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The Role of Insurance in Reducing Losses from Natural Hazards

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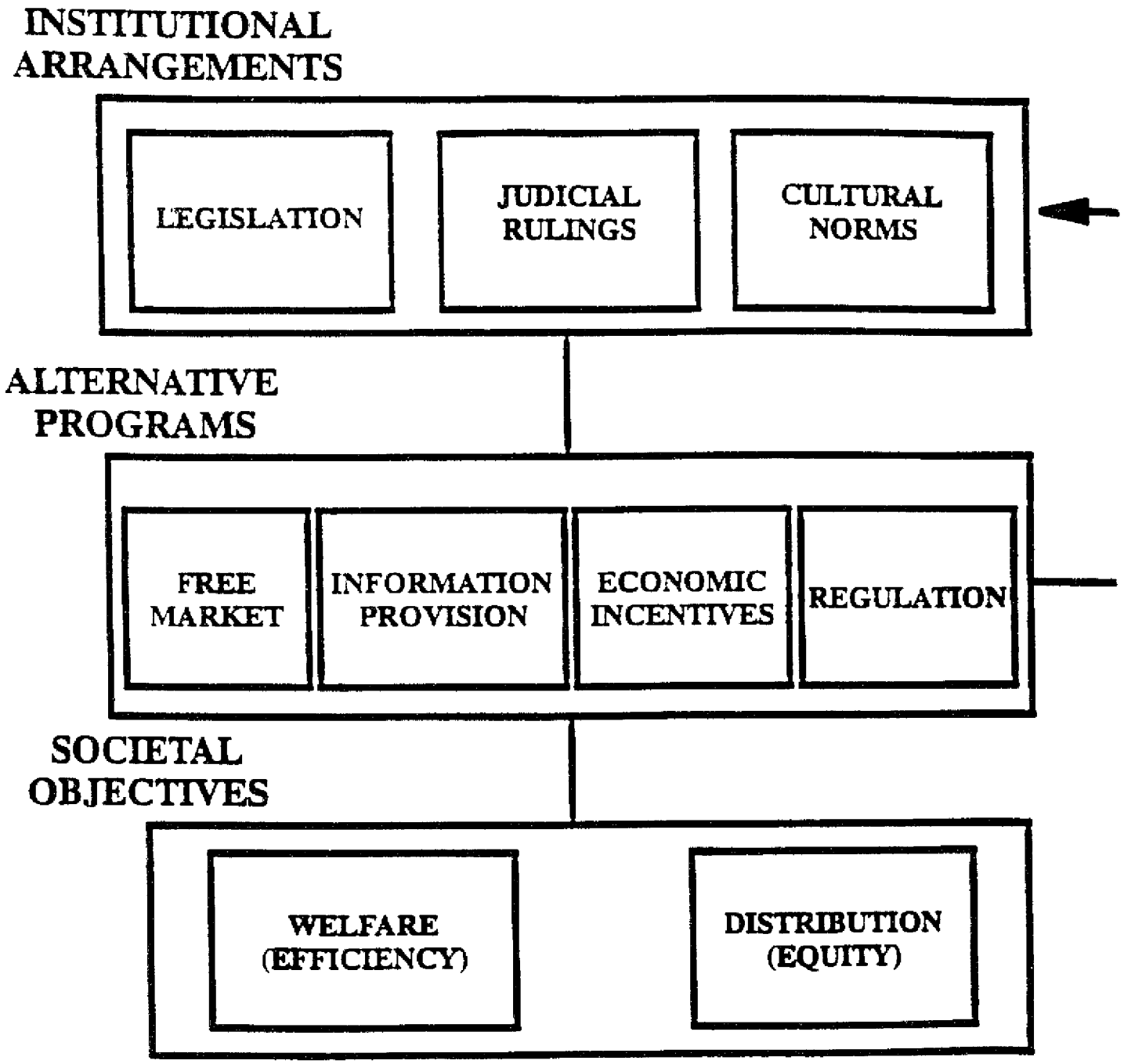
This chapter addresses the role of insurance in reducing losses from natural disasters.[1] In theory, insurance should be ideally suited to aid the financial recovery of victims suffering damage from natural disasters while at the same time reducing losses from future ones. A homeowner or business who has purchased insurance is protected against a severe loss through the payment of a small premium. At the same time, if premiums are based on risk, then insurance should encourage individuals to adopt cost-effective loss-reduction measures on their homes.

Figure 6-1 depicts a conceptual framework that should enable different countries to evaluate how insurance coupled with other policy tools, such as mitigation and land use regulations, can reduce losses from natural hazards. The current institutional arrangements—existing legislation, judicial rulings, and cultural norms—affect the benefits and costs of different strategies for reducing disaster losses.

A starting point is to provide information on the risks facing individuals in hazard-prone areas. Insurance can do this very effectively through a rate schedule. Higher premiums for the same amount of coverage or protection imply a greater chance of suffering losses. Another way to convince individuals to take certain actions is through economic incentives. Here insurance can play a key role by reducing the premiums for persons who invest in mitigation or loss-reduction measures. Finally, one can turn to standards and regulations. Insurers can require that certain standards (for example, building codes) be met before issuing an insurance policy; financial institutions can refuse to issue a mortgage unless the owner has insurance.

Figure 6–1: Framework for LP–HC Events



These different policies need to be evaluated with respect to their effects on resource allocation (efficiency) as well as distribution (equity). For example, if insurance rates are based on risk, then low-income individuals living in high-hazard areas may not have funds to adopt cost-effective mitigation measures or purchase an insurance policy. Should they receive low-interest loans or grants to undertake loss-reduction measures? Should insurance be subsidized so the rates are affordable to them? The answers to these questions will differ between countries as a function of the types of hazards they face, the composition of their population, and the available resource bases. In addition, the current institutional arrangements, as depicted in the top row of figure 6-1, will play a key role in ranking alternative disaster management programs.

In examining the potential role of insurance in reducing losses from natural hazards, the following questions need to be addressed:

1. Why do so few individuals voluntarily purchase insurance and adopt cost-effective mitigation measures for natural hazards?
2. Why are private insurers reluctant to promote and market coverage against natural hazards?
3. What are the features of an insurance program that will be attractive to potential disaster victims and insurers and will promise to reduce losses from future natural disasters?

This chapter addresses the first question by looking at empirical evidence on homeowner behavior in hazard-prone areas of the United States and examines the conditions for making a risk insurable. Next, the challenges insurers face in providing coverage against some natural hazards are examined, followed by discussion of a hazard management plan in which insurance coupled with regulations and standards play a central role. This hazard management plan takes into account individuals' reluctance to protect themselves from disaster damage as well as private insurers' reluctance to provide coverage. Finally, questions are posed regarding implementation of the hazard management plan.

Although the empirical portions of the discussion focus primarily on experience in the United States, the framework and conceptual ideas should have relevance to other parts of the world. Of course, the actual design of a hazard management plan will vary from one country to another because of differences in past history and current institutional arrangements.

Why interest in insurance and mitigation is limited

Consider the following hypothetical example to illustrate the potential role of insurance in reducing losses from natural hazards. Suppose that seismologists have estimated that the annual chances that a severe earthquake will damage a home in Tokyo is 1 in 200 and that the total damage will be $20,000. If there is no deductible on an insurance policy, then the actuarially fair annual premium for covering the $20,000 loss is $100.[2]

If a homeowner is averse to risk and hence wants to pay a small premium to avoid a large loss, then insurance should be an attractive option even if the premium somewhat exceeds $100. Following an earthquake, the family will be reimbursed by its insurance company rather than having to finance recovery with its own resources, bank loans, or disaster assistance from the federal government.

Now suppose that a homeowner could invest $50 to attach the family's water

heater securely to the wall and thus prevent it from toppling during an earthquake. If the water heater falls and breaks a gas or electrical line, the result may be a fire as well as water damage (see California Seismic Safety Commission 1992 for a detailed description of alternative loss-reduction measures that homeowners can adopt). Suppose that by adopting this measure, the best estimate of the *reduction* in damage to the home and contents if a severe earthquake occurs is estimated to be $4,000. This means that the insurer can reduce the actuarially fair premium to the homeowner by $20 (that is, 0.005 x $4,000). The homeowner now has to decide whether to invest $50 today to save $20 each year over the life of the house. This investment is clearly cost-effective for any house that is likely to be occupied for even just a few years (the next section analyzes the relevant tradeoffs in showing how to determine whether a particular mitigation measure is cost-effective).

In developing programs for reducing losses from natural hazards, it is important to recognize that the vast majority of individuals do not purchase insurance voluntarily or invest in mitigation and loss-prevention methods. In a recent survey of 3,500 homeowners in four California counties subject to earthquake damage, Risa Palm and her colleagues reported that only between 5 and 9 percent had adopted any loss-reduction measures (Palm and others 1990). If most of these homeowners had purchased earthquake insurance, their behavior could have been explained by their belief that they were covered against potential losses. That was not the case, however. Although recently there has been much more interest in earthquake insurance than there was twenty years ago, only 30 percent of homes in earthquake-prone areas of California have coverage today.

With respect to flood insurance, most individuals in hazard-prone areas do not purchase coverage voluntarily. Of the approximately 9.6 million households in flood-prone areas of the United States, 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 insurance as of August 3, 1993 (Karr 1993).

There are several principal reasons why individuals do not protect themselves voluntarily against the consequences of natural hazards. Many individuals initially focus on their perceived probability of a disaster (p) and unconsciously set a threshold level (p^*) 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 them and take no protective actions.

This decision to ignore events where $p < p^*$ is exacerbated by a tendency for individuals to underestimate the probability of a future disaster if they have not personally experienced the event. For this reason, many individuals do not believe that they will suffer damage to their homes, even in areas where scientists have predicted that a severe disaster is likely to occur in the next decade.[3]

The contingent weighing model proposed by Tversky, Sattath, and Slovic (1988) provides a useful framework for characterizing how individuals decide whether to adopt protective measures such as insurance. 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 context of the problem and the way in which information is presented. People often weight these dimensions differently than would be suggested by normative models of choice such as expected utility theory (see Camerer and Kunreuther 1989 for a more detailed discussion of the decision processes of individuals with respect to low-probability high-consequence events).

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 weighing the outcome of an event by its perceived probability of occurrence, individuals who use a threshold model treat low probabilities as having a zero chance of occurrence. They do not even consider the consequences of events that they treat as impossible but that, in fact, may actually occur. Those homeowners who follow this decision process have no interest in purchasing insurance because they *do not* think about the consequences of a disaster. Even though their actions *are not* motivated by the possibility of generous disaster relief, such funds may still be available to them after a major catastrophe.

Another reason why many individuals do not voluntarily purchase insurance is because they view such expenditures as poor investments. Many homeowners have a difficult time justifying the voluntary purchase of coverage next year if they have *not* made a claim on their policy in previous years. In the case of natural hazards, it is highly unlikely that a disaster of any magnitude will occur to any specific individual during a three- to five-year time period. It is difficult for many people to continue to buy coverage against a loss and say to themselves and others that the best return is *no* return at all.

A third reason why some homeowners will not invest in cost-effective loss-reduction measures is that they focus on up-front expenditures without recognizing the potential long-term benefits realized by these loss-reduction measures. In other words, their calculation of benefits is based on very short time horizons so that the cost of the investment appears large relative to the returns that are calculated over just the next year or two.

Premium reductions that reflect the benefit of the protective measure would help a person see the wisdom of this investment. However, because of myopic behavior the annual premium reduction has to be relatively large to encourage them to invest in these measures. The example presented in the introduction illustrates this point. If the homeowner only considers the $20 premium reduction over the next two years, then the $50 investment in mitigation appears to be a poor investment (Kunreuther, Slovic, and Hastie 1994).

Homeowners are not the only ones who fail to adopt protective measures and purchase insurance prior to a disaster. While empirical data on business behavior are limited, a recent study reveals that relatively few small businesses have earthquake insurance, unless they are required to purchase coverage in order to secure a loan. In particular, firms located in earthquake-prone areas of the Midwest or Eastern United States appear to have an "it will not happen to me" attitude (Alesch and others 1993).

With respect to the degree of protection undertaken in the public sector, a comprehensive study by Burby (1992) and his colleagues reveals that most local governments do not adopt hazard mitigation measures or purchase insurance. More specifically, a study by French and Rudholm (1990) of the damage to public property in the Whittier Narrows, California, earthquake of October 1987 re-

vealed that few public buildings were protected by earthquake insurance, even though it was readily available from the private sector. Consequently, a large portion of the damage was paid for by the Federal Emergency Management Agency in the form of disaster relief.

What makes a risk insurable

Any firm should be interested in offering coverage against any natural hazard that satisfies the conditions of insurability. The conditions of insurability are widely discussed in most insurance textbooks and were formalized in a book by Berliner (1982). This section discusses the key elements of insurability that need to be taken into account.

Uncertainty

Insurance policies are designed to cover events that are unintended and uncertain. There is general agreement that natural disasters satisfy this condition. A risk is uninsurable based on this condition if seismologists can accurately predict the timing, location, and magnitude of earthquakes in the future. Insurers would then have no interest in providing coverage to individuals and firms who face a certain loss from an earthquake next year, except by charging a premium that approaches the magnitude of the loss itself.

Low correlation

The possibility of a catastrophic loss from a single event may make the risk uninsurable. When the risks covered by the insurer are independent of one another, such as an automobile accident, then the losses from any single event are likely to be small. If the insurer fears the possibility of a catastrophic loss from a single event, such as a flood or an earthquake, then it is reluctant to cover a large number of homes that are located in the same hazard-prone area.

Identification of losses

Losses must be well defined as to time and place. In the case of a piece of property, it is generally possible, using past data, to determine the likely distribution of damages from fires. For natural disasters such as floods and earthquakes, scientific studies by hydrologists and seismologists relate the characteristics of a particular disaster (duration, magnitude) to the loss. For example, to estimate the damage to a particular structure from an earthquake, it is necessary to determine the magnitude and duration of groundshaking, which is then translated into some type of scale such as the modified Mercali intensity. This scale is then used to estimate the percentage of the structure that will be damaged should such a quake occur (Arnold 1990). Even if the epicenter and type of quake that will occur are known, the extent of the damage to the structure is still uncertain (Dames and Moore 1990).[4]

The probability of loss

Ideally, the probability distribution of future losses should be accurately estimated in setting insurance premiums. If considerable ambiguity is associated with the chances of certain events occurring, then the risk may still be insurable. However, underwriters and actuaries generally reflect this uncertainty by charging a higher premium than they do for better specified risks (Kunreuther, Hogarth, and Meszaros 1993).

For frequently occurring disasters, such as fire, it is possible to estimate the chance of their occurrence. Low-probability, high-

consequence events, such as hurricanes, floods, and earthquakes, present more challenging problems because the availability of past data is limited. Here one has to rely on risk assessments undertaken by hydrologists and seismologists. These scientists are the first to admit that estimating the chances that a particular disaster will occur in a specific area is highly uncertain and ambiguous. For example, many seismologists and geologists believe that we are now entering a cycle of high earthquake activity, but they do not know whether this cycle will culminate in a large earthquake in 50, 100, or 200 years and where such a disaster will occur (Hamilton 1992).

Moral hazard

Moral hazard refers to a situation where the insured behaves more carelessly than he normally would simply because he knows that his losses are now covered by insurance. Some hazards have a limited degree of moral hazard because the individual *cannot* control the risk. Natural hazards normally fall into this category, since the events are triggered by external forces. Even in these situations, the possibility of moral hazard exists. For example, if an insured person is warned that a flood may damage the basement of his house, he may move old furniture there with the intention of collecting on his policy.

One way to avoid such behavior is to impose a reasonably high deductible or coinsurance clause on the policy (an 80 percent coinsurance clause indicates that the insurer pays 80 percent of any loss and that the insured party absorbs the other 20 percent). 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.

Adverse selection

A risk is uninsurable if the premium is based on the experience of a large population but only those in the highest risk category purchase coverage. This is known as adverse selection. Insurers inspect a house before providing fire coverage or require medical exams before issuing a health insurance policy in order to estimate individual risks more carefully and charge premiums that reflect these risks.

Adverse selection presents special problems in the case of natural disasters if the insurer sets a uniform premium across a wide area and only those who face the most severe risk purchase coverage. Thus, if only those individuals living closest to the river buy flood insurance at a premium that reflects the damage to a much broader area, then the insurer has an adverse selection of policies.

The principal way of avoiding adverse selection is to take advantage of scientific studies differentiating the hazard coupled with an inspection of individual structures prior to issuing an insurance policy. This would enable insurers to customize rates based on risks. This may be a relatively costly process if the insurer has to bear the costs; however, if each owner incurs this expense as a condition for obtaining a mortgage, then it may be feasible.

Why insurers do not promote coverage against natural disasters

The two principal reasons that private insurers do not offer flood policies or actively promote earthquake and hurricane coverage is because the risk is uncertain and the economic consequences of a catastrophic disaster are too great.