards will be larger than it would be if cost-effective LRMs were adopted on new and existing property. Second, the large losses and potential insolvencies to insurers resulting from a catastrophic disaster will significantly reduce their surplus and lead them to set higher premiums and restrict coverage on policies which are unrelated to the specific disaster in question (e.g.,
automobile coverage, homeowners insurance).

At a theoretical level, Gron (1989), Winter (1988, 1991), Doherty and Posey (1992) have shown that a particular severe flood, earthquake or hurricane could have a very negative impact on the availability of insurance throughout the country. Doherty, Kleffner and Posey (1993) examine how insurers have responded to a variety of surplus shocks in the past. Their analysis suggests that only 50 percent of the lost surplus is likely to be replaced following a catastrophic loss, so that the availability of coverage in many different lines of insurance will have to be reduced.

Third many homes and businesses who suffer uninsured damage will be saddled with large recovery costs following a severe hurricane or other natural disaster. If the past is a guide to the future, the federal government will come to the rescue by providing victims with some form of subsidized disaster relief. Hence all citizens will have to pay for the losses generated by future severe disasters.

B. Key Role of Insurance

The challenge which society faces today is how to promote investments in cost-effective loss reduction mechanisms while at the same time placing the burden of recovery on those who suffer losses from natural disasters. In theory insurance is one of the most effective policy tools for achieving both objectives because it rewards investments in mitigation with lower premiums and provides compensation should a disaster occur.

In practice insurance has not played this role in recent
years. Insurers generally do not charge premiums which encourage loss prevention measures for several reasons. First, they feel that few people would voluntarily adopt these measures based on the relatively small annual premium reductions relatively to the upfront cost (C) of investing in these measures. As discussed in Section II, if individuals have short time horizons then there would be little interest in investing C=$300 in return for a reduction in premiums of $100 as shown.

Insurance is a highly regulated industry with rate changes and new policies generally requiring the approval of state insurance commissioners. The development of premium schedules which provides rate reductions for adoption of certain mitigation measures requires administrative time and energy both to develop and make a case to the state insurance commissioners. If mitigation measures are not viewed as attractive investments by potential policyholders, then an insurer who developed these premium reduction programs would be at a competitive disadvantage relative to those firms who did not.

Finally insurers until very recently may not have promoted loss control measures because they felt it had a negative financial incentive on their profits. Hunter (1994) points out that for many years insurers viewed their role as a pass-through mechanism rather than as a promoter of safety. They saw their profitability related to the level of rates. If they promoted mitigation measures and were able to reduce losses, then this would prevent them from raising premiums and increasing their profits. At the same time if
they promoted loss control through stricter code enforcement, then they would be fight trade associations representing builders and real estate agents. They viewed the choice between promoting loss control or taking a more passive position as an obvious one.

Today the situation is changing. Following Hurricane Andrew the insurance industry has taken a new view toward loss reduction measures because of the severe losses they incurred due to lack of enforcement of building codes. The Insurance Institute for Property Loss Reduction has been founded for the express purpose of developing new approaches for designing structures that will withstand hurricane and wind damage as well as encouraging building code inspection and enforcement. Robert Hunter, who is Insurance Commission of Texas, points out that his Department is attempting to replace 1970-vintage standards for wind-resistant construction with new building codes based on today’s knowledge including lessons learned from Hurricane Andrew (Hunter 1994). There is a clear opportunity for utilizing insurance as an incentive for reducing future hurricane and other natural hazard losses as the centerpiece of a hazards management program.

C. Developing a Hazards Management Program

For insurance to serve as a useful policy tool for helping to reduce future property losses for natural hazards there needs to be a set of well-specified standards and regulations. Below we outline the elements of such a hazards management program.

1. Institute and enforce more stringent building codes. Responsible government agencies should develop stringent building codes which
incorporate cost-effective mitigation measures on new structures, and enforcement them. The limited voluntary adoption of these measures on existing homes in the United States suggests that innovative ways need to be found to encourage homeowners and the building industry to modify structures to meet appropriate standards. Key stakeholders such as the insurance industry, building industry, inspectors and real estate developers need to support such a program for it to work.\textsuperscript{17}

While building codes serve an important function in reducing future property damage, Cohen and Noll (1981) provide an additional rationale for having them. When a building collapses it may create economic dislocations and social costs in addition to the economic loss suffered by the owners. These may not be taken into account when the owners evaluate the importance of adopting a specific mitigation measure.

2. \textit{Use seals of approval on structures meeting codes.} Each building that meets or exceeds the specific building code would be given a seal of approval. This would provide homeowners and businesses with the knowledge that the building has been safely designed and built in accordance with a federal or national code. It would make these property owners more sensitive to the importance of ensuring that their home is appropriately designed

\textsuperscript{17}The Insurance Institute for Property Loss Reduction in the United States is now in the process of establishing a relationship with the American Society of Home Inspectors to enhance building code compliance. The specific elements of the program have not been identified yet. (Personal communication with Paul Cogswell, May 6 1994.)
and protected so that they will be well protected from future hurricane and other natural disaster losses.

One way to institutionalize the seal of approval procedure would be for financial institutions to require an inspection of the facility at the time that a mortgage is issued. This inspection, which would be a form of buyer protection, is identical in concept to the termite and radon inspection that is normally required today as a condition for a mortgage in many parts of the United States. A prospective buyer is unlikely to know how safe the structure is, so this inspection should be viewed as desirable. 18

3. Use insurance to encourage hazard mitigation. To reduce their losses from disasters, insurers may want to limit coverage to structures that are given a seal of approval. If banks require insurance as a condition for a mortgage, then financial institutions together with the insurer can help enforce building code regulations. The reduction in potential losses from the adoption of building codes should be reflected through lower premiums, lower deductibles and/or higher coverage limits.

The government could require insurance as a condition for federally-backed mortgages, as is the case today for structures located in Special Flood Hazard Areas. However, an interesting set of competitive pressures create a lack of interest by many banks in requiring homeowners to take flood insurance as a condition for a

18If a house does not meet the relevant building code then there is the question as to whether it must be improved prior to the sale of the house or if it is sufficient to provide the new buyer with this information. This is an area which has both economic and political ramifications.
mortgage. Prospective homeowners who are unconcerned with the flood hazard will naturally want to obtain their mortgage from a bank that does not require such insurance coverage to save the extra premium.

Until a recent court decision in the state of Connecticut banks have not been fined if a house in the flood-plain is uninsured, nor do they have to pay for any flood damage if the house is flooded. For these reasons, banks have no incentive to ensure that homeowners renew their flood insurance coverage which they purchased at the time of their mortgage.

There is a need to impose fines or other penalties on lenders who are obligated to require flood insurance but do not do so. A recent bill introduced into the U.S. Congress (S.1405) would require lenders to inform purchasers of how to obtain insurance and subject to penalties of up to $350 for each violation. This penalty may only be partially successful in forcing banks to take the appropriate action. A much more effective penalty would be to hold banks and financial institutions responsible for the costs of repair on any uninsured home which had been required to have coverage, with the maximum dollar amount based on the amount of coverage that the structure have been required to have. (Kunreuther and White 1994).

4. Develop all-natural hazards insurance. The insurance industry should be encouraged to market a new type of homeowners insurance which includes protection against earthquake, flood and hurricane damage. Rates would be based on risk, with the potential losses
diversified throughout the country. Such a policy has several advantages over the current system where homeowners and businesses normally have to buy separate policies to cover flood and earthquake damage. By covering a large number of hazards it has a higher premium base to cover losses from any single disaster. There is a smaller chance of insolvency than under the current program if there is some diversification of risks across a wider area.¹⁹

A second reason why an all-hazards program should be attractive to both insurers and policyholders in hurricane-prone areas is that avoids the costly process of having an adjuster determine whether the damage was caused by wind or water. It also averts disputes between the insured and insurer. These are likely to arise today if the adjuster rules that the losses were uninsured because they were caused by water and the policyholder believes it was due to wind.

An all-hazards policy would also eliminate the following inequity which taken from a study by Moore after Hurricane Carla in 1962 and which could still occur today. One contractor built his home with the best available materials so that it withstood the winds from Carla but later was flooded and almost totally destroyed. His damage claim under a homeowners policy was disallowed. Nearby, another house built of cheap materials had its

¹⁹In the case of hurricanes the insured losses from a single disaster will be larger than under the current system since the insurer will be responsible for both wind and water damage. The impact on any specific insurer’s surplus will depend upon the total number of policies written and the degree of diversification of the risk.
shingle roof disintegrated by the wind early in the storm. The insurance claim for total loss was paid. (Moore 1964 p. 188).

Finally an all-hazards policy satisfies the psychological need that individuals have to be protected against all risks without having to buy separate coverage for certain hazards. The attractiveness of insurance which covers all risks was demonstrated experimentally by Kahneman and Tversky (1979 pp. 269-71). They showed that 60 percent of their subjects preferred regular coverage to probabilistic insurance. 20 It has also been observed in other contexts, even when standard benefit-cost analysis argued for maintaining a partial risk. (Baron 1993) 21

5. Institute government reinsurance. The Federal government should provide reinsurance protection against catastrophic losses from all disasters on the newly designed all-hazards policy to the extent that protection from the private reinsurance market is not available. The need for such a government fund arises from the apparent inability of the private reinsurance market, due to limited financial capacity, to provide sufficient protection against large-scale natural disasters. Private insurers would

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20 Kahneman and Tversky’s definition of probabilistic insurance was a policy whereby you pay half of the regular premium. In case of damage, there is a 50 percent chance that you pay the other half of the premium and the insurance company pays all the losses; and there is a 50 percent chance that you get back your insurance payment and suffer all the losses.

21 For example, many persons prefer cleaning up one site so there is zero risk rather than investing the same funds on partially cleaning up several sites where the reduction in risks (e.g. cancer deaths) is much greater. For more details see Baron et al. (1993).
build up the fund by being assessed premium charges in the same manner that a private reinsurance company would levy a fee for excess loss coverage or other protection.

One advantage of a Federal reinsurance program is that it reduces uncertainty to private insurers about the consequences of a catastrophic disaster so that they should be able to lower their premiums for disaster coverage. By having federal involvement in one portion of the natural disaster management program, it is then possible for some government agency (e.g., FEMA) to require the adoption of mitigation measures as a condition for federally-backed mortgages in a manner similar to what is done under the National Flood Insurance Program (NFIP).

In addition federal reinsurance for catastrophic losses will restore the financial conditions of insurers following a catastrophic disaster and hence greatly reduce the likelihood that insurers will cut back on the availability of coverage in the future as they did following Hurricane Andrew.

6. **Subsidize low income families.** Many poorly constructed homes are owned by low-income families so that they cannot afford the costs of mitigation measures on their existing structure nor the costs of reconstruction should their house suffer damage from a hurricane or other natural disaster. Low interest loans and grants could be provided for them to adopt cost effective loss reduction measures (LRMs) or to relocate their home to a safer area. Following a disaster special disaster assistance should be given to them to aid their recovery process.
In summary, by coupling insurance requirements with building codes and risk-based premiums for adopting cost-effective LRMs we will have taken a giant step in reducing losses from future hurricanes and other natural disasters as well as aiding the recovery process for those who suffer severe damage to their property.

VI. Conclusions

The principal message of this paper is that insurance is a potentially valuable tool for encouraging mitigation against hurricanes and other natural disasters; however, for it to serve this role, insurance needs to be coupled with other policy tools such as well specified regulations and standards that are enforced. Other interested parties such as banks and financial institutions, builders and contractors and government agencies need to cooperate with the private insurance industry to enforce specific regulations and standards.

Incentives such as premium reductions, lower deductibles and higher limits of coverage should be given to individuals in hazard-prone areas to encourage them to adopt cost-effective LRMs voluntarily. Private insurers should offer an all-hazards policy backed by the private reinsurance market. To the extent that capacity from private reinsurers is not available, the federal government should provide reinsurance protection against losses from catastrophic hurricanes and other disaster. Special assistance should be given to low income families on equity grounds to
encourage them to adopt cost-effective LRMs and to aid them following a disaster should they suffer damage to their property and its contents.

Finally there are set of lessons which can be learned from comparing natural and technological hazards in terms of how we currently deal with them at the individual, group, organizational and societal levels and what steps can be taken to reduce future losses and damage in an equitable and efficient manner. That, of course, is what this conference is all about.
REFERENCES


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TABLE 2

Ratios of Underwriters Premiums for Ambiguous and/or Uncertain Earthquake Risks Relative to Well-Specified Risks

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N= Number of Respondents
* Ratios based on Mean Premiums Across Number of Respondents for Each Scenario
Source: Adapted from Table 3 in Kunreuther, Hogarth and Meszros (1993)