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Sharing and Reducing the Financial Risks of Future "Mega-Catastrophes"

Robert E. Litan

While policymakers and leaders continue to debate the rebuilding of Gulf areas devastated by Hurricane Katrina, a much greater loss looms on the horizon. Katrina exposed more than problems with poverty, emergency management, and infrastructure. The storm also illustrated the inability of private insurance markets to handle large-scale losses. "Mega-catastrophes" are catastrophic events, like Katrina, whose costs are so large and unpredictable that private insurers either are unwilling to insure against them, or charge premiums so high that significant numbers of customers do not want or cannot afford the insurance.

Without policy solutions, federal taxpayers in particular face unnecessarily large burdens for future disaster relief. The time has come for the federal government to convert what is de facto insurance — relief provided "after the fact" — into a formal re-insurance system that assesses the cost of such catastrophic risks before such events occur. This paper includes proposals to establish an independent federal office to operate a catastrophic reinsurance program. In short, the federal government should formally acknowledge and implement what it already has become: an insurer of last resort for mega-catastrophes.

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Robert E. Litan[1]

Executive Summary

The devastating 2005 hurricane season — especially the three large hurricanes that struck the Gulf Coast and Florida (Katrina, Rita and Wilma) — has graphically demonstrated how dangerous nature can be. The huge storms also should serve as a wake-up call to remind us that, even if the United States manages to escape another terrorist attack, it is virtually certain that at some point there will be one or more natural catastrophes with similar or even greater catastrophic impacts: earthquakes in the West (California, Seattle) or Midwest (along the New Madrid fault) and perhaps multiple Category 4 or 5 hurricanes (like Katrina or worse) in the Gulf or on the East Coast, including a possible direct hit as far north as New York.

So far, policymakers and the media have concentrated on how to rebuild the areas damaged by the storms so that they can withstand Category 4/5 hurricanes in the future. This is appropriate and necessary. But now is the time — before the next hurricane season or the next big earthquake (which could come at any time) — to do more to reduce the potential costs of future "mega-catastrophes" of the kinds just witnessed, singly (Katrina) or in combination, for society as a whole, for the federal government, and for residents of potentially affected areas. Had more thought been given to this subject and suitable action taken prior to this summer, the losses (human and economic) would not have been as great, especially in the case of Katrina, and the process of recovering from losses would have been less chaotic.

Among the many impacts of Katrina, one is especially relevant to this essay. In effect, by the nature and magnitude of its response, the federal government post-Katrina resolved a debate that simmered among policymakers and academic scholars during the 1990s: whether the federal government should provide some kind of "backstop" insurance to the private market for large disasters. Clearly, the answer to that question after Katrina is yes, although the post-Katrina federal backstop has been informal and ad hoc. This essay will argue that this ad hoc or de facto insurance system is also inefficient because it provides inadequate incentives for loss prevention; unfair

because those most at risk from future catastrophes do not bear a disproportionate amount of the costs to repair and rebuild, as they should; and potentially could leave homeowners in the future with less choice among insurers, and conceivably one day, no private insurance at all.

The nation can do better: by establishing a more formal federal reinsurance system for mega-catastrophes, which also has incentives for better loss prevention or mitigation. Such a system should be largely pre-funded (unlike the existing terrorism insurance program) and could be administered by a quasi-independent arm of the Treasury Department (analogous to the regulator for federally-charted banks, the Comptroller of the Currency). The premiums for the reinsurance should reflect actuarial risk, and thus would provide incentives for states and localities to adopt and enforce cost-effective building codes and land use rules.

If the federal government is to be the last "layer" of financial protection, then protection below the threshold for federal government involvement should be a combination of protection provided by the private sector and state governments. In particular, it is fully appropriate that individuals and businesses bear some limited amount of the "first dollar" losses, through insurance policy deductibles; and that private insurers and reinsurers and state-sponsored insurers be next in line, up to some ceiling.

A layered system of financial responsibility coupled with better preparedness and cost-effective mitigation incentives for mega-catastrophes makes sense on many levels:

- It would do a better job of protecting the federal fisc in the long run, reserving federal responsibility for only the large losses that the other actors cannot absorb without significant distortions in the private market. In the process, a pre-funded system is more equitable for current and future generations of taxpayers, who are liable for more of the mega-catastrophic costs under the current, post-event system of disaster aid than they would be under the pre-funded federal reinsurance program recommended here.

- A layered system provides appropriate incentives for the parties in each "layer" to take loss mitigation measures to minimize their own exposures to financial loss in a cost-effective manner. Faced with the actuarially justified annual costs for living or working in exposed areas, some individuals and businesses may choose to locate elsewhere. Others may decide to accept the inevitable risks associated with particular locations, but to improve construction of their houses and businesses to minimize losses. If the federal reinsurance program contains appropriate incentives for well-enforced, up-to-date building codes and sensible land use policies, state and local governments will be more likely to improve public infrastructure and prevent reconstruction in high-risk areas.

- It is fully appropriate that the federal government reinsure against mega-catastrophe risks. Because of its borrowing capacity and its ability to print money, the federal government does not have the "timing risk" — or the risk that losses will occur too soon before premiums are collected to fully fund them — that private insurers, reinsurers, state-sponsored catastrophe insurers and reinsurers inevitably face. By providing backstop insurance for the largest losses, the federal government would dramatically shrink this timing risk, and thus improve the ability of private and state-sponsored insurers and reinsurers to charge actuarially appropriate premiums

that are not burdened with additional and costly risk loadings to help absorb timing risk. Furthermore, actuarially appropriate premiums would promote cost-effective mitigation and thus reduce the social and economic costs of future natural catastrophes.

- Formal federal reinsurance thus also would help ensure that private insurance is more available for homeowners in risk-prone areas of the country.

To anticipate objections to the comprehensive financial and risk mitigation system recommended here, it is useful to briefly provide answers to some of them at the outset. More detailed responses are provided in the body of the report.

Isn't federal insurance a "bailout for the private insurance industry"?

No, to the contrary, a federal insurance program is designed to protect the federal government — and more specifically taxpayers, current and future — from the costs of future mega-catastrophes. History has demonstrated time after time that when disaster strikes — especially mega-disasters — governments will not sit idly by and let injured, but privately uninsured or underinsured people suffer. Government has provided disaster aid to these individuals in the past and always will do so in the future. A key issue for policymakers is how to pay for that aid: wait until the disasters happen, and then borrow or print money, impose higher taxes or cut back other programs; or to pre-fund, to the extent possible, the costs of future mega-catastrophes by charging insurance premiums (through their private insurers) to those most exposed to those losses? This essay argues that the last option is superior to each of the others.

It is useful to think of the proposed system for pre-funding mega-catastrophe risks as the equivalent of the federal government charging a "user fee" for those living in disaster prone areas, just as it now charges individuals to enter a federal park, or airline travelers for airplane security.

Doesn't the private insurance industry have at least $400 billion in capital to cover future catastrophe losses? Why can't it cover these costs by itself?

The $400 billion in surplus held by property-casualty (p-c) insurers doing business in the United States represents capital available to pay for all types of losses that may occur in variety of geographic areas and to satisfy the regulatory requirements of state regulators. The losses include those related to exposures from commercial enterprises, homeowners, and automobile owners due to a wide variety of natural and man-made events, as well as losses suffered by individuals, professionals and commercial enterprises arising out of tort (or liability) lawsuits. The majority of this surplus is not available for the natural disaster losses suffered by property owners, for a variety of reasons:

- none of the surplus held by p-c insurers that do not write property insurance is available;
- multi-line companies generally establish separate affiliates to write property insurance so that capital of their non-property companies (auto, medical malpractice, workers compensation) is not available to cover property losses;
- and even property insurers often establish separate affiliates for high risk states so that the capital of their operations elsewhere is not available to cover losses in those states.

In short, aggregate or industry-wide measures of capital are irrelevant when calculating the ability of the "industry" to absorb future mega-CAT losses.

The same logic holds for global reinsurers, who in 2005, held an estimated $350 billion in capital. This aggregate figure includes premiums collected by some insurers doing business entirely abroad, as well as reinsurers that are also active in the primary insurance market. In addition, reinsurers specialize in different types of risk so that the aggregate capital is not available to cover risks that may be unique to specific reinsurers.

If private insurers don't have the money, why can't the securities markets absorb the risk of losses from mega-catastrophes?

In fact, there is a nascent market in catastrophe-linked securities, which provide higher yields to investors willing to assume the risk of non-payment of interest and principal in the event of a "covered" event. But the catastrophe-linked securities market has never developed in the way and to the extent its advocates claimed it would. In retrospect, one reason is that insurance regulators have not permitted insurers that issue the securities to count them as the equivalent of reinsurance. But even if this policy is changed — as suggested here — policymakers should not count on the catastrophe-linked securities market developing quickly. The securities will not significantly help insurers unless the events that release the issuers from having to repay them are more closely tied to the losses suffered by specific insurers. But the greater the risk that repayment of principal will be cancelled, the higher will be the interest rate premium that investors will demand before they purchase the securities. Because it is far from clear to what extent insurers will want to issue these securities at these higher interest rates, a federal reinsurance program will still be appropriate (at least for some significant period), even if the regulatory (and financial) accounting treatment of catastrophe securities is changed.

Why can't states simply require insurers to offer catastrophe coverage at an affordable price?

However hard they may try, regulators and policymakers cannot change the laws of nature. In order to operate in a safe and sound manner — as they must if they are to honor claims of their policyholders — insurers must be able to charge risk-based premiums on expected future losses. Those expectations, in turn, are based on historical experience, and knowledge gained through scientific studies and computer modeling, adjusted for projected changes in economic exposure (driven by population growth, construction and acquisition of property). If expected losses on this basis rise, then so must premiums.

Regulators that force insurers to charge less than actuarially justified premiums for catastrophe coverage sooner or later will drive insurers from the market; indeed their investors (whether shareholders or policyholders, in the case of mutual companies) will demand that result. When insurance capacity declines, coverage inevitably gets rationed, leaving some customers uninsured. States that counter that result by forcing insurers to subsidize "residual markets" for customers who cannot obtain insurance in the "voluntary market" diminish incentives for insurers to write any insurance in the voluntary market, or to do so with sizeable deductibles that limit insurer exposures.

Further, subsidized insurance rates — in both the voluntary and residual markets — ultimately lead to higher disaster costs in the end, because they discourage individuals and the governments that represent them from undertaking cost-effective steps to reduce losses from catastrophes. As a result, insurance subsidies raise the total costs of disasters. As discussed later, if subsidies are desired to help low-income households purchase

insurance, then that goal is better accomplished through direct budgetary expenditures than implicitly (and less transparently) through modifications to the premium rate structure.

Why can't states with significant catastrophe exposure address the issue themselves through state created programs?

State sponsored plans have helped to remedy dysfunctional markets to a certain extent in Florida and California. Yet, state plans, just like private insurers and reinsurers, do not have sufficient resources to pay for mega-catastrophes. Indeed, those that currently exist cap their exposures, in large part because such events confront state plans, like their private sector counterparts, with substantial timing risk.

The more cost-effective approach to holding down insurance rates and promoting better mitigation is for the only entity that can absorb the timing risk that mega-catastrophes entail — the federal government — to provide reinsurance to the private and state-sponsored insurance markets, with premiums tied to risk exposure, which in turn reflects the mitigation efforts adopted and enforced by state and local governments. Such an approach is also fairer to taxpayers generally, and to those who live in locations not subject to extraordinarily high risks of mega-catastrophes.

Introduction

The 2005 hurricane season will long be remembered as the costliest season yet for natural catastrophes in the United States. Though the official damage estimates will not be known for some time, it is already clear that the total damage to public and private property from just the three largest hurricanes — Katrina, Rita and Wilma — will run into the hundreds of billions of dollars.

The hurricanes left more than death, serious personal injury and devastating financial distress in their wake. It has already been widely commented that Katrina in particular exposed the deep poverty in New Orleans that had long existed but that had not been widely appreciated by Americans across the country. Katrina also made clear that all levels of government were not prepared for a storm of that magnitude, and that government decisions before, during and after the hurricane magnified rather than reduced the damage and loss of life and injury. Officials quickly absorbed some of the lessons from the failures of Katrina in responding to Rita and Wilma, and no doubt will be taking advantage of the respite from this year's hurricane season to develop better disaster recovery and mitigation plans for future hurricane seasons and major earthquakes.

But there is more planning to be done. The 2005 hurricanes should prompt all policymakers and citizens to address two fundamental questions relating to how society should prepare for and pay for future natural disasters, especially mega-catastrophes, or those natural disasters that alone, or in combination with other similar events during the same calendar year, impose extraordinary costs to society:

1. How can the government best prevent or mitigate losses from future natural mega-catastrophes in a cost-effective manner?

2. Given that catastrophes, and especially mega-catastrophes, will continue to occur, who should pay for the damage, how and when?

Until this hurricane season, the answers to these questions seemed fairly well settled. States and local governments were primarily responsible for loss prevention and mitigation, through land use

rules and building code requirements. The federal government also played some role in loss prevention, paying in selective cases for some or all of the infrastructure costs (such as levees) and, in some limited instances, relocation expenses aimed at minimizing flooding in particular. Insurers also have given individuals and firms some incentives to mitigate losses, either by providing lower premiums on structures more resistant to catastrophic damage (on homes bolted to their foundations to reduce earthquake losses, or residences on stilts in low lying areas to reduce exposure to floods), or by denying coverage in some high-risk areas altogether, giving individuals and firms stronger incentives to avoid building or living in those locations.

All of the above parties also have shared in the financial responsibility for catastrophes. Insurers cover the losses of those who insure privately. Most states offer residual market plans, statewide or in catastrophe-prone areas, for residents unable to purchase insurance in the voluntary market. Two states, California and Florida, offer catastrophe plans, one directly to homeowners (California for earthquakes) and the other to homeowners and insurers (Florida for hurricanes). The federal government requires individuals living in designated flood-prone areas to purchase flood insurance (up to a limit), and at least theoretically has charged premiums that are roughly actuarially appropriate (though the program provides subsidies for those purchasing flood insurance for properties acquired before they were identified as being in a flood plain). The federal government also traditionally has provided disaster relief aid after the fact to victims, including uninsured individuals, firms and local and state governments.

Following Hurricane Andrew and the Northridge earthquake in the early 1990s, this mixed private/public system of mitigation and financial responsibility attracted some attention. The system has had its critics through the years — some have questioned its cost-effectiveness and/or its fairness. After a decade of neglect, it is once again attracting serious interest among policymakers. The 2005 hurricane season, Katrina in particular, exposed serious weaknesses in both parts of the system that, in this author's view, cry out for immediate attention.

First, Katrina dramatically demonstrated the cost of not investing in adequate prevention. Had the levee between Lake Ponchatrain and the northern border of New Orleans been built to withstand even a strong Category 3 hurricane,[2] as many had urged for years, New Orleans might have been spared serious flooding, many lives could have been saved, and perhaps $100 billion or more in damage averted. But the New Orleans debacle is only one example of the weaknesses in the current system of loss prevention and mitigation. Despite the clear threat of hurricanes and flooding, millions of Americans continue to move each year to coastal areas along the East Coast and the Gulf, increasing the potential cost of future hurricanes. The same is true in California, where the danger is from earthquakes. It would be one thing if all those moving were made fully financially responsible for the risks that they were voluntarily assuming, but this is not currently the case.

Second, the overwhelming federal disaster relief effort after Katrina has made clear, if there were ever any doubt, that the federal government is the de facto "insurer" of last resort for mega catastrophes. Federal aid for Katrina alone (including both direct federal expenditures and tax relief) ultimately is likely to exceed $100 billion, and an undetermined but certainly large amount will be provided to cover losses that could have been insured against but were not.

Indeed, at the time of this writing, the federal government already was committed to providing $85 billion to the Gulf Region (as announced by the President in his 2006 State of the Union address). Of the amounts committed, more than $7 billion has been obligated for housing assistance, most of which has likely gone or will go to individuals who did not have private insurance. In addition, as of early February, there were vigorous discussions (and some dissension) between the administration and Louisiana authorities, in particular, over how much federal money (another $6 billion at a minimum) should be spent on compensating largely uninsured homeowners.

Given the gravity of the damage, the federal government's response — especially in providing aid to the uninsured — certainly is understandable. It also sets a precedent, however, that is likely to be followed in future catastrophes of this sort, unless ways are found both to mitigate the damage from future such events and to encourage more people to purchase insurance. But in the absence of such measures, then post-catastrophe compensation will continue to be financed as it has been in the case of Katrina, mostly by borrowing more money (with some cuts in spending on other federal programs). While federal financing, in particular, may be appropriate for terrorist attacks — since an assault on any part of the country is an assault on all of us and thus the cost for responding and rebuilding should be borne widely — it is fundamentally unfair to ask citizens who are not exposed to unusually large catastrophe losses to cross-subsidize those who voluntarily choose to live and work in areas where they are so exposed. It is also inefficient to ask future taxpayers generally to pay for catastrophe losses ex post rather than to have, or indeed require, those who are most exposed to those losses pay for them ex ante through actuarially appropriate insurance premiums. If individuals and firms do not bear the costs associated with living and working in certain locations, then too many will subject themselves to catastrophic risks, and those who do decide to locate in such areas will have insufficient incentives to take steps that can reduce the damage from catastrophic events when they occur.

The nation can do better. With the right policies, we can do more to minimize future losses from natural catastrophes — and especially mega-catastrophes — that inevitably will continue to occur. And we can distribute the costs of those events more efficiently and fairly than is the case now. The central solution is to formalize the current de facto federal disaster insurance program by establishing federal catastrophe reinsurance.

Mega-Catastrophes: Defining The Problem

It is necessary to begin by defining the nature or the scope of the problem for which a solution is later outlined — namely, by defining a mega-catastrophe. Admittedly, up to this point the term has no standard definition and the one offered here will be arbitrary. But events like Katrina have a certain "you know it when you see it" character that helps to create a new vocabulary.

As used here, a mega-catastrophe is a single natural disaster, or a combination of lesser disasters in a twelve-month period (the typical property insurance contract period being a year), whose consequences for insurers are so large that going forward they become "uninsurable," or the potential or actual subjects of exclusions in standard policies. Put another way, mega-catastrophes are events or total losses from a series of defined events over a given time period that cause insurance markets to fail in some significant respect.

Insurance is built on several principles, which must be present for insurance companies to operate successfully over the long term. As is now discussed, mega-catastrophes do not satisfy all of these principles.[3]

The Law of Large Numbers

The events at issue must be subject to the "law of large numbers." In statistical terms, this means that the average from a sample of events gets closer to the mean of the population from which the events are drawn as the sample size increases. In less technical terms, it means that for insurers to have some idea of what the risk of a given event is, they must have some idea of how probable it is, as well as the range of its possible severity.

Typically, the actuaries who work for insurers gain knowledge about these parameters from past episodes; they can supplement that knowledge with other information, such as geological (earthquakes) or meteorological (hurricanes and wind storms) studies, engineering knowledge of the likely loads and building responses, combined with computer models that predict amounts of damage from certain events and prevailing insurance arrangements. Fortunately, there is no such historical experience or scientific knowledge associated with terrorist attacks, especially those on the scale of 9/11 or potentially larger, which fall into the category of man-made mega-catastrophes. This was a reason that the Bush Administration did not seek to set reinsurance premiums under the federal terrorism reinsurance program, and instead agreed to legislation requiring "recoupment," but only up to a point, from primary commercial insurers (and ultimately policyholders) after the fact. Nonetheless, terrorism risks are not the focus of this essay, though lessons from the federal government's terrorism program are relevant to the design of an analogous program for large natural disasters and are featured below.

With enough historical data, it is possible to provide rough estimates of the likelihood that mega-catastrophes, as the term is used here, will occur. But the qualifier "rough" cannot be over-emphasized. Whether the 2004–05 hurricane seasons prove to be abnormal, normal, or precursors of even worse seasons will not be known for some time. Thus, actuarial estimates of both the frequency and severity of mega-catastrophe events and seasons are inherently subject to considerable uncertainty. Insurers bearing these risks compensate for that uncertainty by charging higher risk loads, or multiples of annual expected losses.

Independence and Timing Risk

Insurance requires that the insured events be independent; that is, the probability that one insured will suffer a loss should be independent of the probability that others suffer insured losses from the same event. Independence is required so that insurers can diversify their sources of risk and thus not be exposed to a single event or series of events that deplete the insurer's capital or surplus (the amount contributed by investors to absorb losses beyond the loss reserves that insurers establish for likely claims).

Natural and man-made disasters (terrorism) typically violate the independence condition, since many insureds in a given geographic area or areas are damaged at the same time when these occur. Nonetheless, insurers may still be willing to accept and insure such risks if, at the same time, they can purchase and then recover the costs from policyholders of reinsurance from reinsurers, or issue securities to investors, who can pool disaster risks from different parts of the world so that the events themselves (rather than the individuals affected by them) are independent of one another. Still, as discussed below, the price for such reinsurance, given the growing costs and possibly increasing

frequency of mega-catastrophes like Katrina, may be so high that primary insurers are unable (due to demand conditions or to rate regulation) to pass them on to policyholders. In that event, some of those exposed to catastrophe risk either would forego coverage, or insurers will not offer it.

Absence of Adverse Selection

The events insured must not be subject to excessive "adverse selection," so that the insurance is purchased only by those exposed to high risks of claims. This condition is related to the independence requirement. If adverse selection exists then insurers cannot adequately diversify their risks across a wide population, and thus (regulated) premiums may be insufficient to cover claims when the events occur.

There is some element of adverse selection for hurricane and earthquake risks, since many individuals choose to live in high-risk locations and purchase the insurance. But fortunately the regions affected by these potential or actual disasters are large enough so that in any given year, or even over a number of years, the risks tend to be somewhat more widely dispersed. This is not as true for those who live in floodplains, which tend to repeatedly experience flooding. Because these individuals and firms can pinpoint their exposures, flood insurance is especially prone to adverse selection, which is a major reason that private insurers for a long time were unwilling to voluntarily extend coverage. The federal government stepped in with its own flood insurance program in 1968, and even made the purchase of flood insurance mandatory for borrowers from federally-chartered financial institutions, in order to protect both them and their lenders from flood damage.[4]

Summary

In short, a natural disaster or series of disasters in a given time period is a mega-catastrophe when private insurance markets fail in some significant respect. Failure in this particular market is of broader social concern because when individuals or firms exposed to those risks do not find the cost of private insurance to be worth its purchase, then they wittingly or unwittingly may be imposing at least some of the costs of future disasters on the federal government, which experience has shown (especially in the wake of Katrina) will provide disaster relief and some aid to the uninsured after the fact. Although the provision of aid is certainly understandable, it is essential for policymakers to recognize that without appropriate counter-balancing policies, such aid can lead to even more substantial federal (and social) costs when future disasters inevitably visit the same areas. Indeed, as discussed further below, the post-hurricane aid in Florida and the Gulf region already is leading to a rebuilding boom. Unless those who rebuild or purchase property in storm-damaged areas are confronted in advance with the true costs of such reconstruction, location and construction decisions will be distorted, leaving the federal government — and future taxpayers — to pick up a larger tab when the next hurricane strikes than it would if those who put themselves in nature's way pay for that added risk through insurance.

To be sure, the federal government's disaster relief programs cover all types of disasters, and it would be a mistake for policymakers to treat all of them as mega-catastrophes. If they did, federal aid could crowd out the private insurance market altogether, including insurance for lesser losses that the private market can readily and cost-effectively absorb. But mega-catastrophes are qualitatively and quantitatively different, in that the losses from the event and amounts of post-event federal assistance are potentially so great that insurers and the investors who back them in the future will seek either to exclude coverage for them altogether or to require

such high premiums or deductibles in future policies that, going forward, large numbers of consumers will choose to forego coverage. This is an undesirable outcome not only because it leaves the federal government to pay some additional disaster aid in the future, but also because it can discourage these individuals and firms from undertaking cost-effective loss prevention measures (or supporting state and local officials who adopt and enforce more effective building codes and land use rules).

Admittedly, the line between ordinary disasters and mega-catastrophes is an arbitrary one. I would simply assert that, given the extraordinary level of federal assistance that eventually will be provided in the wake of Katrina, that events or similar episodes (such as those illustrated in Table 2 discussed in the following section) should be viewed as mega-catastrophes. State policies indirectly also suggest that events of lesser magnitude would qualify as well. As discussed further below, Florida's catastrophe reinsurance fund has a current annual cap of $15 billion, suggesting that insured losses above that level are deemed too expensive even for a state-sponsored plan. The California Earthquake Authority, meanwhile, has current claims paying capacity of approximately $7 billion, implying that insured losses above that level are too large for that system to bear.

The Rising Risks and Costs of Mega-Catastrophes

Disaster losses are not unusual for property-casualty (p-c) insurers; that is why standard homeowners', automobile, and business property policies cover damages from windstorms and hurricanes (earthquakes are treated specially, and are discussed below). As long as the costs of these events are manageable and capable of being reinsured (by reinsurers or the markets), they are insurable by primary p-c carriers.

There is a disturbing trend, however, toward more frequent and more severe catastrophic events. Table 1 on the following page lists the twelve most costly insured catastrophes in the United States, all expressed in 2005 dollars. What jumps out from the list is that eight of the twelve most costly episodes have occurred within the past four years, and three of them (Katrina, Rita and Wilma) have occurred in just the last calendar year, and those followed a succession of four hurricanes in the same region the year before. Total insured catastrophe losses for 2005 alone should top $50 billion, the largest "Cat" figure in the industry's history.

In the case of hurricanes, it is only natural to wonder whether 2005 (or 2004, for that matter) was an unusual year, or whether, for any number of reasons, recent experience is only a harbinger of future hurricanes to come. If data alone are any guide — and historical data are the principal basis for actuarial estimates of future expected losses — then clearly recent trends do suggest a higher probability and severity of future hurricanes. There is also scientific support for this view. Many scholars believe that the entire North Atlantic region is now in the midst of a several decade long upsurge in intense hurricane activity.[5] The damaging impact of this upsurge in storms could be aggravated if, as some scholars also believe, global warming may be leading to greater numbers of and more intense hurricanes.[6]

Even if hurricanes turn out not to be more frequent in the future, continuing population shifts and additional construction are likely to increase their severity, measured in damage costs, though various mitigation measures — such as better building codes that are effectively enforced and restrictions on building in especially high risk areas (close to beaches, for example) — may slow the rate of increase. Thus, according to a recent

Table 1. Twelve Costliest Insured Catastrophes in the United States
(Costs in Billions of 2005 Dollars)

Year	Event	Cost
2005	Hurricane Katrina	50+
1992	Hurricane Andrew	21
2001	9/11 Terrorist Attacks	20
1994	Northridge Earthquake	16
2004	Hurricane Charley	8
2005	Hurricane Wilma	4–10
2004	Hurricane Ivan	7
1989	Hurricane Hugo	6
2004	Hurricane Frances	5
2004	Hurricane Jeanne	4
2005	Hurricane Rita	3–6
1998	Hurricane Georges	3

Source: Insurance Information Institute; RMS, AIR Worldwide, and Equecat for Wilma and Rita

demographic analysis by *USA Today*, population in coastal areas along the Atlantic and the Gulf Coast has increased by 2 million (to over 44 million) since 2000, despite the increased frequency and intensity of hurricane activity. The same report indicates that about 1,000 people arrive as new residents in these areas every day.[7] Individuals also continue to move into areas subject to earthquake risk.

Not only are people moving to risk-prone areas, but property development there is booming. Although the hurricanes in Florida and the Gulf are inducing some long-time residents to think about never returning, property developers are anticipating that many new residents can be attracted to coastal areas after they are rebuilt. In the words of a recent *Wall Street Journal* article, "the spate of storms is fueling an extraordinary level of new economic development …" One of the contributing factors cited is post-disaster infrastructure redevelopment funded by the federal government. As one Florida planning department administrator put it: "This is federally-funded urban renewal for resort areas."[8]

Indeed, looking back, the nation is "lucky" that some of the most naturally devastating events of the past occurred when far fewer people were exposed: the Galveston hurricane of 1900, the California earthquake of 1906, the Great Hurricane of 1938 (the "Long Island Express"), or the New Madrid earthquakes of 1812–14. Had those events occurred in recent years, the property damage and lives lost could have been as catastrophic as Katrina, or worse.

Looking ahead, as more people move into and construction proceeds in areas of the country prone to natural catastrophes, the costs of such events — whether or not they become more frequent — will only grow. Table 2 below illustrates the possible property losses for several potential natural catastrophes, assuming they would soon occur (the costs would be higher in the future, because of population growth and additional construction). While most of the property losses for the hurricanes would be insured, the fraction of insured losses would be much less in the case of earthquakes, where the insurance take up rate is much lower, as discussed shortly (though, even for earthquakes, the insured costs could still be substantial). The key point from Table 2: the unprecedented insured losses from Katrina easily could be surpassed by any number of possible natural catastrophes in the future.

To be sure, the probability that any of the events listed in Table 2 would occur in any single year is low. But it is likely that at least one of them will occur at some point in the future. Indeed, the nation and the potentially affected areas have been lucky in the past. If Hurricane Andrew in 1992 had hit thirty miles to the north, or Katrina forty miles further west, or had Rita stayed a Category 5 and hit Houston, the damages from those disasters would have been much greater.

Table 2. Potential Current Property Losses Due To Various Possible "Mega-Catastrophes"

Event	Loss (Billions of 2005 dollars)
Hurricanes:	
Category 5 in Houston	40
Category 5 in Tampa	65
Category 5 in Miami	155
Category 5 in New York area (including New Jersey And Long Island)	96
Earthquakes:	
7+ in Los Angeles	140
8+ in San Francisco	200
7.5+ New Madrid (St Louis/Memphis and other Areas)	90

Note: Losses are for both residential and commercial properties, but only those on-shore (the loss estimates do not include covered losses to offshore energy facilities and other marine exposures). Insured losses as a fraction of total losses are likely to be much less for earthquakes due to low take-up rates for earthquake insurance.

Source: AIR-Worldwide (supplied to the author).

Where Will New Private Capital To Support Catastrophe Policies Come From?

In theory, private insurers, perhaps working with reinsurers and the capital markets, could pay for substantially higher losses associated with single mega-catastrophes, or combinations of somewhat less severe events in a single year with similar cumulative losses, by charging substantially higher premiums than in the past and/or by requiring significant deductibles on the policies they do offer.

But, in practice, insurers and investors may not be able or willing to put their money at risk. Not only do mega-catastrophes pose substantial financial risks, but their timing is highly uncertain, thus giving rise to what is known in the industry as timing risk. This means that insurers who assume the risk of covering losses from catastrophes confront the possibility of having to pay potentially huge claims to policyholders (or to primary insurers, in the case of reinsurers) well before they are able to collect sufficient premiums to cover their costs.

The problems of timing risk can be aggravated by state regulation that does not permit primary insurers to pass on the costs of reinsurance. Moreover, reinsurance may be so expensive that primary insurers choose not to purchase it. This failure to purchase coverage is a problem even when insurance premiums are artificially suppressed. For example, as discussed shortly, relatively few eligible California homeowners have purchased earthquake insurance from the California Earthquake Authority (CEA), a specialized entity established after the Northridge earthquake in 1994 to provide earthquake coverage.

The fact that following Katrina and through the end of 2005 reinsurers reportedly raised $21 billion in capital — through the startups of new off-shore entities and additional capital raised by existing reinsurers — is somewhat comforting, but in no way does it rebut the fact that reinsurers, like primary insurers, face significant timing risk. Anecdotal evidence, at the time of this essay, indicates that reinsurance rates for 2006 are up substantially from 2005 levels, a development discussed further shortly.[9] Furthermore, it is not yet clear how much of the $21 billion in capital represents net new capital, since much of the capital recently flowing into the reinsurance industry is likely to be needed to replace capital that was depleted by the 2005 storms (that was not otherwise offset with reinsurers' profits).

The nature and magnitude of catastrophe risks, as well as the unique timing risk that mega-catastrophes in particular pose for insurers, can be illustrated by the following rough hypothetical calculations.

Assume for illustrative purposes that all of the property-casualty coverage for residents of coastal regions along the Gulf and the Eastern seaboard — or those most exposed to hurricanes — is written by carriers who operate in all those states, so that the catastrophe risk is spread among insurers in proportion to their premiums. The 44 million people who now live in these areas comprise approximately 15 percent of the nation's population, and thus would account for roughly 15 percent of the $78 billion in premiums (in 2004) for homeowners and commercial multi-peril damage (see Table 3 on the following page), or about $10 billion.[10] In contrast, hurricane losses over just the last four years, 2002–05 (2001 is excluded because of the extraordinary losses associated with the 9/11 terrorist attacks, or man-made events), as calculated from the data shown in Table 4 on page 16, have averaged over $20 billion annually.

Again, for illustrative purposes only, suppose that this $20 billion in annual catastrophe losses is likely going forward, and that roughly $3 billion of the $10 billion in premiums collected is designated for natural disaster losses. These assumptions imply that premiums would then need to increase by $17 billion ($20 billion minus $3 billion), or to nearly triple (from the assumed $10 billion base level), in order to cover future expected losses. But even this calculation is conservative, since it ignores timing risk in that it assumes no extraordinary years — like 2005 — when insured costs could be two to three times higher than the assumed $20 billion annual average. In that event, insurers could only pay claims during an extraordinary claims year if they had accumulated surplus from profits earned in prior years. And even then, that surplus would have been accumulated to pay off unexpected claims due to non-catastrophic events. Depleting surplus for catastrophes — before sufficient premiums have been collected to fund them — would leave insurers without capital to cover these extraordinary claims. Furthermore, having depleted accumulated surplus for one extraordinary year could force insurers to shrink their customer base to fit their smaller capital base, while leaving them in future years exposed to potential ruin if hurricane costs in any single year again reached multiples of the assumed $20 billion in annual costs.

The ability of private insurers at least to partially address timing risk is impaired by the federal income tax laws, which do not permit insurers to

Table 3. Property-Casualty Insurance Industry Key Statistics 2004

Line of Business	Net Premiums Written (Billions)
Total P-C Industry	**436**
Private Passenger Auto Liability	93
Automobile Physical Damage	72
Homeowners' Multi-Peril	49
Worker's Compensation	46
Other Liability	40
Commercial Multi-Peril	29
Commercial Auto Liability	19
Reinsurance	9
Medical Malpractice	9
Fire	8
All Other	61

Source: A.M. Best, *Best's Aggregates & Averages*, 2005, p. 98.

deduct annual contributions or set-asides to reserve accounts for future catastrophe losses.[11] State catastrophe funds, discussed shortly, are not subject to this constraint. They can accumulate catastrophe reserves that are not subject to federal (or state) income tax and thus can build reserves for catastrophes at a faster pace than their private sector counterparts, yet even these state funds must find ways to address the timing risks posed by mega-catastrophes.

Table 4. Insured Catastrophe Losses, By Year

(Billions of Dollars of that Current Year)

Year	Losses
1992	22.9
1993	5.5
1994	16.9
1995	8.3
1996	7.4
1997	2.6
1998	10.1
1999	8.3
2000	4.6
2001	26.5
2002	5.9
2003	12.9
2004	27.5
2005	50+

Source: Insurance Information Institute; Estimate for 2005 includes $40 billion estimated through Katrina, plus some additional allowance for Hurricanes Rita and Wilma, and additional insured claims associated with Katrina.

National Underwriting Does not Solve the Timing Risk Problem

One might think that insurers in the illustrative hypothetical just outlined could avoid financial ruin by operating on a nationwide basis — namely, by collecting premiums from policyholders around the country to help defray the claims costs associated with policyholders in areas exposed to high hurricane risk. But this not only would be unfair to policyholders elsewhere in the country, but competition will not sustain such cross-subsidies on an ongoing basis. If national underwriters deliberately set premiums in such a way that lower-risk policyholders were charged more to keep rates down for policyholders in higher-risk areas, eventually regional carriers operating only in lower-risk areas would take market share — and ultimately perhaps most, if not all, of the customers in those areas — away from the national carriers. Indeed, this is a central reason why many national underwriters establish separate state-chartered insurers, so that at least legally, insurer surplus in low risk states cannot be used to pay off claims in higher risk states. (National insurers nonetheless may allow such transfers on an episodic basis for marketing reasons, but that is a matter of choice, not a legal requirement.)

Private Reinsurance Does not Solve the Timing Risk Problem

While there is little doubt that reinsurers will be able to handle claims even from the extraordinary 2005 hurricane season, the critical question is how reinsurers will respond going forward. Here, reinsurers must operate from the same set of actuarial principles that govern primary insurance. If there is a region of the world that consistently faces higher risk of damage than elsewhere — and the coastal regions of the United States confronting hurricane risk presumptively fit this pattern — then

even reinsurers that now operate on a global scale (and thus are able to spread losses across insurers from many regions) eventually will be forced by competition to charge much higher rates to primary insurers who are exposed to those risks. Insurers call this additional amount the risk load — or the multiple by which reinsurers multiply expected annual losses to protect themselves both against timing risk and uncertainties involved in estimating the expected losses themselves. Pre-Katrina, a risk load of five to seven times annual expected loss was typical.[12] In the wake of Katrina, demand for reinsurance by primary insurers is virtually certain to grow, but reinsurers already are meeting the demand only by offering coverage at premiums with substantially higher risk loads (multiplied by higher expected losses, given the enormous losses of the 2004–05 hurricane seasons).

Reinsurance premiums (including risk loads) are a cost of doing business for primary insurers, who will then attempt to pass them on to policyholders, if state regulators permit. If they do not, then primary insurers will not purchase the reinsurance, and indeed will have incentives to avoid putting themselves at risk in the first place, by withdrawing from offering policies to customers in high-risk markets entirely, or by significantly cutting back their coverage (through higher deductibles and, if regulators will let them, by denying catastrophe coverage altogether). In short, the inability of primary insurers to price coverage with high-risk loads to reflect timing risk in the catastrophe risk market is what leads to market failure.

It is widely recognized that reinsurance is a heavily cyclical industry, in which premiums rise and fall with some regularity. In so-called "soft markets," there is plenty of capital and competition among reinsurers (and insurers) to deploy it through underwriting coverage, which drives down premiums and eventually profits. "Hard markets" typically arise after profits indeed have fallen or after a period of unusually high losses, which slows down or halts capital inflows into the industry, which in turn drives premiums back up. Eventually profits increase, attracting some (but perhaps not all) capital back to the industry and the cycle resumes.

The extraordinary losses during the 2004 and 2005 hurricane season will not repeal the reinsurance cycle. Rather, to the extent reinsurers believe that these losses portend a permanent upward shift in either or both the frequency and severity of such storms, they will commit capital to reinsurance only at a higher premium level than otherwise would have been the case, and even then in smaller amounts. In effect, the cycle will continue, but from a higher base. Indeed, as primary insurers seek to replace capital lost from catastrophes in 2004–05, this additional demand alone already has placed upward pressure on reinsurance premiums, as will the reevaluation by ratings agencies and regulators of the amounts of capital required by primary insurers to maintain their secure claims-paying ratings.

Indeed, the recent intense scrutiny by investors and regulators of the reinsurance industry is likely to reinforce this outcome. One result of the increased attention is likely to be greater transparency among reinsurers, and specifically disclosure of the extent to which they are covering different types of risk. Reinsurers backing insurers exposed to hurricane areas in the United States, in particular, are likely to face pressure to justify their rates for reinsurance in these areas. And with more advanced risk-pricing tools, they are likely to be in a better position to respond to such pressure. As a result, if primary insurers truly are exposed to greater claims losses, then enhanced disclosure and greater use of risk-based pricing should help

ensure that reinsurance premiums will be priced higher to reflect that risk.[13]

Financial Markets Have Not Solved nor Are Likely To Solve the Timing Risk Problem

In the 1990s, there was a flurry of optimism that the global financial markets — which are much deeper and more liquid even than global reinsurance markets — would come to the rescue and pick up catastrophe risks that primary insurers and reinsurers would or could not bear.

The initial catastrophe-related securities in fact were derivative instruments — futures contracts and options, launched by the Chicago Board of Trade. Under these instruments, payoffs were contingent on catastrophe losses hitting certain levels: on a national basis, for five regions and for three states (California, Florida and Texas). Trading volumes were low for these derivatives and they were later withdrawn. Professor David Cummins of the Wharton School of Finance at the University of Pennsylvania speculates that this happened because the insurers who would have issued the contracts could not be certain that the counterparties who bought them actually would pay off in the event a catastrophic event required them to. In addition, the contracts could not protect the insurers against "basis risk," which arises from the fact that the loss indices were too broad to have covered more geographic-specific risks (and thus the contracts would not have paid off for the insurers in the event of the catastrophe they were most worried about, such as a Florida hurricane).[14]

Subsequently, catastrophe-linked bonds, or CAT bonds, have been developed and sold to investors by insurers, or through related entities (typically a single purpose reinsurer, or SPR). These securities pay investors a premium interest rate to accept the risk of non-payment (cancellation of the principal) in the event of a catastrophic event, which can either be defined in physical terms (earthquake or hurricane of a certain magnitude), or by industry-wide or insurer-specific losses. At various times, proponents of these bonds have argued that investors should be interested in them not only because of their high yields, but because the performance of the bonds is likely to be uncorrelated with that of equities, thus offering opportunities for large institutional investors to invest in the bonds as means of diversifying their portfolios.

Key to the structure of the CAT bonds is the definition of the event that can trigger the release of the issuer's obligation to repay them. This definition, in turn, involves an inevitable tradeoff between moral hazard (the increased incentive to take a risk or at least not to avoid it, knowing one has the insurance) and basis risk. Securities that are tied to the losses of specific insurers (indemnity CAT bonds) are the functional equivalent of reinsurance and thus have no basis risk, but can entail moral hazard (less incentive to be prudent in paying claims) if the issuer does not bear at least some portion of any loss once the triggering event has occurred (as is true for federal terrorism insurance). At the other extreme, securities that are tied to industry-wide losses or to specific named events (such as an earthquake above a certain magnitude) reduce or eliminate moral hazard, but entail some basis risk since insurers cannot know whether the indices or the event will relieve them of the obligation to repay the bond, and thus act like reinsurance. For this reason, state insurance regulators have not yet approved non-indemnity based CAT as reinsurance for regulatory accounting purposes, which reduces the interest of insurers in issuing them (because regulators presumably require insurers to back their premiums with greater capital instead).

Professor Cummins argues that this regulatory treatment has limited the interest of insurers in issuing CAT bonds, and thus has limited the size of the market. Through March 2005, for example, he notes that the approximately 120 CAT bond issues to date have raised about $10 billion in funds for insurers, of which only about $2 billion were then outstanding — both small amounts compared to the $350 billion in capital in the global reinsurance industry and roughly $400 billion in capital in the U.S. property-casualty industry (figures which are discussed in more detail below).[15] Indeed, insurer interest in issuing the bonds seems to be on the decline. New CAT bond issues totaled $1.14 billion in 2004, down from $1.73 billion in 2003.[16]

What accounts for the disappointing volume of catastrophe-linked bonds? Cummins suggests that insurers view CAT bonds to be too expensive compared to reinsurance (or self-insurance). Although spreads over LIBOR (the short-term London Interbank Borrowing Rate, a conventional interest rate yardstick) on CAT bonds have come down from the more than 6 percentage points (or 600 basis points) in the late 1990s, they were still hovering in late 2005 at 4.5 percentage points (450 basis points). Cummins suggests that the interest rate premium is still high because investors may continue to be unfamiliar with the bonds and worried about the reliability of catastrophe loss prediction models; the trading of such bonds is infrequent; and a belief by some investors that big catastrophe in fact would be correlated with the stock market and thus the bonds in fact do not represent good diversification vehicles (if the "Big One" hits, the bonds will cancel and the market will go down, both at the same time). Nonetheless, Cummins draws comfort from the fact that large institutional investors still seem to be interested in the securities, as reflected in their declining spreads. He also argues that insurer interest in issuing them, meanwhile, would be furthered if regulators were to permit insurers to count non-indemnity CAT bonds as reinsurance for regulatory purposes.[17]

Clearly, insurers would be more interested in issuing non-indemnity CAT bonds if regulators changed their accounting policy, which I recommend and discuss below. But it is far from clear that even if this recommendation were adopted, investors would be interested in buying sufficient volumes of these securities that the financial markets would thus solve the timing risk and catastrophe insurability problems that primary insurers and reinsurers now confront. For this reason, it would be a mistake in my view for policymakers to assume otherwise. And the reason, ironically, is underscored by what happened in the CAT bond market after Katrina.

One would think that if there were ever an event that would trigger the principal cancellation provisions of non-indemnity CAT bonds, it would have been a mega-hurricane like Katrina. But this outcome turns out not to have been the case. The wind speeds were not high enough nor the barometric pressure low enough during the hurricane to trigger the event language written into some of the bonds, while the aggregate insured losses may not be high enough to trigger the principal cancellation provision in others.[18] While this is clearly good news for investors in CAT bonds, it cannot give much comfort to insurance company issuers, who are still obligated to repay the bonds. In effect, then, the bonds that are outstanding in the market therefore have not functioned like reinsurance and thus have done nothing to cushion the financial blow suffered by the insurers that issued them.

If insurers are going to look to CAT bonds to be

the functional equivalent of reinsurance in the future — and, indeed if state regulators are to be more inclined to treat the bonds this way, especially in light of the failure of Katrina to trigger non-payment of the bonds — the trigger points and possibly other features of those bonds will have to be changed, to reduce basis risk and thus increase the likelihood that insurers will be able to cancel their repayment obligations. But any moves in this direction, which would enhance insurer interest in selling the bonds, also would discourage potential investors from buying them, whether or not the bonds count as reinsurance for regulatory accounting purposes.[19]

Summary

In sum, there is market failure for mega-catastrophes: the losses and timing risks they entail are so large that market-determined premiums may not be charged. Even if premiums are artificially suppressed, many of those at risk may be unwilling or unable to purchase coverage. Katrina demonstrates what happens then: the federal government becomes the de facto insurer of last resort, and not only for political reasons. Only the federal government, which essentially has unlimited borrowing capacity, has the ability to withstand early claims payment without going bankrupt in the meantime. As discussed below, a central policy issue going forward is whether the de facto nature of the current federal insurance backstop (provided in the form of disaster aid) should be formalized, and if so, how.

Existing Insurer Capital Is Insufficient and Irrelevant Going Forward

If insurers cannot pay for future mega-catastrophe costs out of future premiums, it may be tempting to conclude that they can cover these costs out of the $400 billion in capital or surplus that the property-casualty insurance as a whole has accumulated over time through retained earnings and invested capital. Or if this capital is not sufficient, then the primary insurers can call on another $350 billion in capital held by global reinsurers.

Even if these figures accurately represented sums available to pay catastrophe claims, it is important to recognize at the outset that any surplus accumulated in the past cannot be looked to as a sustained source of funding for future catastrophic events for several fundamental reasons.

First, the surplus amounts, by definition, are inherently backward looking. They afford insurers and reinsurers a cushion against financial failure in the event of a sharp spike in claims costs and/or losses in their investment portfolios, but once these untoward events have occurred and existing surplus has been depleted, there will be no surplus available for future and continuing losses caused by mega-catastrophes or to support the more routine insurance needs of a growing population — unless premiums are significantly increased and in fact paid by policyholders so that future surplus can be generated. If it were otherwise, then insurance would not be a sustainable business. And if premiums cannot sustain future losses, or consumers are unwilling or unable to pay actuarially appropriate premiums, then the insurance market will have failed. In less technical terms, insurer surplus is like having a finite number of cookies in a cookie jar. Take a lot of the cookies away — because of one or more large catastrophic events — and there are no more cookies available in the event they are needed for continuing, future catastrophes.

Second, the aggregate surplus figures for the entire p-c industry, or for the global reinsurance industry, cover many different lines of insurance, only a few of which are even relevant to natural

catastrophes. Although surplus is not reported by line of insurance, it should be somewhat proportional to premiums written by line, data for which are available. As illustrated in Table 3, premiums for homeowner's and commercial multi-peril policies — those most affected by natural catastrophes — accounted for just $78 billion of the $436 billion in total p-c premiums collected in 2004, or roughly 18 percent of the industry figure. Applying that percentage to the $402 billion in surplus available industry-wide in 2004 yields a total of $72 billion in surplus — a rough estimate of the capital backing property coverage.

Of course, the "true" figure varies somewhat from this number because some insurers write coverage across multiple lines, which would tend to raise the total surplus available. On the other hand, even multi-line insurers, as well as their "monoline" counterparts (those engaged in underwriting only one type of risk), often establish separately capitalized insurers for the sale of property insurance in different states, which lowers the amount of surplus available to satisfy claims on a nationwide basis. Many insurers also establish single-line companies for high-risk states, which further lowers the amount of capital available to pay claims arising in those states. It is conceivable that these various effects cancel each other out, but whether or not they do, the central point is that far less than half, or probably less than a quarter, of the surplus among all primary p-c insurers is realistically available to pay catastrophe claims.

The aggregate figures for reinsurer surplus also cover many different lines of primary insurance — predominantly for high-frequency risks — as well as different regions of the world.[20] In particular, the figures include reinsurers that extend coverage only outside the United States, and clearly this capital is not available to pay for U.S.-based catastrophe claims. There is also a certain amount of double counting of reinsurer capital in this $350 billion figure. This arises because the aggregate reinsurer figures count the surplus of a number of major reinsurers that also are active in the primary insurance market (so the figures for reinsurance partially back the primary market as well).

Third, the aggregate surplus figures for the entire primary and reinsurance industries, as well as within any particular line of coverage, by definition sum the surplus of individual insurers, which are exposed in different ways to different types of risk. In other words, the capital backstopping various catastrophe risks is not evenly distributed. And at the end of the day, it is the surplus that is held by these individual insurers that matters, since the capital of one insurer cannot be called upon to pay claims of other insurers (except in a very limited way, through state guaranty funds, under which all surviving insurers in a state can be assessed annually to pay claims of insurers that fail in that state).

State Catastrophe Plans Alone Cannot Be Counted Upon To Solve the Catastrophe Problem

Two states, California and Florida, have recognized the difficulties entailed in underwriting catastrophe risks, and have responded by organizing state funds to provide insurance or reinsurance for this purpose. Although the two funds differ in structure, both of them still involve the private insurance industry in some way — so that the private sector remains exposed to loss. At the same time, neither of these state funds cover all catastrophe risks, especially the losses of very large, or mega-catastrophes, and thus leave consumers and businesses at risk for potentially significant losses. The Florida catastrophe reinsurance fund (the

"Florida CAT fund") caps coverage at $15 billion, while the California Earthquake Authority currently can cover only about $7 billion in earthquake damages. In addition, as will now be discussed, catastrophes in years like 2005 are putting enormous strains on some state plans and threaten their long-term viability.

Nonetheless, the California and Florida catastrophe plans each have brought much greater stability to insurance markets in those states than would have occurred otherwise. But neither plan was devised to deal with the mega-catastrophes that possibly lie ahead.

Florida

Florida responded with various initiatives following the devastation of Hurricane Andrew, which up to that time was the most expensive hurricane in the United States. Insurers not surprisingly wanted to withdraw from covering property in all or part of the state, or if they stayed, to raise premiums. The Florida legislature thwarted these efforts by requiring insurers previously doing business in the state to renew most preexisting policies and limiting rate increases.[21] Rate regulation, however, discouraged insurers from extending new policies. Florida responded to this problem by creating a residual market facility, the Florida Residential Property and Casualty Joint Underwriting Association (the JUA), which acted as an insurer of last resort. A similar residual market facility was created just for wind damage along the coast, The Florida Windstorm Underwriting Association. Insurers doing business in the state were financially responsible for both associations, and were subject to assessments if premiums set by these facilities — which deliberately were set below market — proved to be insufficient to cover claims. In 2002, the two facilities were merged into a single entity, Citizens Property Insurance Corporation, which not only has the ability to assess insurers for premium shortfalls, but to issue tax-exempt bonds if necessary. Citizens currently accounts for about one-third of the Florida property insurance market.

Meanwhile, Florida also required insurers offering property-casualty coverage in the voluntary market to purchase reinsurance from Florida Hurricane Catastrophe Fund (FHCF or the "Florida CAT fund"), at premiums based on their exposure to hurricane losses in the state. The coverage only kicks in once damages in any year exceed $4.5 billion (2005 retention), but is capped at approximately $15 billion in annual losses. Although the FHCF is not backed by the state, it is operated as a state agency, exempt from both state and federal income taxes, and as noted earlier, can accumulate reserves much more rapidly than can any private insurer. The Florida CAT fund also has the ability to impose additional assessments on all policyholders of primary insurers exposed to hurricane losses in the event of shortfalls and to issue bonds if needed to provide short-term financing (with debt service covered by post-event assessments).

California

The California Earthquake Authority (CEA) was established in 1996 by the California legislature, following the Northridge earthquake of 1994. The CEA essentially supplements the private insurance market and its insurance is distributed through private primary insurers, which must offer earthquake coverage as part of their homeowners' policies, either their own or the insurance provided by the CEA. Strictly speaking, the CEA is not as clearly a residual market facility, as is found in Florida and other states. Instead, the CEA has a mandate to offer earthquake coverage at actuarially-based premiums, though the

Authority does allow for some subsidies for those in especially high-risk areas.

As it has turned out, the CEA has not crowded out private insurers, who underwrite about half of the earthquake coverage in the state directly on their own account (not through the CEA), though the voluntary coverage is concentrated in lower risk areas.[22] CEA policies tend to cover higher-risk areas. Still, however, only a small portion of eligible California residents purchase any type of earthquake coverage: just 13.6 percent in 2003, down from 33 percent in 1996, the CEA's first year.[23]

One explanation for the low take-up rate is that unlike the wind peril policies in Florida, mortgage lenders do not require homeowners to purchase earthquake coverage. Another key factor is the high deductibles, at both the initial and upper layers of damage. Thus, the standard CEA policy deductible is 15 percent of any loss (though homeowners can purchase policies with a 10 percent deductible at a significantly higher premium). As property values and replacement costs have risen over time, so has the absolute dollar amount of this deductible, reducing the value of the coverage. The CEA's contract also contains various exclusions and tight caps on contents and living expenses.[24] In addition, the CEA's claims paying ability is limited; at year-end 2004, it stood at $6.9 billion.[25] By comparison, the insured component of a large future California earthquake (such as one depicted in Table 2) could easily exceed this figure (applying the 14 percent take-up rate to the estimate of total loss).

Limitation of State Funds

Meanwhile, nature has already tested the state residual markets facilities in Florida and the Gulf, and all are now under significant pressure. After the 2004 hurricane season, Citizens Property Insurance Corp. in Florida stood in deficit of over $500 million, prompting the company to assess private insurers in the state during this past summer, which insurers have now passed on to their policyholders. With Katrina and Wilma having hit the state this season, future premium hikes are in store for 2006. Policyholders in coastal areas, in particular, are facing premium increases of as much as 130 percent.[26] Louisiana's facility, the Louisiana Citizens Property Insurance Corp., is likely, after Katrina and Rita, to have a deficit of roughly $600 million, in a far smaller state. Indeed, half of the 32 state-organized risk pools for disasters are now in deficit.[27]

An inherent problem with state-run residual market funds is that they are subject to strong political pressures to charge premiums that are actuarially too low.[28] This has been a chronic problem in Florida, even prior to the 2004–05 hurricane seasons.[29] Citizens, and other state funds like it, can issue bonds to cover revenue shortfalls in the short run, but eventually they must charge higher premiums to policyholders, if the interest on those bonds is to be paid. Clearly, if the 2005 hurricane season is a harbinger of things to come, and if premiums are not raised to their actuarially-justified levels, then Citizens (and other similarly situated state funds) will not be financially viable over the long run.

This is not just a short or even long run financial problem. Holding down rates below actuarial levels reduces incentives for loss mitigation, which raises disaster costs over the long run. If state policymakers want to subsidize the premiums of low-income purchasers, for equity reasons, then that goal is much better accomplished through direct budgetary expenditures than by fiddling with the rate system so that policyholders who obtain their insurance in the "voluntary market" finance any

shortfall in the residual markets facility. Not only are direct budget expenditures more transparent, but it is inappropriate to assume that all those who obtain insurance from the residual insurer have low incomes, and that those who purchase in the voluntary market have moderate to high incomes. Both "markets" have customers with a range of incomes. If the objective is to have higher income residents finance insurance purchases by those with lower incomes, then transfers accomplished through the rate structure cannot guarantee that result.

The recent experience of Florida's residual markets insurer, Citizens Property Insurance Corporation, illustrates the point. Whereas Citizens sells only 2 percent of its policies to homeowners with residences valued above $1 million, these policyholders account for 10 percent of possible losses (or loss exposure) of the company.[30] This would not happen if the legislature instead directly provided insurance premium subsidies only to homeowners with properties valued below a certain level. Accordingly, direct subsidies — even if financed by assessments on private insurers (which would be passed on to their policy holders) — are much preferred over residual markets facilities if policymakers deem it appropriate to assist homeowners having low or moderate incomes with their insurance rates (Even then, however, it would be appropriate to limit such subsidies to existing residents only. Otherwise, the subsidies would attract individuals not living in hazardous areas to relocate to them, which would only lead to larger disaster losses in the long run).

Finally, laws requiring insurers to remain in state, subject to government imposed rate limitations, drive ever more homeowners to the residual plans, which face deeper financial problems as catastrophe losses climb higher. That leaves the federal government as the true insurer of last resort, which Katrina demonstrated it to be (although the government did not collect any premium up front to help pay for this risk).

De facto Federal Insurance for Mega-Catastrophes Is Inefficient and Unfair

In fact, through the federal government's various disaster aid programs, the government has always been somewhat of an insurer of last resort for disasters, large and small. The large ones are the focus of this essay. Table 5 on the following page lists the top eight natural disasters in which the federal government has provided aid in the past, ranked by cost.

The federal government provides aid to individuals and households to cover some losses; and to state and local governments and non-profit organizations for recovery and repair. Individual and household aid is available from a number of agencies and programs, listed in Table 6 on the following page. Much of this aid goes to individuals who do not have insurance or whose insurance does not cover all of their losses. In the case of Katrina, the aid for repair and reconstruction of entire cities and towns will be extraordinary, perhaps in excess of $100 billion (counting both direct budget outlays and the costs of various tax incentives), as already noted. This amount also almost certainly exceeds what the federal government would have had to contribute if effective incentives for loss mitigation had been in place prior to this awful event.

Disaster aid is a humanitarian response by government to events that cannot be controlled. But like all aid, it must be financed. Aid that comes in the form of insurance claims is paid for out of accumulated premiums. Aid that is provided by

government ultimately must come from taxpayers, either immediately through higher taxes or cuts in other programs (which rarely occurs) or eventually to service the debt that is issued to finance it (the typical response, especially when the federal government is already in deficit, as has been the case through the past two severe hurricane seasons).

Federal Disaster Aid as De facto Insurance

Government aid, after the fact, effectively is de facto insurance. That is, by consistently providing disaster aid, the federal government has an implicit contract with American citizens that in the event of a natural disaster — small or large — the federal government will compensate some

Table 5. U.S. Federal Disaster Aid

(Billions of 2005 dollars)

Year	Event	Amount (Billions)
2005	Hurricane Katrina	85 (likely to top 100)
2001	9/11 Terrorist attacks	20.0
1994	Northridge Earthquake	15.5
2004	Florida Hurricanes	14.0
1992	Hurricane Andrew	10.8
1989	Loma Prieta Earthquake	7.6
1993	Midwest Floods	7.0
1989	Hurricane Hugo	3.1

Source: Insurance Information Institute and 2006 State of the Union Address (for the 2005 estimate)

Table 6. Federal Disaster Aid Programs for Individuals, Households and Small Businesses

Agency	Type/Amount of Aid
FEMA	Cash grants of up to $26,000 for temporary housing and other needs (such as medical and transportation costs)
SBA	Low interest loans to cover expenses of individuals, farmers, and small businesses not covered by state or local programs or private insurance; individuals who do not qualify for loans may get cash assistance
VA	Adjustment to mortgages for veterans
IRS	Casualty loss deductions
Labor	Disaster unemployment benefits

uninsured losses suffered by individuals, businesses, and governments. In this connection, it should be noted that individuals and business also directly benefit from federally-funded reconstruction of public infrastructure, which is typically more modern than what previously existed. In addition, when the government provides funds for prevention or mitigation — for example, by building higher levees after hurricane-related floods (as is expected in the case of New Orleans) or by financing the construction of seawalls and the restoration of local beaches — then individuals and businesses who return or who are attracted to the area later also benefit.

The critical policy question, then, is not whether the federal government is going to provide de facto insurance in the form of disaster relief, but how such insurance is going to be financed: specifically, by taxing current or future generations of Americans, regardless of where they live and thus regardless of the exposure they may have to disasters, or by charging insurance premiums in advance (or ex ante) to those who are most exposed.

There is a good case for asking all Americans to pay for costs associated with terrorist attacks, which technically may be attacks on particularly visible targets (such as the World Trade Center and the Pentagon), but in reality are attacks on the nation. We do not tax people or businesses by their residence or location to pay for national defense. By the same token, it would be inappropriate to require residents of the areas surrounding the location of the attacks to bear the sole burden for reconstruction and compensation.

Existing Federal Catastrophe Reinsurance

Nonetheless, after 9/11, federal policymakers responded by creating a more formal federal program for terrorism insurance, as some other countries have done (see Appendix A for details). Until that event, private insurers had provided terrorism coverage only implicitly. After it, insurers sought and obtained specific exclusions in most states where they did business. Concerned that the unavailability of terrorism coverage would thwart future construction of some properties, Congress responded by enacting the Terrorism Risk Insurance Act of 2002, which was renewed just before it expired on December 31, 2005. TRIA (including the latest revisions) has several key features:

- TRIA is a reinsurance program, covering only commercial losses of primary insurers. TRIA does not apply to life, health, or personal property lines of insurance. TIRA also acknowledges that not all terrorist acts (notably nuclear or radiation-related events) are covered by its insurance contracts.

- TRIA requires private insurers to bear the first loss of terrorist attacks, events which must be declared as such by the Secretary of the Treasury,[31] initially up to 15 percent, rising in 2007 to 20 percent of insurers' premiums earned on TRIA-eligible lines offered the previous year.

- As revised, TRIA covers 90 percent of losses above the deductible in 2006, and 85 percent of losses above the deductible in 2007.

- TRIA requires the government to recoup in future years, through annual premium surcharges on insurers of up to 3 percent on commercial policyholders, a limited amount of the federal payouts (initially $15 billion minus the sum of insurer deductibles and co-payments, since revised to $25 billion in 2006 and $27.5 billion in 2007, minus the other adjustments).

The Secretary of the Treasury has the discretion, however, to increase private insurers' retention up to the full amount of claims paid by the federal government.

The Administration has not requested nor has Congress required the federal government to collect premiums for terrorism reinsurance in advance. This is due to the inability to assign an actuarial risk of terrorism, and thus to set an appropriate premium. In addition, TRIA potentially contains an element of federal subsidy, since the recoupment of federal payouts is expressly limited (although the Treasury Secretary may lift the limit).

The federal government has adopted a more formal primary insurance program for one type of natural disaster — floods. Unlike terrorism reinsurance, flood insurance is paid for by traditional premiums in advance, which theoretically do not carry a subsidy. In addition, flood insurance is mandatory, at least for homeowners in flood plains who finance their property with loans obtained from federally-chartered or insured financial institutions. In practice, however, the insurance requirement is not effectively enforced; while banks may be able to require the purchase of the insurance at the time they extend a mortgage, there is no system to ensure that homeowners continue to carry the insurance thereafter. In addition, in practice, flood insurance premiums for many purchasers are subsidized: 26 percent of the policies are for structures that receive a discount of 60 percent off actuarially appropriate rates.[32] Furthermore, in the wake of Katrina, which put the entire program into deficit by perhaps $15 billion or more,[33] it is likely, going forward, that all flood insurance policyholders will be subsidized to some extent by other policyholders or taxpayers, since it is unlikely that future premiums will fully reflect the elevated risks of hurricane-related floods. Even with the subsidy and the purchase requirement, take-up rates for flood insurance among eligible purchasers appear to be below 30 percent.[34]

Problems With De facto Federal Insurance

Having established more formal insurance programs for terrorism and floods, the question naturally arises: is there anything wrong with the federal government continuing to provide de facto insurance coverage for large natural disasters — notably hurricanes and earthquakes — through existing disaster aid programs? The answer is yes, for at least three reasons.

First, asking future taxpayers throughout the country to pay for disaster costs associated with specific, well-identified high risk areas — the coasts along the Gulf and Florida clearly exposed to hurricanes, and California and perhaps a few other states exposed to earthquakes — is fundamentally unfair to citizens who live in lower risk areas. Hurricanes and earthquakes are not like terrorist acts, where an impact felt by some is fundamentally an attack on all. These natural catastrophes are much more akin to floods, where the government already has clearly recognized the unfairness of asking citizens in areas not exposed to flood risks to subsidize those who choose to live and work in floodplains (although some subsidies occur because of the decision to discount some premiums from actuarially sound rates).

Second, because the risks of hurricanes and earthquakes — even low probability, but high consequence "mega" events — can be actuarially estimated, it is inefficient and more costly to society over the long run to provide compensation after the fact rather than to charge those who live and work in higher risk areas in advance for the estimated annual damages associated with these natural disasters. This is because insurance

premiums, when adjusted for risk exposure, provide incentives for policyholders to reduce their risk exposure, by purchasing or upgrading structures that are better insulated against disaster risks, and by applying political pressure on, or at least not opposing, state and local officials who adopt and enforce building codes and land use policies designed to reduce loss exposures in the event of future natural disasters. Indeed, the failure to provide monetary incentives through insurance actually encourages construction of structures that are in harm's way and thus invites future disaster aid — activities that are already under way in Florida and the Gulf, as noted earlier. In short, as the Congressional Budget Office has concluded:

> "Federal disaster assistance undoubtedly reduces financial hardships, but it may also discourage individuals and state and local governments from purchasing adequate insurance against future losses. *In effect, it subsidizes development in disaster-prone areas (ones for which insurers might be reluctant to provide coverage), and it weakens people's incentives to take actions that would reduce the cost of future natural disasters.*"(emphasis added).[35]

Third, except in the case of post-disaster aid for reconstructing and repairing public infrastructure, which typically covers a high proportion of the costs, after-the-fact disaster aid while providing some form of de facto insurance, does not compensate for losses as appropriately as would a typical insurance policy. Under a private insurance contract, payouts (and premiums) have more of a relationship to the pre-catastrophe steps insureds take to minimize their losses.

Paying For Future Mega-Catastrophes: A Layered Approach

There is a better way. By converting de facto federal insurance for mega-catastrophes into a formal insurance program — without subsidies and with incentives for cost-effective mitigation — federal policymakers can rectify each of the flaws in the current system: its unfairness, its inefficiency, and its insufficient protection to potential victims. In the process, a formal government reinsurance program can help ensure that private insurance remains available at actuarially appropriate rates which do not reflect unduly high risk loads that are otherwise necessary for private insurers to bear timing risk.

Why focus only on mega-catastrophes? Because private insurance markets, including securities markets (with appropriate reform, as suggested below), can handle natural events below this threshold (to be defined shortly). But at some point, the timing risk becomes so substantial that actuarially appropriate premiums make private insurance (and catastrophe-linked bonds) too expensive for many individuals and firms to want to purchase. This is not simply a matter of fairness, but also efficiency, because when private insurance markets do not work and the federal government steps in after the fact — as it inevitably does — the flaws just described with de facto insurance become evident and relevant.

The broad approach for financing future mega-catastrophes suggested here is a layered one where individuals, insurers, reinsurers, securities markets, and state catastrophe insurance and reinsurance funds — in that order — bear the costs up to some threshold. After that point, the federal government steps in, through reinsurance provided at actuarially appropriate premiums, taking into account state and local efforts to mitigate losses (see Figure 1 on the following page). To some extent this approach has been taken with terrorism risks, though no terrorism-related securities

currently are on the market; premiums are not charged in advance by the federal government in its role as a reinsurer; and thus monetary incentives from the federal government do not exist to encourage mitigation.

It bears emphasis that even with a federal reinsurance program for the risks to privately owned property, federal disaster aid still will be forthcoming to assist local and state governments in cleanup and reconstruction of public infrastructure following disasters. However, to the extent that an appropriate reinsurance program enhances the take-up rate for private insurance, it will relieve the federal government of the need to provide some disaster aid, while also encouraging private and public sector efforts to implement and enforce appropriate building codes and land use policies that reduce the total costs of future catastrophes (for individuals and their governments alike).

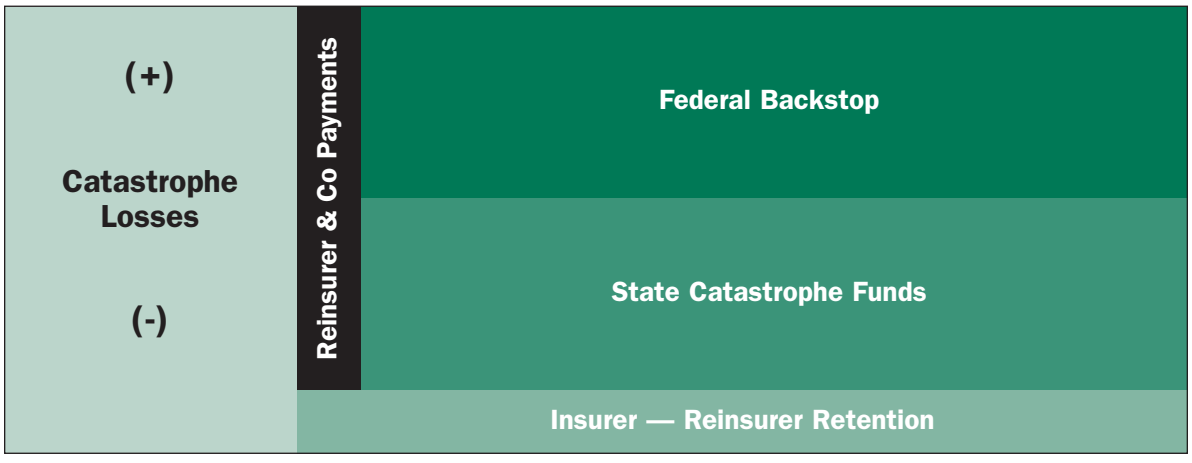
Policyholders Should Bear The First Loss — With Limits

Virtually all insurance policies contain deductibles, or amounts that the policyholder must bear before the insurer pays any claim. Deductibles help to reduce moral hazard. At the same time, insurance markets can fail if, because of the nature of the risk, insurers can only provide insurance with appropriately high deductibles, even as much as the first 5 percent of loss. In that event, insurance take-up rates are likely to be low, and even then, those who do buy policies may be those especially prone to risk, subjecting the insurance pool to adverse selection. This appears to be the present state of affairs in California, where as noted, coverage provided by the CEA carries a large deductible and the take-up rate, not surprisingly, is very low.

Private Insurance and Securities Markets

Primary insurers, reinsurers and catastrophe-linked securities should pay for the next layer of losses associated with mega-catastrophes. It is important that in setting the attachment point at which federal reinsurance would kick in, the private market has the ability and incentive to absorb catastrophe losses. A private role is necessary because primary insurers have strong incentives to charge actuarially appropriate premiums, unless they are prevented from doing so by government regulation.

Figure 1



In fact, there is a way in which state regulators in particular can accelerate the disappointingly slow development of the catastrophe-linked bond market in particular. As discussed earlier, to this point, state insurance regulators have not allowed insurers issuing non-indemnity catastrophe-linked bonds to claim any reinsurance treatment or credit for these securities. This is because any bond whose non-payment is triggered by anything other than insurer-based claims losses by definition has some basis risk, and is technically not reinsurance.

But this all or nothing approach to the treatment of these securities is ill-advised. Even bonds with some basis risk can afford insurers some protection. Accordingly, insurance regulators should assign these securities some partial reinsurance credit, depending on the likelihood that any index or event definition would trigger non-payment of the bond principal. Bonds with triggers with lower basis risk than others should receive a greater degree of proportional reinsurance credit.

Clearly, there are actuarial and measurement issues here that must be resolved before regulatory and financial accounting for such securities is changed. The National Association of Insurance Commissioners (NAIC), the body representing all state insurance regulators, should establish a working group or commission to develop appropriate methods for assigning partial reinsurance credit for non-indemnity catastrophe bonds. Assuming those methods are accepted by insurance regulators, the NAIC should urge the Financial Accounting Standards Board, which sets financial reporting standards for all publicly-held companies, to adopt them as well for financial reporting purposes. Once these events occur, then insurers would have greater incentives to issue the bonds, especially if the obligation to repay the principal is more likely to be cancelled than is the case now with catastrophe-linked bonds that are now on the market.

Policymakers should not assume, however, that merely because insurers would be more likely to issue the bonds that investors would snap them up at current, or ideally lower, interest rate premiums than these bonds now command. As also discussed earlier, securities that are more likely to have their principal repayment obligation cancelled also carry more risk for investors, who naturally would respond by demanding higher interest rates. Given the present state of the catastrophe bond market, it is not possible a priori to predict whether, at the end of the day, insurers still would issue more bonds at higher interest rates, but with the more liberal accounting treatment. Regulatory reform, in other words, should not be viewed as a silver bullet that will enable the securities markets to solve the catastrophe insurability problem. Moreover, rate suppression that disallows the full cost of such bonds as a component of insurer expenses can further compound the problem.

One important public policy issue is whether catastrophe coverage — hurricanes for coastal areas and earthquakes for exposed areas — ought to be mandatory. Although a mandate would reduce the need for federal disaster relief, it would be difficult to enforce, as experience with the federal flood insurance demonstrates. In particular, it is virtually impossible to enforce such a mandate after lending institutions have provided homeowners with the mortgage they need. In addition, in the case of catastrophe coverage, a further difficulty is defining exactly what kind of policy ought to be required (including the specific events, deductibles, and so forth). Furthermore, the catastrophe insurance market has not yet benefited from having a federal backstop insurer, which should bring greater rationality to premiums. In

light of the other practical difficulties with any mandate, the suggestion here is that policymakers therefore wait to see what happens to take-up rates following the implementation of an appropriate government reinsurance plan before considering any mandate.

State Catastrophe Funds

State catastrophe funds, whether for primary coverage or reinsurance, can and should play an important role in any overall natural catastrophe financing system. The local nature of these funds also provides states with greater incentives to engage in better land-use planning and mitigation. Yet, as noted earlier, these funds were not set up to deal with mega-catastrophe risk alone, nor can they be realistically expected to do so, given the timing and uncertainty risks that mega-catastrophes entail. As a result, both the California and Florida plans cap the coverage they provide. A federal backstop program, like the one outlined below, solves the timing and uncertainty risk problems that the state plans (and private insurers) inevitably face.

Federal Reinsurance

Given the timing risk inherent in mega-catastrophe risks, coupled with the uncertainties surrounding the willingness of insurers to issue and investors to buy catastrophe-linked securities, the federal government — and thus ultimately taxpayers — remains the insurer of last resort for such events. The proposal here is to formalize this reality by establishing a National Catastrophe Insurance Program (NCIP) to provide reinsurance to primary insurers and/or state plans offering catastrophe coverage.

Like its terrorism counterpart, the NCIP could be administered directly by an office within the Treasury Department. However, because the suggested program entails more duties, it would enhance the office's independence under the plan recommended here if the office had separate agency status, but formally belonged to the Treasury Department (much as the Comptroller of the Currency, the regulator of national banks, does now). The more independent is the office, the more insulated it is likely to be against political pressures to provide the reinsurance at subsidized rates, as has happened with the federal flood insurance program and, to varying degrees, with some state residual market mechanisms. Furthermore, if such an agency were established, it could make sense to place within it the terrorism risk insurance program and the federal flood insurance program, which is currently administered by the Federal Insurance Administration, currently a part of the Federal Emergency Management Agency (FEMA), which in turn is part of the Department of Homeland Security.[36]

A series of design issues must be resolved in establishing any federal reinsurance program. The most important of these are discussed in turn.

Attachment Point: Perhaps the most important design issue for any reinsurance program is the nature of the trigger that invokes federal reinsurance. In the case of the terrorism program, the trigger is a combination of an event — a terrorist act as certified by the Secretary of the Treasury — coupled with an insurer-specific dollar amount as an attachment point, or equivalently, a deductible. In the original Act, this deductible was set at 15 percent of the earned premium from TRIA-eligible insurance or commercial lines. In the extension to the Act enacted at the close of 2005, the deductible for all claims is gradually being raised to 20 percent. The advantage to the primary insurers, and thus to their policyholders, of an insurer-specific attachment point is that it

eliminates basis risk and thus makes the program true reinsurance. Moral hazard is avoided by requiring private insurers to bear some portion of the loss above the attachment point.

The event-dollar magnitude approach of TRIA can be readily applied, at least in principle, to mega-catastrophe risk reinsurance. The eligible events could include hurricanes (perhaps above a certain defined level, such as at least a Category 2 or 3), and earthquakes (perhaps above a certain Richter-scale magnitude, which could vary by geographic region, since a lower magnitude earthquake along the New Madrid could impose just as much or even more damage than a California earthquake 10 or more times as powerful). Meanwhile, the percentages themselves could be similar or equal to those in TRIA (as recently modified). A percentage deductible, in particular, is especially appropriate if the reinsurance is sold to primary insurers and reinsurers, in addition to state plans.

Alternatively, the legislation could define eligible events to include catastrophes below a certain probability, such as one in fifty or one in a hundred year events on a state-specific basis, and let independent actuaries retained by the federal reinsurance agency define the level of damage associated with that probability threshold.[37] This approach is better suited for state plans, where the geographic scope of the coverage is better defined and thus more amenable to a probabilistic estimate than is the case for a geographically diversified insurer or reinsurer.

Whatever approach is taken, policymakers must balance two competing considerations. On the one hand, they should want to avoid setting the attachment too low, since that would crowd out private reinsurance and capital markets, and the innovation that each can bring to the marketplace. In addition, private sector entities set premiums only on an actuarial basis, and are prevented from doing so only by state regulators in response to political pressure to keep insurance rates down.

On the other hand, the desire to make catastrophe insurance affordable, even in higher risk areas, should drive policymakers away from setting the attachment point too high. As argued throughout this report, the federal government has an inherent advantage relative to the private sector in that it can better afford to bear timing risk, and thus does not need to add the kind of risk load to premiums that private insurers, reinsurers, and the capital markets would demand. If the attachment point is too high, then the risk grows that the private market will not supply insurance above some level short of the attachment point at premiums that homeowners and commercial purchasers would be willing or able to afford. This not only would reduce coverage available, but would continue to expose the federal government to higher costs for disaster relief following mega-catastrophic events.

In any event, the federal insurance agency should have the freedom to sell policies with different deductibles (either state or region wide, or insurer-specific, and at different levels), and to charge appropriate premiums accordingly.

Premiums and Recoupment: The proposed program would differ from TRIA in one fundamental respect. Unlike terrorism risk, which currently is not subject to actuarial estimation, catastrophes can at least be roughly modeled and their probabilities and damages can be estimated accordingly. Thus, it is appropriate that the federal government charge premiums in advance for catastrophe reinsurance, rather than rely solely on recouping a portion of claims after the fact.

Pre-funding has two principal advantages. First, it helps assure that the government will not subsidize the reinsurance. Second, since the premiums on the reinsurance eventually will flow through to premiums charged by primary insurers, pre-funding confronts insurance buyers with the true social cost of their location decisions, and thereby encourages them to take appropriate measures to mitigate future losses.

Admittedly, it may not be easy to set premiums in a way that is fully insulated from the kinds of political pressure that have affected rate setting in the federal flood insurance program and in the state residual market facilities. Ideally, it would be desirable if the reinsurance offered by the federal government could be auctioned off to primary insurers (and to speculators as well, who would add liquidity to the market), since that would enable the market to set the price of the reinsurance, though the federal reinsurance agency probably still would be required to make some adjustment to that price to provide the mitigation incentives just outlined. In fact, an auction mechanism for such reinsurance contracts was at the heart of a number of catastrophe reinsurance proposals considered by the Clinton Administration and the Congress during the 1990s. These "excess of loss" (or XOL) contracts would pay off to their holders in the event aggregate or industry-wide catastrophe losses from a single event or over a calendar year (depending on the proposal) exceeded a certain attachment point, but only up to some ceiling. The XOL contracts could come in various forms, as national contracts (where a $25 billion attachment point was considered, along with a $50 billion ceiling), or regional or state-specific contracts (with correspondingly lower attachment points and ceilings).

Proposals involving the sale of XOLs were not adopted, in part because of administrative questions or issues surrounding the contracts. For example, if tied to specific events, how quickly would the contracts pay out, especially since it takes time after a disaster to know the amount of insured losses, not just for individual insurers but also for the entire industry? There was also uncertainty about how "thick" the market for various XOL contracts would be, and thus how well the market would actually price the contracts. This uncertainty stemmed in part from the basis risk inherent in the contracts, just as it is inherent in non-indemnity catastrophe-linked bonds. Since individual insurers (and the various state plans) could not know in advance whether their losses would be covered by any contract — until the industry-wide loss figures came in — it was not clear how much interest insurers would have in buying (or selling) them.

The auction-XOL approach is not likely to be suitable for catastrophe reinsurance, since the payoff amounts — whether provided by state plans or private insurers/reinsurers — would be insurer-specific and thus not uniform, as they were for the proposed XOL contracts. Thus, the catastrophe reinsurance premiums would have to be set actuarially. This does not mean, however, that the federal agency charged with setting the premiums would have to operate as a large bureaucracy. Rather, the premium-setting process could be modeled on the Florida reinsurance CAT Fund, which has an actuarial staff of only a few persons, and which relies on independent modeling firms to help provide premium estimates. The Florida fund deals with many insurers as well. To be sure, a federal agency would be required to deal potentially with many more parties, but the agency should be able to carry out its responsibilities with a staff that is only some multiple of the small Florida staff — most likely less than 100

individuals, which in Washington would make it a small agency indeed.

Given the federal government's advantage with respect to bearing timing risk, a critical issue in setting premiums is the appropriate risk load that should be incorporated in the reinsurance premiums. As discussed earlier, the risk load is the multiple that is applied to the annual expected loss to reflect timing risk and general uncertainty surrounding the loss estimate itself. In private markets, the risk load is typically five to seven times (400 to 600 percent) expected loss. At this level, it is not surprising why some individuals choose not to purchase private insurance. On the other hand, the CBO has reported, in the context of prior XOL proposals, that a risk load of two to three times expected loss (100 to 200 percent) is too low to protect taxpayers.[38] The CBO also concluded that those prior proposals probably would be costly to taxpayers, though it admitted the budgetary impact, including any offsetting impacts of lower amounts of disaster aid, was uncertain.[39]

The proposals the CBO were costing out, however, did not have the incentives for mitigation that are built into the proposal suggested here, and thus a risk load of 100 to 200 percent for the proposed catastrophe reinsurance program should be appropriate, if not unduly generous. More important, unlike the XOL proposals, the proposal suggested here would require the federal reinsurance agency to impose post-event assessments to recoup all federal payouts that may be required if catastrophes forced the fund to pay claims greater than accumulated premium reserves. Unlike TRIA, these post-assessments would not be capped, although the reinsurance agency should have discretion to decide the period of recoupment (subject perhaps to a ceiling, such as 20 years) to cushion the annual impact of the assessments on insurers and their customers. The impact also would be cushioned if the assessments were applied to all purchasers of the reinsurance, wherever they are located, not just to those in the affected areas that may trigger claims. While more targeted assessments would closely align risks with insurance costs, the assessments could be so high as to invite political pressure to be curtailed (in much the same manner as under TRIA). Furthermore, since the federal fund, by design, would cover risks for the entire nation, it would be appropriate to charge all insurers, since areas that might not trigger federal claims payments in one year may suffer catastrophic events in future years that could trigger an assessment.

In any event, a system of pre-funding coupled with post-event assessments, if necessary, means that the proposed system of catastrophe reinsurance would not be subsidized, while removing the timing risk problem that currently can make it too expensive or coverage too limited for consumers to want to buy it. Any practical difficulties of setting premiums that appropriately reflect risk should not be overstated and should not be showstoppers to the adoption of a federal program. Policymakers should not let the perfect be the enemy of the good. Even an imperfect premium structure for federal catastrophe reinsurance, coupled with a recoupment system to correct for mistakes and catastrophes that strike too early (or before sufficient insurance premiums have been collected to pay for future catastrophe costs) would be far superior to the current system of de facto insurance that imposes little or no charge on those who choose to expose themselves to catastrophe risk.

Finally, any legislation creating a federal reinsurance fund should contain language ensuring that the premiums collected are deposited in a separate account (analogous to the account created for the

collection of bank deposit insurance premiums), which cannot be used to support other federal spending, although the federal reinsurance agency would be directed to invest the proceeds in Treasury securities, which are the lowest risk instruments. In addition, the agency should be directed to accept only a modest degree of interest rate risk, and thus to invest in securities with maturities no longer than a given number of years.

Promoting Mitigation: Any federal plan should encourage cost-effective mitigation, in order to lower social and federal costs of future natural catastrophes. Setting reinsurance premiums on an actuarial basis will do this. The federal agency administering the program could provide additional incentives for mitigation by giving actuarially appropriate discounts on premiums to state plans in particular where state and local governments adopt and enforce effective building codes and pursue sensible zoning policies.[40] It is not recommended, however, that the federal government itself set building codes or zoning rules, since these decisions properly lie with state and local governments.

To be sure, any system for providing mitigation-related discounts will not be easy to implement. The federal agency that implements the program will require experts capable of reviewing state and local building codes and zoning rules for adequacy, for monitoring (most likely through spot checking) how these rules actually are enforced, and for translating both the rules and the degrees to which they are enforced into credits or reductions of reinsurance premiums. Most likely, much of the cost and effort associated with this endeavor would be incurred only in the initial year or two, since high performing states and localities once identified may need only to be spot-checked infrequently thereafter. This would allow the agency to concentrate its oversight efforts on states and localities identified initially to have subpar mitigation measures in place.

The federal government also could encourage mitigation by encouraging or even requiring the two federal housing government-sponsored enterprises — Fannie Mae and Freddie Mac — to set standards for and then help securitize "mitigation loans." One of the reasons why individuals may not adopt mitigation on their own — by bolstering foundations to house frames (to address earthquake risks) or bracing roof trusses and reinforcing ties between roofs and the rest of the house (to minimize hurricane damage) — is that such measures require up-front capital expenditures that many individuals may not be able to afford without financing. Professors Paul Kleindorfer and Howard Kunreuther of the University of Pennsylvania's Wharton School have suggested that individuals be able to obtain mortgage-like loans, with maturities similar to those on a mortgage.[41] If Fannie Mae and Freddie Mac would extend their mortgage guarantees to securities backed by these mitigation loans that would encourage lending institutions to make the loans available — indeed, even advertise them, and thereby encourage individuals to adopt measures to reduce their damage exposures to natural catastrophes they otherwise might not take.

Promoting Actuarially Appropriate Premiums: One possible supplement to the proposed program could be a feature that encourages those states that now operate state plans to avoid building in subsidies in their insurance rates. In particular, the federal reinsurance agency could award some defined credit against reinsurance premiums for private and state-sponsored insurers in states that operate their catastrophe insurance plans substantially in accord with actuarial principles or which set their premiums substantially based on risk.

The availability of such credits at least would offset some of the political pressure on the administrators of those plans to set premiums at subsidized levels. Indeed, coupled with the lower insurance rates that federal reinsurance should make possible (especially if state and local mitigation measures are adopted and enforced), such credits might allow premiums for many customers to be set at or below current levels.

Conclusion

Often it takes a major event to set the stage for policy action. Congress reformed the nation's laws governing depository institutions after several thousand of them failed during the 1980s, costing taxpayers roughly $150 billion (and the depository industry itself tens of billions more, in the form of deposit insurance premiums). After 9/11, Congress quickly acted to restore health to the commercial insurance market by establishing a federal terrorism risk reinsurance program.

In 2005, nature has intervened, generating the worst year of catastrophe damage on record. Though much of this cost will be paid by insurers, most of it — especially that associated with Katrina — will not. Citizens in need, and their political leaders, have looked to the federal government to ease the financial pain of the victims and to pay for the expensive reconstruction of the devastated areas.

This outcome is natural and understandable, but it is also inefficient and unfair to ask taxpayers generally to pay for the expected costs of future disasters, rather than, to the maximum extent feasible, impose such costs in advance on an actuarial basis on those that choose to be most exposed to these risks. At the same time, it is also inefficient and unfair to ask those at risk to pay for insurance that is more expensive than it needs to be or too limited in coverage.

Here is where the federal government can help in a constructive way. Because only the federal government can afford to pay claims arising out of large catastrophes before sufficient premiums have been collected to finance them, it does not have the timing risk that inevitably confronts private insurers, reinsurers, and investors in catastrophe-linked securities. Accordingly, at some level of exposure, the federal government can and should formalize its post-catastrophe aid to victims by establishing a reinsurance program for catastrophe risks.

The reinsurance proposal outlined here borrows some features from a similar program already present for terrorism risks, but also differs in key respects from the terrorism reinsurance program: it is largely pre-funded, and the proposal contains incentives for individuals, states and localities to take action to prevent or minimize future catastrophe losses.

We may not be able to control nature, but government can and should take measures to minimize the damage it can sometimes cause. The proposal suggested here does that, and more — by providing risk-based insurance against catastrophe risks with incentives for loss mitigation. If there is a silver lining to the horrible 2005 hurricane season, it is that the tragic events of the past year may create a unique window and political environment for policymakers to address a problem that has long needed attention.

Appendix A

Government Catastrophe Insurance in Other Countries

Other countries have established formal government insurance or reinsurance programs for catastrophes, both natural and man-made (terrorism).

A number of countries use tax revenues to prefund natural disaster relief accounts: Australia, Denmark, Mexico, the Netherlands, Norway and Poland.[42] Others have established formal government plans. Spain has a plan for "extraordinary risks" (natural disasters and terrorism), which is mandatory and included as an add-on in private property insurance policies. France requires catastrophe coverage in all private non-life policies, whose underwriters can reinsure with a state-guaranteed reinsurer. The French government sets the premium surcharge for the reinsurance. Japan has a similar reinsurance program for natural hazards (earthquakes and tsunamis).

Eight OECD countries have formal terrorism insurance programs, all established after 9/11, except for the programs in Spain and the United Kingdom (where terrorism had occurred previously).[43] The plans vary in coverage layers and amounts, whether a premium is charged in advance, and whether the coverage is temporary or permanent.

Notes

1. The author is a Senior Fellow in the Economic Studies Program at the Brookings Institution and Vice President for Research and Policy at the Kauffman Foundation. This document updates an earlier Working Paper of November 11, 2005, taking into account more recent information, as well as comments and suggestions provided at two meetings the author attended shortly after release of the Working Paper: the National Catastrophe Insurance Summit, held on November 15–16, 2005 in San Francisco and the Annual Meeting of the National Conference of Insurance Legislators (NCOIL), held on November 17–20 in San Diego. The views expressed here are the author's own and do not necessarily reflect those of the officers, trustees or employees of either organization with which he is affiliated.
2. Katrina initially was rated a Category 4 storm, but later was downgraded to a Category 3.
3. This typology draws on David Cummins, 2005. "Should the Government Provide Insurance for Catastrophes?" paper presented at a conference at the Federal Reserve Bank of St. Louis, October 21–22, 2005.
4. For a thorough description of the flood insurance program, especially in the wake of Katrina, see Center on Federal Financial Institutions (COFFI), 2005. "Federal Flood Insurance After Katrina" (October 16, 2005), at www.coffi.org.
5. Bjorn Lomborg, "Gulf Coast Consensus," *The Wall Street Journal*, October 11, 2005, p. A16.
6. See, e.g. Emanuel, Kerry, *Nature*, August 4, 2005; Webster, P.J., G.J. Holland, J.A. Curry and H.R. Chang, *Science*, Vol. 309, Issue 5742, September 16, 2005, pp. 1844–46. There is a debate within the meteorological community, however, on whether and to what extent global warming is likely to increase the frequency and/or severity of future storms. See Valerie Bauerlein, "Hurricane Debate Shatters Civility Of Weather Science," *The Wall Street Journal*, February 2, 2006, p. A1.
7. Haya El Nasser and Paul Overberg, "Despite Storms, Coasts Fill Up," *USA Today*, October 21–23, 2005, p. A1.
8. Evan Perez, "Battered By Storms, Florida Panhandle Sees Property Boom," *The Wall Street Journal*, October 25, 2005, p. A1.
9. Guy Carpenter, *U.S. Insurance Renewals at January 1, 2006: Divergent Paths After Record Storms*, p. 2
10. This is most likely an underestimate because coastal areas carry higher risk and thus premiums there should be somewhat above average.
11. However, insurers do have the ability to carry losses back and forward, once the losses have occurred, but not to take deductions for contributions toward a reserve in advance.
12. Congressional Budget Office, 2002. *Federal Reinsurance for Disasters* (Washington, D.C.), p. 24.
13. The pressures for greater transparency by reinsurers, coupled with their development and use of better risk-based pricing, are described in Standard & Poors, *Global Reinsurance Highlights,* 2005 edition, pp. 11–12. Significantly, this document was published before Katrina, and thus its forecast of falling reinsurance premiums no longer is relevant.
14. Cummins, 2005, p. 18.
15. Ibid, p. 20.
16. Aaron Pressman and Chester Dawson, "An Unbreached Financial Levee," *Business Week*, September 26, 2005, p. 97.
17. Cummins, 2005, pp. 21–22.
18. Pressman and Dawson.
19. The discussion of CAT bonds in this section applies to so-called "pre-event" bonds, or bonds sold before some event has occurred. The limitations with these securities do not apply to "post-event" bonds, which state sponsored plans may issue to cover the costs of catastrophes once they have occurred. These bonds are backed by assessments on policyholders and thus have a secure revenue stream to finance debt service.
20. Cummins, 2005, p. 13.
21. In any single year, insurers were permitted to drop no more than 10 percent of their residential policies in any county and no more than 5 percent statewide. CBO, 2002, p. 14.
22. California Department of Insurance, 2005. "2004 California P&C Market Share Report: Line of Business, Earthquake,"
23. Cummins, 2005, p. 25.
24. CBO, 2002, p. 7.
25. Price-Waterhouse-Coopers, 2005. *California Earthquake Authority: Report on Audits of Financial Statements for the Years Ended December 31, 2004 and 2003*.

26. Liam Pleven, 2006, "Who Should Pay?" *The Wall Street Journal*, February 1, 2006, p. B1.
27. Chad Terhune and Theo Francis, "Hurricanes Squeeze State Insurers of Last Resort," *The Wall Street Journal*, October 24, 2005, p. A1.
28. The federal reinsurance program described below, which backstops state funds, has a mechanism to ensure that the funds charge actuarially sound rates.
29. Collins Center for Public Policy, 1995. *Final Report of the Academic Task Force on Hurricane Catastrophe Insurance* (Tallahassee, Florida).
30. Pleven, p. B2.
31. Specifically, the Act (as amended in December 2005) defines a terrorist act as a violent act or an act that is dangerous to human life, property or infrastructure, causing damage in excess of $50 million (rising to $100 million in 2007) and to have "been committed by an individual or individuals acting on behalf of any foreign person or foreign interest, as part of an effort to coerce the civilian population of the United States or to influence the policy… of the United States Government by coercion." The law excludes acts of war.
32. COFFI, 2005. p. 2.
33. Ibid, p. 8.
34. Ibid, p. 2. Professor Howard Kunreuther has suggested that insurance policies be changed to cover "all hazards," including flood, in the future. See Howard Kunreuther, 2006. "Has the Time Come for Comprehensive Natural Disaster Insurance?" in Ronald J. Daniels, Donald F, Kettle, and Howard C. Kunreuther, eds., *On Risk and Disaster: Lessons from Hurricane Katrina*. Among other things, the main advantage of doing this would be to avoid the kinds of coverage disputes — "was it wind (which is covered by the standard homeowners' policy), or was it water (which is covered by flood insurance, if purchased)?" — which have emerged in the wake of Hurricane Katrina. The problem with this concept, however, is that private insurers are unlikely to willingly offer an "all hazards" policy which includes flood risks, because flood risks are highly location-specific, and thus are typically bought only by those most likely to experience a flood. This is the familiar "adverse selection problem," discussed above, which makes insurance infeasible. As a result, if an "all hazards" policy were mandatory, it is very likely that insurers would substantially increase premiums on all properties in flood areas, or perhaps refuse to write any policies at all in those areas, just as insurers have withdrawn from covering wind risks alone in coastal areas already. See Pleven, p. B1–B2.
35. CBO, 2002, p.17.
36. Many of the issues discussed here in connection with reinsurance for natural disasters arise with respect to terrorism risk insurance. For a guide to this topic, see Howard Kunreuther and Erwann Michel-Kerjan, 2004. "Challenges for Terrorism Risk Insurance in the United States," *Journal of Economic Perspectives*, Vol. 18, No. 4, Fall, pp. 201–14.
37. There are a number of nationally recognized firms that, among other things, develop these probabilities. The government agency could look to these firms, and any qualified new entrants, and take an average of their projections (much as the Congressional Budget Office now does with budget projections, taking into account an average of multiple private sector forecasts of GDP in setting its own GDP forecast).
38. Congressional Budget Office, *Cost Estimate for H.R. 21, Homeowners' Availability Act of 1999* (February 9, 2000); *Cost Estimate for H.R. 219, Homeowners' Availability Act of 1998* (September 23, 1998); and *Cost Estimate for H.R. 230, Natural Disaster Protection and Insurance Act of 1997* (October 8, 1997).
39. CBO, 2002, p. 24.
40. Providing such discounts is more difficult (or may be impossible) to do for reinsurance sold to primary insurers or reinsurers, since these entities have customers from many states.
41. Paul Kleindorfer and Howard Kunreuther, 1999. "The Complementary Roles of Mitigation and Insurance in Managing Catastrophic Risks," *Risk Analysis*, Vol. 19, pp. 727–38.
42. Paul K. Freeman and Kathryn Scott, 2005. "Comparative Analysis of Large Scale Catastrophe Compensation Schemes," in *Catastrophe Risks and Insurance* (Paris: Organization for Economic Cooperation and Development).
43. For an extensive description, see OECD, 2005. *Terrorism Risk Insurance in OECD Countries* (Paris: Organization for Economic Cooperation and Development).

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The Brookings Office of Communications
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