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People Get Ready

Disaster Preparedness

*Natural catastrophes are becoming more common and more expensive,
but human and financial losses can be greatly reduced
through incentives to purchase insurance and install protective measures.*

In recent years, we have witnessed a dramatic increase in the economic cost and human impact from hurricanes, earthquakes, floods, and other natural disasters worldwide. Economic losses from these catastrophic events increased from \$528 billion (1981–1990) to more than \$1.2 trillion over the period 2001–2010.

Although we are only halfway through 2011, an exceptional number of very severe natural catastrophes, notably the March 2011 Japan earthquake and tsunami, will make 2011 a record year for economic losses. In the United States, the southern and midwestern states were hit by an extremely severe series of tornadoes in April and May, and at about the same time, heavy snowmelt, saturated soils, and over 20 inches of rain in a month led to the worst flooding of the lower Mississippi River since 1927. Hurricane Irene in August caused significant flooding in the northeast and is responsible for at least 46 deaths in the United States. Global reinsurance broker Aon Benfield reports that U.S. losses

from Irene could reach as high as \$6.6 billion; Caribbean losses from Irene are estimated at nearly \$1.5 billion.

Given the increasing losses from natural disasters in recent years, it is surprising how few property owners in hazard-prone areas have purchased adequate disaster insurance. For example, although it is well known that California is highly exposed to seismic risk, 90% of Californians do not have earthquake insurance today. This is also true for floods. After the flood in August 1998 that damaged property in northern Vermont, the Federal Emergency Management Agency (FEMA) found that 84% of the homeowners in flood-prone areas did not have insurance, even though 45% of these individuals were required to purchase this coverage because they had a federally backed mortgage. In the Louisiana parishes affected by Hurricane Katrina in 2005, the percentage of homeowners with flood insurance ranged from 57.7% in St. Bernard Parish to 7.3% in Tangipahoa when the hurricane hit. Only 40% of the residents in Orleans Parish had flood insurance.

Similarly, relatively few homeowners invest in loss-reduction measures. Even after the series of devastating hurricanes that hit the Gulf Coast states in 2004 and 2005, a May 2006 survey of 1,100 adults living in areas subject to these storms revealed that 83% of the respondents had taken no steps to fortify their home and 68% had no hurricane survival kit.

For reasons we will explain in this article, many homeowners are reluctant to undertake mitigation measures for reducing losses from future disasters. This lack of resiliency has made the United States not only very vulnerable to future large-scale disasters but also highly exposed financially. Given the current level of government financial stress, it is natural to wonder who will pay to repair the damage caused by the next major hurricane, flood, or earthquake.

To alleviate this problem, we propose a comprehensive program that creates an incentive structure that will encourage property owners in high-risk areas to purchase insurance to protect themselves financially should they suffer losses from these events and to undertake measures to reduce

property damage and the accompanying injuries and fatalities from future disasters.

Why are losses increasing?

Two principal socioeconomic factors directly influence the level of economic losses due to catastrophic events: exposed population and value at risk. The economic development of Florida highlights this point. Florida's population has increased significantly over the past 50 years: from 2.8 million inhabitants in 1950 to 6.8 million in 1970, 13 million in 1990, and 18.8 million in 2010. A significant portion of that population lives in the high-hazard areas along the coast.

Increased population and development in Florida and other hurricane-prone regions means an increased likelihood of severe economic and insured losses unless cost-effective mitigation measures are implemented. Due to new construction, the damage from Hurricane Andrew, which hit Miami in 1992, would have been more than twice as great if it had occurred in 2005. The hurricane that hit Miami in 1926 would have been almost twice as costly as Hurricane

TABLE 1

15 most costly catastrophe insurance losses, 1970–2010 (in 2011 U.S. dollars)

Cost (\$ billion)	Event	Victims (dead or missing)	Year	Area of primary damage
48.6	Hurricane Katrina	1,836	2005	USA, Gulf of Mexico, et al.
37.0	9/11 Attacks	3,025	2001	USA
24.8	Hurricane Andrew	43	1992	USA, Bahamas
20.6	Northridge Earthquake	61	1994	USA
17.9	Hurricane Ike	348	2008	USA, Caribbean, et al.
14.8	Hurricane Ivan	124	2004	USA, Caribbean, et al.
14.0	Hurricane Wilma	35	2005	USA, Gulf of Mexico, et al.
11.3	Hurricane Rita	34	2005	USA, Gulf of Mexico, et al.
9.3	Hurricane Charley	24	2004	USA, Caribbean, et al.
9.0	Typhoon Mireille	51	1991	Japan
8.0	Maule earthquake (Mw: 8.8)	562	2010	Chile
8.0	Hurricane Hugo	71	1989	Puerto Rico, USA, et al.
7.8	Winter Storm Daria	95	1990	France, UK, et al.
7.6	Winter Storm Lothar	110	1999	France, Switzerland, et al.
6.4	Winter Storm Kyrill	54	2007	Germany, UK, Netherlands, France

Katrina had it occurred in 2005, and the Galveston hurricane of 1900 would have had total direct economic costs as high as those from Katrina. This means that independent of any possible change in weather patterns, we are very likely to see even more devastating disasters in the coming years because of the growth in property values in risk-prone areas. In addition, recent climate studies indicate that the United States should expect more extreme weather-related events in the future.

Table 1 depicts the 15 most costly catastrophes for the insurance industry between 1970 and 2010. Many of these truly devastating events occurred in recent years. Moreover, two-thirds of them affected the United States.

Increasing role of federal disaster assistance

Not surprisingly, the disasters that occurred in now much more populated areas of the United States have led to higher levels of insurance claim payments as well as a surge in the number of presidential disaster declarations. Wind coverage is typically included in U.S. homeowners' insurance policies; protection from floods and earthquakes is not.

The questions that need to be addressed directly by Congress, the White House, and other interested parties are:

- Who will pay for these massive losses?
- What actions need to be taken now to make the country more resilient when these disasters occur, as they certainly will?

In an article published this summer in *Science* about reforming the federally run National Flood Insurance Program (NFIP), we showed that the number of major disaster declarations increased from 252 over the period 1981–1990, to 476 (1991–2000), to 597 (2001–2010). In 2010 alone there were 81 such major disaster declarations.

This more pronounced role of the federal government in assisting disaster victims can also be seen by examining several major disasters that occurred during the past 60 years as shown in Table 2. Each new massive government disaster relief program creates a precedent for the future. When a disaster strikes, there is an expectation by those in the affected area that government assistance is on the way. To gain politically from their actions, members of Congress are likely to support bills that authorize more aid than for past disasters. If residents of hazard-prone areas expect more federal relief after future disasters, they then have less economic incentive to reduce their own exposure and/or purchase insurance.

Reducing exposure to losses from disasters

Today, thanks to developments in science and technology, we can more accurately estimate the risks that different commu-

nities and regions face from natural hazards. We can also identify mitigation measures that should be undertaken to reduce losses, injuries, and deaths from future disasters, and can specify regions where property should be insured. Yet many residents in hazard-prone areas are still unprotected against earthquakes, floods, hurricanes, and tornados.

We address the following question: How can we provide short-term incentives for those living in high-risk areas to invest in mitigation measures and purchase insurance?

We first focus on why many residents in hazard-prone areas do not protect themselves against disasters (a behavioral perspective). We then propose a course of action that overcomes these challenges (a policy perspective). Specifically, we believe that multiyear disaster insurance contracts tied to the property and combined with loans to encourage investment in risk-reduction measures will lead individuals in harm's way to invest in protection and therefore be in a much better financial position to recover on their own after the next disaster. The proposed program should thus reduce the need for disaster assistance and be a win-win situation for all the relevant stakeholders as compared to the status quo.

Empirical evidence from psychology and behavioral economics reveals that many decisionmakers ignore the potential consequences of large-scale disasters for the following reasons:

Misperceptions of the risk. We often underestimate the likelihood of natural disasters by treating them as below our threshold level of concern. For many people, a 50-year or 25-year storm is simply not worth thinking about. Because they do not perceive a plausible risk, they have no interest in undertaking protective actions such as purchasing insur-

TABLE 2

Examples of federal aid as percentage of total disaster losses

Disaster	Federal aid as % of total damage
Hurricane Ike (2008)	69%
Hurricane Katrina (2005)	50%
Hurricane Hugo (1989)	23%
Hurricane Diane (1955)	6%

Source: Michel-Kerjan and Volkman-Wise (2011)

ance or investing in loss-reduction measures.

Ambiguity of experts. Experts often differ in their estimates of the likelihood and consequences of low-probability events because of limited historical data, scientific uncertainty, changing environmental conditions, and/or the use of different risk models. The variance in risk estimates leads to confusion by the general public, government entities, and businesses as to whether one needs to pay attention to this risk. Often, decisionmakers simply use estimates from their favorite experts that provide justifications for their proposed actions. We recently conducted an empirical study of 70 insurance companies and found that insurers are likely to charge higher premiums when faced with ambiguity than when the probability of a loss is well specified. Furthermore, they tend to charge more when there is conflict among experts than when experts agree on the uncertainty associated with the risk of flood and hurricane hazards.

Short horizons for valuing protective measures. Many households and small businesses project only a few years ahead (if not just months) when deciding whether to spend money on loss-reduction measures, such as well-anchored connections where the roof meets the walls and the walls meet the foundation to reduce hurricane damage. This myopic approach prevents homeowners from undertaking protective measures that can be justified from an economic perspective after 5 or 10 years. This short-sighted behavior can be partly explained by decisionmakers wanting to recoup their upfront costs in the next year or two even though they are aware that the benefits from investing in such measures will accrue over the life of the property.

Procrastination. If given an option to postpone an investment for a month or a year, there will be a tendency to delay the outlay of funds. When viewed from a long time perspective the investment will always seem worthwhile, but when one approaches the designated date to undertake the work, a slight delay always seems more attractive. Moreover, the less certain one is about a correct course of action, the more likely one is to choose inaction. There is a tendency to favor the status quo.

Mistakenly treating insurance as an investment. Individuals often do not buy insurance until after a disaster occurs and then cancel their policies several years later because they have not collected on their policy. They perceive insurance to be a bad investment by not appreciating the adage that the “best return on an insurance policy is no return at all.”

Failure to learn from past disasters. There is a tendency to discount past unpleasant experiences. Emotions run high when experiencing a catastrophic event or even viewing it

on TV or the Internet. But those feelings fade rapidly, making it difficult to recapture these concerns about the event as time passes.

Mimetic blindness. Decisionmakers often imitate the behavior of others without analyzing whether the action is appropriate for them. By looking at what other firms in their industry do, or following the example of their friends and neighbors, decisionmakers can avoid having to think independently.

In addition to these behavioral biases, there are economically rational reasons why individuals and firms in hazard-prone areas do not undertake risk-reduction measures voluntarily. Consider the hypothetical Safelee firm in an industry in which its competitors do not invest in loss-prevention measures. Safelee might understand that the investment can be justified when considering its ability to reduce the risks and consequences of a future disaster. But the firm might decide that it cannot now afford to be at a competitive disadvantage against others in the industry that do not invest in loss prevention. The behavior of many banks in the years preceding the financial crisis of 2008–2009 is illustrative of such a dynamic.

Families considering whether to invest in disaster prevention may also find the outlay to be unattractive financially if they plan on moving in a few years and believe that potential buyers will not take into account the lower risk of a disaster loss when deciding how much they are willing to offer for the property. More generally, homeowners might have other rational reasons for not purchasing disaster coverage or investing in risk-reduction measures when this expense competes with immediate needs and living expenses within their limited budget. This aspect has more significance today given the current economic situation the country faces and the high level of unemployment.

Reconciling the short and long term

The above examples demonstrate that individuals and businesses focus on short-term incentives. Their reluctance to invest in loss-prevention measures can largely be explained by the upfront costs far exceeding the short-run benefits, even though the investment can be justified in the long run. Only after a catastrophe occurs do the decisionmakers express their regret at not undertaking the appropriate safety or protective measures.

But it does not have to be that way. We need to reorient our thinking and actions so that future catastrophes are perceived as an issue that demands attention now.

Knowing that myopia is a human tendency, we believe that leaders concerned with managing extreme events need

to recognize the importance of providing short-term economic incentives to encourage long-term planning. We offer the following two concepts that could change the above-mentioned attitudes.

Extend financial responsibility over a multiyear period. Decisionmakers need an economic incentive to undertake preventive measures today, knowing that their investments can be justified over the long term. The extended financial responsibility and reward could take the form of multiyear contracts, contingent or delayed bonuses, reduced taxes, or subsidies.

The public sector should develop well-enforced regulations and standards to create level playing fields. Government agencies and legislative bodies need to develop well-enforced regulations and standards, coupled with short-term economic incentives to encourage individuals and the private sector to adopt cost-effective risk-management strategies. All firms in a given industry will then have good reasons to adopt sound risk-management practices without becoming less competitive in the short run.

Insurance mechanisms can play a central role in encouraging more responsible behavior in three ways. First, if priced appropriately, insurance provides a signal of the risk that an individual or firm faces. Second, insurance can encourage property owners in hazard-prone areas to invest in mitigation measures by providing them with premium reductions to reflect the expected decrease in losses from future disasters. Third, insurance supports economic resiliency. After a disaster, insured individuals and firms can make a claim to obtain funds from their insurance company, rather than relying solely on federal relief, which comes at the expense of taxpayers.

A multiyear approach

We propose that insurance and other protective measures be tied to the property rather than the property owner as currently is the case. We recommend the following features of such a program:

Required insurance. Since individuals tend to treat insurance as an investment rather than a protective mechanism, it may have to be a requirement for property located in hazard-prone areas, given the large number of individuals who do not have coverage today.

Vouchers for those needing special treatment. We recommend a new disaster insurance voucher program that addresses issues of equity and affordability. This program would complement the strategy of risk-based premiums for all. Property owners currently residing in a risky area who require special treatment would receive a voucher from

FEMA or the U.S. Department of Housing and Urban Development as part of its budget or through a special appropriation. This program would be similar to the Supplemental Nutrition Assistance Program (food stamps) and the Low Income Home Energy Assistance Program, which enable millions of low-income households in the United States to meet their food and energy needs every year. The size of the voucher would be determined through a means test in much the same way that the distribution of food stamps is determined today.

Multiyear insurance tied to property. Rather than the normal one-year insurance contract, individuals and business owners should have an opportunity to purchase a multiyear insurance contract (for example, five years) at a fixed annual premium that reflects the risk. At the end of the multiyear contract, the premium could be revised to reflect changes in the risk.

Multiyear loans for mitigation. To encourage adoption of loss-reduction measures, state or federal government or commercial banks could issue property improvement loans to spread the costs over time. For instance, a property owner may be reluctant to incur an upfront cost of \$1,500 to make his home more disaster-resistant but would be willing to pay the \$145 annual cost of a 20-year loan (calculated here at a high 10% annual interest rate). In many cases, the reduction in the annual insurance premium due to reduced expected losses from future disasters for those property owners investing in mitigation measures will be greater than their annual loan costs, making this investment financially attractive.

Well-enforced building codes. Given the reluctance of property owners to invest in mitigation measures voluntarily, building codes should be designed to reduce future disaster losses and be well enforced through third-party inspections or audits.

Modifying the National Flood Insurance Program

The National Flood Insurance Program (NFIP) was established in 1968 and covers more than \$1.2 trillion in assets today. The federally run program is set to expire at the end of September 2011, and options for reforms are being discussed. We believe that revising the program offers an opportunity to take a positive step in implementing our above-mentioned proposal.

We recently undertook an analysis of all new flood insurance policies issued by the NFIP over the period January 1, 2001, to December 31, 2009. We found that the median length of time before these new policies lapsed was three to four years. On average, only 74% of new policies were still in force one year after they were purchased; after five years,

only 36% were still in force. The lapse rate is high even after correcting for migration and does not vary much across different flood zones. We thus propose replacing standard one-year insurance policies with multiyear insurance contracts of 5 or 10 years attached to the property itself, not the individual. If the property is sold, then the multiyear flood insurance contract would be transferred to the new owner.

Premiums for such multiyear insurance policies should accurately reflect risk and be lower for properties that have loss-reduction features. This would encourage owners to invest in cost-effective risk-reduction measures, such as storm shutters to reduce hurricane damage. If financial institutions or the federal government provide home improvement loans to cover the upfront costs of these measures, the premium reduction earned by making the structure more resistant to damage is likely to exceed the annual payment on the loan.

A bank would have a financial incentive to make such a home improvement loan because it would have a lower risk of catastrophic loss to the property that could lead to a mortgage default. The NFIP would have lower claims payments due to the reduced damage from a major disaster. And the general public would be less likely to have large amounts of their tax dollars going for disaster relief, as was the case with the \$89 billion paid in federal relief after the 2004 and 2005 hurricane seasons and resulting floods. A win-win-win-win situation for all!

A governmental program that has some similarities to our proposal is the Property Assessed Clean Energy (PACE) program, which has been adopted by 27 states for promoting energy efficiency. PACE provides short-term rewards to encourage investments in technologies that will have long-term benefit. PACE provides long-term funding from private capital markets at low cost and needs no government subsidies or taxes. It increases property values by making heating and cooling less expensive, and it enjoys broad bipartisan support nationwide at state and local levels. Several features of the program that encourage property owners to take measures to make their home more energy-efficient mirror how property owners would want to make their homes more disaster-resistant:

Multiyear financing. Interested property owners opt in to receive financing for improvements that is repaid through an assessment on their property taxes for up to 20 years. PACE financing spreads the cost of energy improvements such as weather sealing, energy-efficient boilers and cooling systems, and solar installations over the expected life of these measures and allows for the repayment obligation to transfer automatically to the next property owner if the property is sold. PACE solves two key barriers to increased adoption

of energy efficiency and small-scale renewable energy: high upfront costs and fear that project costs won't be recovered before a future sale of the property.

Annual savings. Because basic energy-efficiency measures can cut energy costs by up to 35%, annual energy savings will typically exceed the cost of PACE assessments. The upfront cost barrier actually turns into improved cash flow for owners in much the same way that the reduction of annual insurance premiums could exceed the annual loan costs.

Transfer to new property owner. Like all property-based assessments, PACE assessments stay with a property after sale until they are fully repaid by future owners, who continue to benefit from the improvement measures. The multiyear insurance and mitigation contracts we propose would operate in the same way.

Now is the time

The nation has entered a new era of catastrophes. Exposure is growing, and the damage from disasters over the next few years is likely to exceed what we have experienced during this past decade. When the next catastrophe occurs, the federal government will very likely come to the rescue—again. If the public sector's response to recent disasters is an indicator of its future behavior, new records will be set with respect to federal assistance.

In order to avoid this outcome, we recommend that the appropriate governmental bodies undertake an economic analysis of the benefits and costs of the proposed multiyear insurance and risk-reduction loan programs compared to the current system of private and public insurance and federal disaster assistance.

We need bold leadership for developing long-term strategies for dealing with low-probability, high-consequence events. If Congress authorizes a study that examines these and other proposals when the NFIP comes up for renewal in September, it will be major step forward in setting a tone for addressing the challenges of managing catastrophic risks. The United States is at war against natural hazards and other extreme events. Winning this war will be possible only if public policy integrates behavioral factors much more systematically into efforts to find sustainable solutions. As we have indicated, taking these steps will be difficult because of human reluctance to change. But we know what steps need to be taken. All it takes is the courage for us to act and the initiative to do so now.

Recommended reading

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