

VICTIMIZATION BY NATURAL HAZARDS IN THE UNITED STATES,  
1970-1980: SURVEY ESTIMATES\*

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Estimates of average annual damages and personal injuries over the period 1970-1980 to households in the United States from each of five hazards--household fires, floods, tornadoes, hurricanes and earthquakes--are derived from national sample surveys. The annual incidence rate for the four natural hazards combined is 18.7 per 1,000 households, or approximately 1.5 million household annually experiencing one or more incidents of floods, hurricanes, tornadoes or earthquakes. Average annual damages from the same hazards reported by the households amount to U.S. \$6.1 billion (in 1980 dollars). Analyses of aid received in the forms of insurance payments, gifts, grants and loans show that floods present the most serious problems to households when experienced, not only causing more damage but also more likely not to be covered by insurance and more likely to lead the household into enlarging its debt burden. No substantively significant biases were found in the distribution aid to households afflicted by natural hazards.

Existing estimates of the total annual losses from all natural hazards in the United States vary from five to ten billion dollars, counting all costs--direct and indirect, public and private (Cochrane, 1975; Dacy and Kunreuther, 1969; White and Haas, 1975). Although the variation among estimates is large, all agree that the annual toll is in the billions. Such estimates are typically constructed by summing over various component costs, some of which may be relatively precisely known (e.g., Small Business Administration disaster loans) and some of which may be charitably regarded as

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"educated guesses" (e.g., local community unreimbursed expenditures).

Perhaps the least well known with any precision are the costs borne by victimized households who receive no reimbursements from private insurance, from government grant or loan programs or from other sources. There are no centralized records maintained by federal agencies, national private relief organizations, casualty insurers, or any other agency that allow an accurate estimate of these losses, nor are there good records of injuries resulting from natural hazards (Rossi et al., 1978). Even the American National Red Cross, which records deaths and injuries from the incidents to which it responds, worries about events to which it does **not** respond and about injuries or other losses that may not come to its attention.

The research reported here provides more precise and all-encompassing estimates of the damage and injury tolls experienced by households that arise from natural hazard events. The research also addresses a common hypothesis in the literature on natural hazards, namely, that the costs are borne differentially among various social groupings, primarily by the disadvantaged (the poor, the old, the handicapped) (Barton, 1969; Bates, 1963; Cochrane, 1975; Friesema et al., 1981; Haas et al., 1977; Kunreuther, 1977; Mileti, 1975; Vinso, 1983; Wright and Rossi, 1981; etc.). We also present information on the coverage and contact rates of various relief agencies and organizations, and to that extent, on the equity of the organizational response to disaster (Dynes, 1970; Mileti et al., 1975). This paper summarizes results reported more fully in Rossi et al. (1983).

To calculate these estimates, we went to the primary source of such information, households themselves. A large national sample of telephone-owning households (approximately 13,000) was selected by random digit dialing methods (Dillman, 1978; Groves and Kahn, 1980), and screened to identify households who experienced a flood, hurricane, tornado, or earthquake between 1970 and 1980. To provide a comparative frame, experiences with household fires were also ascertained. Telephone interviewing took place during November and December of 1980.

About 2,600 households were found to have had one or more such experiences and were then contacted again by mail with a questionnaire asking for detailed information on injuries, damages, financial and other aid received from whatever source, and whether contacts were experienced with disaster agencies or other organized sources of aid. Approximately 1,400 questionnaires were returned (response rate = 54 percent).

The research design employed allowed the screening of a large number of households in order to identify and reach the small proportions who had been victimized by the natural hazard events studied. Random digit dialing techniques make it possible to generate a random sample of telephone households (including those with unlisted telephone numbers). Telephone surveys are relatively

inexpensive and have been shown to produce data that are indistinguishable in quality from those produced in face-to-face interviewing. Of course, the small proportion of households (approximately 6 percent in 1980) who do not have telephone service are entirely omitted, along with those who do not ever answer their phones or whose phones are out of service. The bias so introduced, we believe, is more than compensated for by the more extensive coverage of households the telephone makes possible at a considerably lower unit cost.

Ordinarily, mail surveys suffer from unacceptably low response rates. But, our mail survey enjoyed a relatively high response rate: 54 percent of the households sent questionnaires returned one or more of them. When attempting to reach households scattered across the length and breadth of the continental states, mail surveys can be, as in this case, efficient and cost effective. As has been shown (Dillman, 1978), mail survey data cannot be distinguished from face-to-face survey data with respect to a wide variety of quality indicators.

### The Incidence of Disaster Experience

Since the screening survey asked each household whether or not it had experienced each of the five hazards during the eleven year period, 1970-1980, the results can be used to estimate the incidence and distribution of hazard events among telephone-owning households for the continental United States as a whole. Using the least stringent definition of hazard experiences--households who said they "experienced" such an event, regardless of injuries or damages--about one in four experienced at least one hazard event sometime during the decade, which gives a projected annual number of about 4 million affected households. "Experiencing" under this definition clearly includes many whose experiences were trivial in that neither injuries nor damages were sustained. For example, households who were near the path of a tornado or who experienced the heavy rains accompanying a hurricane could, and apparently did, claim an "experience".

Using a more stringent definition of victimization, one that includes only experiences causing injuries and/or damages, the incidence is lowered to about 25 victimizations per 1,000 households annually. Table 1 displays the resulting annual victimization rates for each of the five hazards studied along with the absolute numbers of households affected annually.

Tornadoes and severe windstorms have an estimated annual incidence rate of 10 per 1,000 households. Projected to the total household population of the continental U.S., this leads to an estimated 800,000 households per year experiencing non-trivial tornado and severe windstorm losses. Floods and hurricanes (and severe tropical storms) are all about equally common, each victimizing more than a

quarter of a million households annually, on the average. Earthquakes and tremors appear to be the least frequent among the natural hazards studies.

A 10 percent subsample of the screening interview households were also asked whether they had, in the same ten years, ever experienced a variety of other unpleasant but fairly common calamities.

Interestingly, the four hazards taken together were experienced less frequently than, say, automobile accidents, marital dissolution, or unemployment, but were experienced more frequently than, say, birth of a defective child, personal bankruptcies, arrest, or being the victim of a shooting. In short, natural hazards experiences are among the fairly common "bad luck" happenings that occur to the American population.

**Table 1:** Annual Rates of Natural Hazards Victimization<sup>a</sup> And Projected Annual Numbers of Households Affected

Hazards	Natural Hazards Victimization <sup>b</sup>	
	Annual Rate per 1,000 Households	Projected Annual Number of Households <sup>c</sup>
Household Fires	5.8	464,000
Floods	3.4	272,000
Hurricanes and Severe Tropical Storms	3.4	272,000
Tornadoes and Severe Windstorms	10.0	799,500
Earthquakes and Severe Tremors	1.8	138,000
Any of the Four Natural Hazards	18.7	1,495,000
Any of the Five Hazards (including Fires)	24.5	1,959,000

a A victimization is defined as any reported "experience" with a hazard event that involved injury to household members and/or non-zero damage to real or personal property of the household or its members.

b Based on estimated 79.5 million households as of 1980.

c Data from random digital telephone survey (N=13,006).

Although the geographic, ecological, and regional distribution of natural hazards events is fairly well known, the differential impact of such events on various social groups is not. The existing literature provides some clues as to how disaster impacts may be differentially absorbed in the various social strata. There is evidence, for example, that the old and poor suffer disproportionate economic losses (Vinson, 1983); that the young are emotionally traumatized (Erikson, 1976), that debt burdens generally increase, especially among economically marginal families (Cochrane, 1975); that poorer and less educated families are less likely to prepare themselves for a disaster (e.g., Turner et al., 1983) or to purchase hazards insurance (Kunreuther, 1977) etc. Almost without exception, however, these conclusions are derived from case studies of one or at most a small handful of relatively destructive disasters. Data reported here make it possible to test some of these findings on a national sample of disaster victims.

To this end, we investigated the differential impacts of hazards on various income levels, age groups, ethnic groups and the like. No strong patterns emerged. Younger households appear to be more likely to be victims of household fires, floods, and tornadoes; and higher income households appear to experience tornadoes and windstorms slightly more often than their poorer counterparts; but there were no other relationships of note. Indeed, it must be stressed that even these differences are quite small, indicating that natural hazard events tend to be rather equally distributed among all social groups. Hazards are egalitarian, striking with about equal frequency among the several social classes, major ethnic and racial groups, and renters and owners. (See Rossi et al., 1983, for more detailed presentation of these results.)

Of course, hazards risks are concentrated in regions, the association between East Coast and Gulf States and hurricanes illustrating that well known pattern (Hebert and Taylor, 1975). Vulnerability to hazard events appears to be more a matter of regional location than of position within the social structure.

#### Hazard Injuries and Damages

Households who claimed in telephone interviews to have experienced hazard events were sent mailed questionnaires that called for fine details on injuries and damages sustained. Data on injuries and damages are summarized in Table 2. Injuries to household members occurred in 9 percent of household fires, and 8 percent of floods, but in only about 2 percent of the other hazard events. All told, injuries were not frequent. Deaths to household members were even more unusual events, occurring in less than 1 percent of all the incidents. (Of course, the death estimates are biased downward since some households would have been dissolved by the deaths in question.)

Damages to real and personal property holdings were considerably more frequent than injuries to household members. Nine out of ten household fires resulted in property damages that amounted on the average to U.S. \$10,500. Three out of four flood events resulted in damages that also averaged U.S. \$10,500. About half of the hurricane experiences were accompanied by damages averaging U.S. \$3,500, and two out of three of the tornado events produced damages averaging U.S. \$2,500. The earthquake and tremor experiences of the period were on the whole trivial, only 14 percent involving damages that averaged U.S. \$2,000. Although the average amounts of damages inflicted appear to be high, these averages are very much influenced by a few households that experienced very large amounts of damages: The median values of damages in every hazard type are much lower than the arithmetic averages.

Summed over the entire period, the annual average damages (in 1980 dollars) are shown in Table 3. Annually, the dollar damages (in constant 1980 dollars) amount to U.S. \$6.1 billions from the four natural hazards and U.S. \$10.7 billions when household fires are also included, figures that are clearly compatible with extant estimates. It should be noted that these estimates are **not** the net costs to

**Table 2:** Hazard Generated Injuries and Damages (From Mail Survey)

	Hazard Event				
	Fires	Floods	Hurricanes	Tornadoes	Earthquakes
Percent With Any Injuries	9	8	2	2	2
Percent with Any Damages	86	76	55	65	14
N	267	151	261	581	363
Average U.S.\$ Loss For Those With Any Loss	10,500	10,500	3,500	2,500	2,000
Median U.S.\$ Loss For Any Loss	2,500	3,000	800	700	1,000
Percent of Damage That is Structural	39	31	40	46	55
N	218	112	142	365	44

households themselves since some of the losses are borne by insurers, some are covered by government and private agency grants, and still others may be covered by gifts from many sources. However, even if the net costs amount to as little as 50 percent of the gross costs shown in Table 3, the burden on American households would be quite large.

Most of the damages were to the housing structures occupied by households. Structural damages to housing ranged from 31 percent (for floods) to 55 percent (for earthquakes) of all damages claimed by households. The remaining costs were incurred through the destruction or damage of furnishing and other personal property item.

When we consider the "total dollar cost" of household hazard experiences (defined as the sum of all dollar costs incurred through injuries, deaths, or property damages), we find that it largely uncorrelated with household or social characteristics. Fires and floods are likely to be more costly to owners (as compared to renters), but this is easily accounted for since renters do not generally bear the costs of structural damages. Also, higher income households experienced less damage from floods than lower income households, perhaps because they are less likely to live in flood-hazard areas. Effects of other variables were generally insignificant.

The main factor affecting total household costs appears to be the extensiveness of the natural hazard event. Hazards events that involve other households in the neighborhood and community tend to inflict higher total costs to each household than events that involve only one or a few households. (This information is derived, of course,

**Table 3:** National Annualized Adjusted<sup>a</sup> Estimates of Total Costs Inflicted by Natural Hazard Events

Hazard	Adjusted <sup>a</sup> National Annual Estimates
Household Fires	4.6
Floods	2.8
Hurricanes and Severe Tropical Storms	.9
Tornadoes and Severe Windstorms	2.0
Total of All Five Above	10.7
Total of Four Natural Hazards	6.1

a Amounts adjusted to 1980 U.S. dollars.

from a survey question asking how many other families in the neighborhood or community were involved in the disaster event, not by oversampling areas known to have been stricken by a natural disaster. Our finding is thus that the more widespread the disaster was reported to be by the respondent, the more total dollar damages sustained by the respondent's household.)

### Sources of Help to Victimized Households

Traditionally, Americans have acted with great generosity towards the victims of natural hazards. A dense network of voluntary organizations has provided relief on the local community level (Dynes, 1970). This network consists of existing local organizations plus the local manifestations of national private relief organizations, notably the Red Cross and The Salvation Army. In the last two decades the federal government has also set up programs that are more or less automatically triggered when large scale hazard events occur (FDAA, 1978). On top of all that, individual households help one another in a variety of ways. In addition, casualty insurance coverage is routinely purchased by households and provides for reimbursement of some or all damages incurred through risks that are commonly insurable. Indeed, all homeowner's insurance policies cover fire losses and windstorm damages, and many renting households obtain similar coverages for their personal property. Of course, some hazards risks--such as flood and earthquake--are not routinely covered in standard homeowners' policies. Still, flood insurance is becoming more available to purchase as more and more local communities comply with the requirements of the National Flood Insurance Program. Earthquake insurance can also be purchased relatively inexpensively (under state subsidized plans in California). (See Kunreuther et al., 1978, for details on flood and earthquake insurance.)

All of these sources of aid cannot fully restore the status quo ante, but individually and in combination they can ease the road to recovery considerably. The mail questionnaire asked for considerable detail on aid received in the form of reimbursed insurance claims, loans, gifts and grants, and informal aid from relatives and friends. The data indicate that households suffering serious damages make considerable use of the sources of aid available to them (see Table 4).

A majority of households that suffered damages from fires, tornadoes, or hurricanes received some reimbursement from insurance companies. Homeowner's policies routinely cover damages inflicted by high winds, wind-driven water damages, and household fires. As shown in Table 4, a majority of households victimized by those events received some financial help from the coverages purchased. On a followup question, households said they were highly satisfied with the treatment they received from the insurance companies and their

representatives, with some complaints registered that the payments were not high enough to cover full replacement costs.

In contrast, few households received insurance payments in the cases of flood or earthquake damages. Of course, this finding reflects that during this historical period, insurance coverage for these hazards was simply not available at "reasonable prices": such coverage is not ordinarily provided in the usual homeowner's insurance package. The end result was that only small minorities (22 percent and 8 percent, respectively) received any help through insurance for flood and earthquake damages.

Although relatively few receive loans in the case of any of the

**Table 4:** Sources and Types of Help Received by Households With Serious Hazard Experiences

Sources	Hazard				
	Fires	Tornadoes	Hurricanes	Floods	Earthquakes
Percent Receiving Some Insurance Payment	76	61	56	22	8
N	213	324	125	108	37
Percent Receiving Loans	6	5	7	13	9
N	218	365	144	112	44
Percent Receiving Grants or Gifts	17	6	7	18	14
N	218	365	144	112	44
Average Number of Informal Sources of Help	1.34	1.02	1.26	1.57	.39
N	222	342	142	119	50
Average Number of Agency Contacts	.92	.56	.87	1.81	.42
N	213	333	136	109	52
Percent Receiving Help From One or More of Above Sources	94	77	79	89	36
N	184	302	126	102	50

hazards, this source of aid tends to be relied upon by households who have suffered the greater losses and by those who are relatively poor. (This latter is consistent with findings reported by Cochrane, 1975; and by Vinso, 1983.) Of course, greater losses mean greater need for financial aid and loans may be taken simply because other sources cannot provide all the financial aid necessary. Poor households may also be unable to draw upon their savings for the funds necessary to make repairs or to purchase replacement property.

We also note that loans are more likely to be resorted to by flood and earthquake victims and that the lenders are often low-cost federal loan programs (that of the Small Business Administration in particular).

Grants and gifts received by households tend to be smaller in value than loans but are received by more households. Especially important as a source of financial aid are the grants and gifts received by flood and earthquake victims. The activities of such organizations as the American National Red Cross are especially visible as a frequent source of such gifts. Also impressive is that the American Red Cross is mentioned as a source of aid by at least some respondents in all types of hazards and especially in the case of floods.

The abundant generosity of Americans is shown most clearly in the fact that informal sources of help, usually in the form of labor and small gifts, are very frequently reported by hazards victims.

Contacts of one sort or another with organizations, governmental and private, are reported by families in every hazard type.

Indeed, when we consider the combined coverage of insurance and all other sources of help, strong majorities of all victims (with the exception of earthquake victims) have received help from one or more sources, ranging from a high of 94 percent in the case of household fires to a low of 77 percent for tornado victims. In the cases of earthquake victimizations, little aid was received from each of the sources and from all combinations of sources, a reflection of the fact that few seismic events during 1970 to 1980 were serious enough events to activate much in the way of disaster services. (The San Fernando earthquake in 1971 is the major exception.)

A persistent but largely unanswered question in the study of disaster relief has been whether or not the aid rendered by all sorts of agencies has been equitably distributed to victims of such events (e.g., Mileti, 1975). The data provide an opportunity to answer that question. By holding constant the amount of damages reported by victimized households and other features of the hazard event, we can observe the extent to which aid of various types is differentially distributed to households varying in other ways, e.g., in income, race, tenure, age composition, etc.

The multivariate analyses that resulted are reported in greater detail in Rossi et al. (1983) and only a summary analysis (as shown in Table 5) can be presented in this paper. Table 5 shows the regression of a dichotomous variable--whether or not a household has received

some financial aid from at least one source excluding insurance payments--on hazard and household characteristics. The regression coefficients are unstandardized coefficients that reflect changes in the probability of receiving any aid associated with unit changes in the corresponding independent variable. For example, the regression coefficient, .353, associated with fire hazards is to be interpreted as follows: compared to earthquakes (the omitted category), persons experiencing fires have a .353 higher probability of receiving aid from at least one source.

As suggested earlier, all of the hazards are more likely to receive some aid compared to what happens in the case of earthquakes. Fire victims are most likely to receive aid, followed by flood victims, with

**Table 5:** Regression of Any Help on Hazard and Household Characteristics<sup>a</sup>

Independent Variables	b	SE
<b>A. Hazard Type</b>		
Fire	.353***	.043
Hurricane	.148***	.039
Flood	.320***	.048
Tornado	.118***	.033
<b>B. Hazard Event Futures</b>		
Total Damages (U.S.\$) to Household	.062***	.007
Hazard Event Size	.039***	.014
Public Service Interruptions	.076***	.009
Percent Household Loss Reimbursed by Insurance Claims	.000	.000
<b>C. Household Characteristics</b>		
Age of Oldest Person in Household	-.003**	.001
Household Income at Time of Event	-.003**	.001
Household Size	-.002	.007
Renter	-.020	.029
White	-.009	.030
Education of Respondent (Years)	-.000	.005
D. Intercept	.147	.087
	$R^2 = .41$ ***	
	$N = 1192$	

\*\*\*  $p < .001$

\*\*  $p < .01$

\*  $p < .05$

hurricanes and tornadoes being least likely of the four to generate aid. Note that these are "net" probabilities, that is, all other independent variables in the equation are being held constant.

Hazard characteristics also clearly make a difference in the probability of receiving some aid. The more damages (in dollar terms) experienced by a household, the more likely aid is to be received. The more widespread the hazard event and the more public utilities interrupted by the event, the more likely the household is to receive aid. This last finding reflects that federal programs of all sorts are triggered primarily in large scale disaster events. Note that whether insurance claim payments have been received by a household does not affect the probability of receiving additional aid from other sources.

Household characteristics appear to have little effect on the probability of receiving non-insurance aid. Older households are slightly less likely to receive aid, the coefficient associated with age being statistically significant but small. The coefficient indicates that a household with a 65 year old person as a member is about .12 less likely to receive aid than a household whose oldest adult is 25. This difference might reflect the greater reluctance of older respondents to assume additional debts, as reported by Vinso (1983). Households with higher incomes are also less likely to receive aid, but here again the coefficient involved is small. This last finding may reflect that more affluent households can draw upon their savings or other assets to restore or replace damaged possessions.

None of the other household characteristics apparently make any significant difference in the probability of receiving non-insurance aid. Whites are no more likely than non-whites, renters no more likely than homeowners, and households with highly educated respondents no more likely than those with lesser amount of education, to receive aid. Similar findings were obtained for analyses involving specific forms of aid--loans, gifts and grants, informal help from friends and relatives, and reimbursement from insurance claims.

In short, the distribution of aid to victimized households appears to be only marginally sensitive to household characteristics. If there is any bias, it appears to be minor and directed against households containing older persons and possibly against high income households. Whether these small amounts of bias reflect the decisions of aid givers or the decisions of households not to seek aid cannot be discerned from these data.

The major factors in the distribution of aid appear to be related to the nature of the hazard event--type of hazard, the amount of damage sustained by the household, and whether the hazard was a large or small scale event.

The analysis in Table 5 considers the probability of receiving any aid from any of a diverse set of sources. When the patterning of aid by sources is examined in detail, an interesting pattern of complementarity appears. Thus, when insurance payments to a household

are large, loans and gifts from government agencies or private sources tend to be smaller, and vice versa. Because insurance coverage varies by disaster type, the role of insurance payments vis a vis other sources also varies by hazard type. Government gifts and loans in particular dominate as major sources of aid to households in floods and earthquakes and are subordinate to insurance payments in the other hazards. This last finding, of course, cannot be surprising to hazard relief policy analysts to whom the fiscal burden on the federal government of flood relief is a constant source of concern. What may be of some surprise is that the total amount of aid, from whatever combination of sources, appears to be relatively constant once the amount of damages is taken into account. In other words, in this historical period (1970-1980), households patched together about the same amount of financial aid from a variety of sources, whatever the mixture might have been.

### Recovery and Lingering Effects

The mailed questionnaires also collected data on the aftermath of the hazard experiences, including appraisals of possible lingering effects. Most households claimed to have been able to restore themselves to reasonable functioning within the span of a few days; at least, their dwellings could be patched up enough for them to return to a semblance of workaday routine. However, as noted by others, one of the important aftermaths reported frequently by our respondents is an increase in household debt burden. Households that had to take out loans from one source or another experienced corresponding restrictions on their market baskets. Also, some of the households were affected strongly enough by the event to report symptoms of depression. (To avoid misunderstanding, these are derived from questions included in the mail survey; respondents were asked whether they had to borrow money in the aftermath to pay for replacements or renovations, whether they experienced symptoms of depression after the event; and so on. Our data are thus self-reports, not documented financial or clinical assessments.)

Analyses of the data indicate that feelings of both depression and heightened debt burden increased with the amount of debt involved and were inversely related to the financial resources of the families. Thus, if there is a bias in the hazard relief system of the United States that was in place during the period in question, its impact on poor households was through the imposition of somewhat onerous debt burdens. More affluent households avoided debt by drawing on their resources, but poorer households that were hit by hazard events for which there was inadequate or no insurance coverage were helped out of their troubles by loans whose effects on family finances lingered long after the restoration or replacement of damaged property and possessions.

Among the interesting results of our "aftermath" analysis was that experiences of depression **increased** the more contacts a household had with governmental and private agencies. It is quite expectable that a family that doubles its mortgage payments should feel an additional financial burden, but it is not at all clear why contacts with agencies should also produce heightened depression (!) Perhaps the best interpretation is that contacting agencies is an indicator of trouble: Those households with more troubles arising out of the hazard experience sought contact with private and public agencies more frequently. Such households were also more likely to show lingering effects of the disaster in the aftermath.

### Conclusions

Non-trivial experiences with natural hazard events are relatively rare, but sufficiently frequent to affect about one percent of American households annually. A network of federal and local governmental organizations plus private relief agencies is activated to help victimized households when insurance coverage is not enough. Informal help from relatives, friends, and neighbors is always available but limited typically to non-financial help. Large majorities of victimized households took advantage of the help proffered and managed quickly to restore functioning to their households. For hazard events for which insurance coverage is generally not purchased, large amounts of damages led to increased debt burdens, effects that often lingered long after.

We believe these findings suggest that policy makers should once again explore the potential social and individual costs and benefits of policies that would foster the growth of all-hazard insurance coverage plans. The almost universal coverage of fire insurance has reduced the long lasting impact of this hazard on households, despite the fact that the damages typically are greater than those resulting from any of the natural hazard events. If similar relief from the imposed burdens of hazard related damages could be obtained from almost universal coverage of all-hazard insurance, without untoward negative side effects (to victims, the government, or the insurance industry), then similar benefits might be realized by the many victims of floods, earthquakes and other currently uncovered hazards.

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