
WMD Terrorism

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Responding to WMD Terrorism Threats: The Role of Insurance Markets

Dwight Jaffee and Thomas Russell

Insurance offers three important benefits that can help an economy deal with the catastrophic losses that arise from both natural disasters and manmade events: risk sharing, mitigation and price discovery. *Risk sharing* is the direct benefit of insurance, whereby those at risk from an event pay a relatively small annual premium to an insurer, which later uses its accumulated funds to reimburse those parties that suffer actual losses. Risk sharing per se, however, does not reduce the physical losses from the event. Nevertheless, most economic activities and industries could not operate without the benefits of insurance or a comparable government program. For example, in the absence of auto insurance, a family could be readily bankrupted if a family member were held liable for a large sum due to a serious auto accident. As a result, it is unclear how the automobile industry could have developed unless the risk-sharing benefits of insurance were available to eliminate this risk of personal financial disaster. We will see in section 9.1 that insurance plays as important a role in sharing the economic risks created by terrorist attacks using weapons of mass destruction as it does with the daily risks of automobile driving.

Mitigation is a second benefit of insurance, whereby insured parties take actions to reduce their expected losses in order to obtain lower premiums. The incentive to mitigate is created by *risk-based premiums*, whereby each insured party pays a premium commensurate with his or her risk. For example, when insurers charge property owners lower premiums if they protect their buildings from terrorist attacks, this gives owners an incentive to carry out this mitigation. In contrast, providing insurance *without* risk-based premiums actually deters mitigation activity, since the insured parties pay the same insurance premium and are covered for their losses whether or not they mitigate. In section 9.3.4, we discuss specific issues of mitigation as they relate to terrorist attacks.

Price discovery, meaning that insurance premiums offer a market determined quantification of an insured risk, is the third fundamental benefit of well functioning insurance markets. The accuracy of insurance premiums as a measure of risk is

enhanced by the insurance industry's ability to efficiently aggregate information from a wide range of sources. The information summarized in the premiums can then be applied to resource allocation and investment decisions, of which mitigating terrorism risks is just one important case. As another example, Laster and Schmid (2005) note that the decision to produce ultralarge oil tankers was reversed when insurers indicated that they would require very large premiums to insure the tankers against environment risks.

The risk-sharing, mitigation, and price-discovery roles of insurance all rely on the fact that profit maximization within the insurance industry provides a powerful incentive to aggregate information efficiently, resulting in an accurate measure of risk that can be applied in a wide range of economic decisions. In a fundamental sense, the less transparent the risk, the more valuable insurance markets can be in providing the best available risk quantification. In this chapter, in particular, we will show that for issues of homeland security, where the risks may even be intentionally opaque, the tools and methods of insurance can have exceptional value.

Insurance benefits generally rise with the size of the possible loss, so insurance is particularly valuable for *catastrophes*, the term we use to cover both natural disasters (such as earthquakes and hurricanes) and *man-made events* (covering industrial accidents and terrorist attacks). Figure 9.1 shows the worldwide level of insured losses from each of the two categories of catastrophes as compiled by the

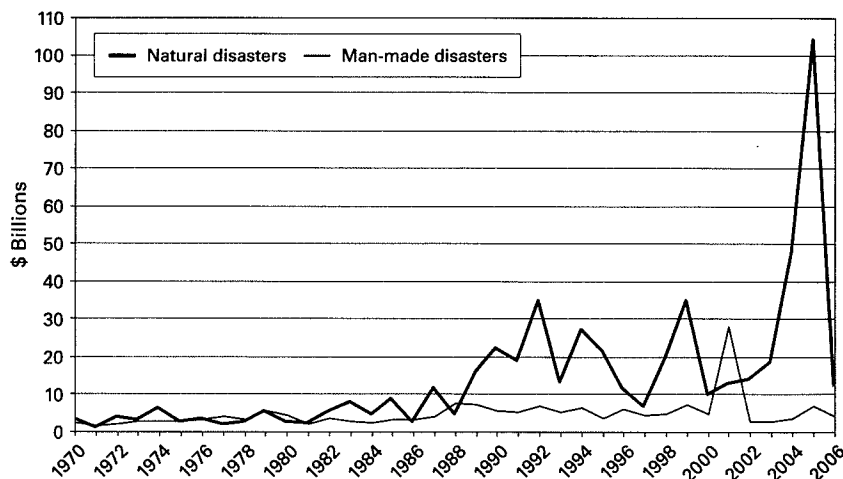


Figure 9.1
Insured losses from catastrophes, billions of dollars.

reinsurance firm Swiss Re. The September 11 attack accounts for the 2001 spike in losses from man-made losses, and Hurricane Katrina accounts for the 2005 spike in natural disaster losses. The long experience in observing and insuring natural disaster risks will provide a useful benchmark for our discussion of how insurance markets for terrorism risks might best operate.

This chapter focuses on the enormous losses that could arise from terrorist attacks using weapons of mass destruction (WMD), hereafter WMD terrorist attacks. We will see that a WMD attack could readily create \$100 billion in insured losses, and some estimates exceed \$700 billion, far more than even the record \$100 billion loss from natural disasters in 2005. The terrorism insurance literature often refers to the risks created by WMD attacks as CBRN risks: chemical, biological, radiation, and nuclear. Table 9.1 provides a summary description of CBRN weapons compiled by the General Accountability Office (2006e). For brevity, we will refer to the full set of such attack modes as WMD risks, but we will also discuss the special issues that arise from the specific forms of CBRN attacks.¹

While insurance is particularly valuable for catastrophic risks, catastrophic risks also raise special issues that often preclude a viable and dependable supply from private insurance providers. In fact, while the U.S. economy had functioning private insurance markets for earthquakes, hurricanes, and conventional terrorism risks just fifteen years ago, each of these private markets has since broken down as the result of a major event.² Given that insurance is critical to the functioning of the economy, such breakdowns in supply have always elicited a government policy intervention, ranging from attempts to reopen the private markets to the direct provision of government insurance. Whatever the specific form of government intervention, these policies have always been politically and economically contentious.

This chapter analyzes the issues that arise in providing insurance against WMD terrorist attacks and evaluates alternative solutions for the United States. The chapter is organized as follows. Section 9.1 summarizes the basic principles of insurance and the benefits it provides in the context of WMD terrorist attacks. It also surveys the reasons why so few private insurance markets currently operate to provide coverage against catastrophic risks, including WMD terrorist attacks. Section 9.2 describes the range of governmental solutions that have been tried or are currently proposed for insuring terrorism risks. Section 9.3 analyses the issues and recommends strategies for providing viable WMD terrorism insurance for individuals and firms. Section 9.4 provides a brief conclusion.

9.1 Basic Insurance Principles

We begin by reviewing the basic economics of insurance as it relates to WMD terrorism.

Table 9.1
Description of CBRN weapons

	Weapon description	Examples of agents
Nuclear	A nuclear explosion would have immediate blast effects that would destroy buildings. The explosion also would produce high-energy radiation and extreme heat, and form a cloud from which highly lethal radioactive material would fall. The overall effect would depend on the size of the weapon and how high above the ground the detonation occurred.	The explosion of the weapon, a bomb or missile, would be generated through nuclear fission of uranium or plutonium or nuclear fusion of hydrogen atoms.
Biological	Biological attacks can involve two basic types of biological agents: contagious and noncontagious. With most biological agents, an attack may not be recognized immediately because the symptoms may be attributable to several causes or because the disease the agent causes has an incubation period.	Many different agents such as smallpox or anthrax, each with its own characteristics, could be used for biological attacks.
Chemical	Chemical attacks entail the dispersal of chemical vapors, aerosols, liquids, or solids and affect individuals through inhalation or exposure to eyes and skin. Chemical weapons act very quickly to kill or harm humans, often within a few seconds.	Many different agents such as sarin and hydrogen cyanide, each with its own characteristics, could be used for chemical attacks.
Radiological	A "dirty bomb" uses conventional explosives to disperse radioactive material across the immediate area, which could vary in size depending on the amount of explosive. The primary short-term exposure hazard to humans would be inhalation of radioactive material suspended in the dust and smoke from the explosion.	Different radioactive agents, including americium, cesium, and plutonium, could be used to create a dirty bomb.

Source: Government Accountability Office 2006e

9.1.1 Demand for Insurance

Consider an individual facing a choice between a sure loss of \$100 or a risky loss of the same expected value, say a 1 percent chance of losing \$10,000 ($\$100 = .01 \times \$10,000$). Most individuals are *risk averse*: they would opt to pay the sure cost of \$100 in order to avoid the small chance of losing the larger \$10,000. Using this definition, it is easily proven that risk averse individuals should always fully insure their risks, as long as the insurance premium is *actuarially fair*, meaning that the premium equals the expected value of the loss (Arrow 1965).

Of course, insurance companies have operating costs and expect to earn a profit, so quoted insurance premiums generally include a *loading*, which is the amount by which quoted premiums exceed the actuarially fair amount. When insurance premiums include a loading, the optimal behavior is for parties to insure only a part of the full risk; in the preceding example, for instance, an insured party might accept a deductible amount of \$1,000 relative to the full \$10,000 risk.³ The perception of actuarially unfair premiums may also arise if the insured parties believe that the likelihood of the loss and/or the size of the loss are smaller than the actuarial values being used by insurers to set their premiums. Although we would theoretically expect firms to be less risk averse than individuals, in practice we observe firms purchasing insurance in much the same manner as individuals.⁴

9.1.2 The Costs of the September 11 Attack

Terrorist attacks inflict losses on various insurance lines, including property and casualty, workers compensation, and life insurance. Part A of table 9.2 shows how the total insured losses from the September 11 attacks of \$35.9 billion were distributed across the various lines of insurance. Property and casualty coverage includes property damage, business interruption, liability, and related risks. Workers compensation insurance covers workers injured on the job and is required in all states. Life insurance, of course, provides compensation upon a death.

The total costs of the September 11 attacks also include uninsured losses, indirect economic costs, and even unquantifiable effects such as pain and suffering or the dread of a future event. Part B of table 9.2 shows the support that the various forms of federal disaster assistance provided after the September 11 attack. The largest transfer was provided under the Federal Victims Compensation Act, which paid nearly \$7 billion to the families of September 11 victims, in return for which the families relinquished any right to sue those considered to be responsible. The total sum for all federal assistance was \$30.5 billion in then current dollars, about equal to the total insured losses measured in Part A in 2006 prices. Finally, in Part C of table 9.2, the estimates from Hartwig (2006) indicate that the economic losses in New York City alone exceeded \$90 billion and that the total economic costs associated with September 11 approach \$200 billion.

Table 9.2
Estimated costs of the attack on September 11, 2001

A. Insured Losses*		
Insurance category	Cost, \$billion, 2006 prices	Percent of total insured losses
Property damage	\$11.9	33.1%
Business interruption	\$11.2	31.1%
Liability, aviation, misc.	\$8.6	24.0%
Workers' Compensation	\$2.0	5.6%
Life insurance	\$1.1	3.1%
Event cancellation	\$1.1	3.1%
<i>Total insured losses</i>	<i>\$35.9</i>	<i>100.0%</i>
B. Federal Disaster Assistance**		
Assistance category	\$billion	Percent of total assistance
Federal Victims Compensation Act	\$7.0	23.0%
New York City infrastructure	\$5.6	18.4%
Revitalization of Manhattan economy	\$5.5	18.0%
Grants to U.S. airlines for losses sustained	\$5.0	16.4%
Housing assistance, facility rebuilding, etc.	\$4.8	15.7%
Initial response, search and rescue, debris removal	\$2.6	8.5%
<i>Total federal assistance</i>	<i>\$30.5</i>	<i>100.0%</i>
C. Total Economic Costs*		
Geographic area	\$billions	Percent of U.S. total
New York City alone	\$90	45.0%
<i>Total U.S.</i>	<i>\$200</i>	<i>100.0%</i>

Sources: * Hartwig 2006; ** Congressional Budget Office 2007

9.1.3 The Structure of Insurance Markets

In insurance markets, policy holders contract directly with *primary insurers* who normally write the policies and settle claims. The largest U.S. property and casualty insurers by revenue are American International Group, Berkshire Hathaway, State Farm, and Allstate. Primary insurers may hold the risks they underwrite, or they may transfer the risks to counterparties, primarily reinsurance firms and capital market investors.

Reinsurers are insurance firms that accept and diversify risks from primary insurers for a fee. Most of the world's largest reinsurers reside outside the United States, including Swiss Re and Munich Re. For most insurance lines, an active reinsurance market exists on a continuing basis. In fact, approximately two-thirds of the \$35.9 billion in insured losses from the September 11 attack were paid by reinsurance firms (Insurance Information Institute 2007b). However, just as the primary insurers exited the terrorism risk line immediately following the September 11 attack, so did the reinsurers. Indeed, the reinsurers' exit proximately caused the overall market failure so that any solution will have to reactivate the reinsurance market or provide a substitute for it (American Academy of Actuaries 2006).

Capital market investors represent a second set of counterparties to whom primary insurers can transfer those risks that they choose not to hold themselves. *Insurance linked securitization* (ILS) is the primary mechanism through which both primary insurers and reinsurers transfer their catastrophe line risks to capital market investors. We provide more details on ILS in section 9.3.3. To date, however, ILS has not succeeded in offsetting the main supply-side problems that face the provision of terrorism insurance (Doherty et al. 2005).

9.1.4 The Supply of Catastrophe Insurance

Despite continuing strong demand, the private supply of most lines of catastrophe coverage has recently broken down. We now survey the two primary explanations for this failure in the supply of catastrophe insurance, namely large losses and limited information.

Large Losses Could Bankrupt Insurers and Reinsurers Catastrophic risks are created by low-probability, high-consequence, events. Table 9.3 shows the insured losses for property damage alone from the world's five largest natural disasters and terrorist attacks.

Hurricane Katrina, with over \$41 billion in insured property damage, is currently the world's single most costly event. According to Zanetti, Schwartz, and Lindemuth (2007), when business interruption losses are included, the insured losses from Katrina reach \$66 billion, and the total damage created by Katrina is estimated

Table 9.3
The most costly natural disasters and terrorist acts, by insured property, in billions of 2006 dollars

Natural disasters		Terrorist acts	
Hurricane Katrina August 2005	\$41.9	World Trade Center September 2001	\$11.9
Hurricane Andrew August 1992	\$22.3	NatWest Tower bomb London, April 1992	\$1.0
Northridge earthquake January 1994	\$17.0	IRA car bomb Manchester, UK, June 1996	\$0.8
Hurricane Wilma October 2005	\$10.6	World Trade Center Garage, February 1992	\$0.8
Hurricane Charley August 2004	\$8.0	Financial District bomb London, April 1992	\$0.7

Source: Insurance Information Institute n.d., 2007a

to be \$144 billion. In this chapter, we use the experience of how insurance markets responded to these large natural disasters to project how insurance markets and the government might and should respond to WMD terrorist threats.

Among the terrorist acts shown in table 9.3, only the losses from the World Trade Center attack of September 11 are of the same order of magnitude as the largest natural disasters. Otherwise, not one of the terrorist acts created insured property damage above \$1 billion. In catastrophe insurance markets, events with insured losses at or below \$1 billion do not create a major concern. This is one reason why the World Trade Center garage attack in February 1992 did not focus insurance industry attention on the possibility of much larger future losses from terrorist attacks. Today, of course, there is full recognition that a WMD terrorist attack is possible, and, as we will see later, the damages could readily exceed \$100 billion.

The potentially large losses from catastrophic events create serious supply problems for the insurance industry for two related reasons. The main problem is that the annual premiums obtained by catastrophe risk insurers necessarily represent only a small fraction of the indemnification payment that will become due if and when the dire event occurs.⁵ For example, when insuring a 1 in 100 year event, the annual actuarially fair premium would equal just 1 percent of the total loss. While insurance companies can accumulate reserves to cover even the worst outcome in principle, a variety of tax, accounting, and profit issues make it uneconomic for them to do so (Jaffee and Russell 1997).

As of year-end 2007, all property and casualty insurers held \$518 billion in capital to cover losses, of which it is estimated that 38 percent or \$197 billion could

have been transferred to pay terrorism losses (Hartwig 2006). Of course, a specific terrorism event will normally affect only a small number of firms, and their capital will be only a small part of the industry aggregate. Furthermore, reinsurers face the same issues as the primary insurers: The American Academy of Actuaries (2006) estimates that reinsurers currently maintain at most \$9 billion in reserves to back-stop all terrorism risks, while CBO (2007) indicates that no more than \$1.6 billion is available to cover WMD terrorism risks. Clearly, these sums are highly inadequate if the reinsurance industry is to cover \$100 billion plus terrorism events.

The bottom line is that the losses that could be created from a large conventional terrorism act, let alone a WMD terrorism attack, could readily bankrupt any insurer or reinsurer that happened to retain a significant amount of that particular risk. We thus conclude, consistent with GAO (2006e), that most insurance managers are unwilling to offer catastrophe coverage because they perceive that taking on such risks exposes their firms to a serious chance of bankruptcy. The obvious desire to avoid bankruptcy is reinforced for multiline insurance firms that earn a significant share of their profits from noncatastrophe insurance activities such as auto insurance. The managers of such firms reasonably conclude that it would be imprudent to offer catastrophe insurance if this creates a risk of bankruptcy for their otherwise safe and profitable firms.

There may also be a principal-agent conflict between the managers of insurance firms and their shareholders. The shareholders may be enthusiastic for the high returns, albeit high risks, available from insuring catastrophes, because limited liability restricts their maximum loss. Managers, in contrast, may feel that the bankruptcy of their firm would put their entire career in jeopardy, along with reducing the value of any shares and options they hold in their firms. The following quote from Edward Liddy, president of Allstate Insurance, in the *Wall Street Journal*, September 6, 2005, illustrates this concern: "The insurance industry is designed for those things that happen with great frequency and don't cost that much money when they do. It's the infrequent thing that costs a large amount of money to the country when it occurs—I think that's the role of the federal government."⁶

Finally, insurers may also avoid catastrophe risks because they fear that rating agencies may downgrade their firms (GAO 2006e).

The Difficulty of Ascertaining Actuarially Fair Premiums For catastrophe lines, where by definition events occur rarely, the historical data normally used for premium setting are necessarily limited. This is especially true for WMD terrorist risks for which, fortunately, no historical data are available. Of course, insurers can still set premiums using the evidence from comparable events, or from models of the risks. However, managers still know that they might underestimate the risk and

therefore include an “ambiguity” component in their premiums.⁷ As a result, consumers may protest that the premiums are too high.

All states also have insurance commissioners, who command various degrees of control over the allowed levels of insurance premiums. In the case of catastrophe insurance lines, it is not uncommon for consumers and the regulators who represent them to feel that the premiums charged exceed the level justified by the actuarial risk and the need for a fair profit. Where they have the power, the regulators may place a ceiling on the allowed premiums. And even where the regulators allow the higher premiums, customers may feel their insurer is “gouging,” and take all of their insurance business to another firm. In either case, insurance firm managers often conclude that the best business decision is for their firm simply not to offer catastrophe coverage.

9.1.5 Insurable and Uninsurable Risks

Most insurance providers have long excluded the risks created by acts of war, as well as most chemical, biological, radiation, and nuclear (CBRN) risks, from their policies (GAO 2006e). These risks are considered to be uninsurable because they represent the extreme form of the circumstances under which the private market supply of catastrophe insurance breaks down, namely large size and sparse data for premium setting. On the other hand, going back no more than fifteen years, coverage was readily available for earthquake, hurricane, and conventional terrorist risks. But since then, the supply of coverage from the private market broke down for each of these major catastrophe lines following, respectively, the Andrew Hurricane of 1992, the Northridge earthquake of 1994, and the September 11, 2001, terrorist attack.⁸ In each case, coverage for the respective risks was readily available the day before the event, and almost no new coverage was available the day after; furthermore, for all three lines, the coverage that is available today is primarily the result of government intervention. The lessons from all three examples are very similar; in keeping with the focus of this chapter, the next section concentrates on the availability of WMD terrorism insurance following September 11.

9.2 Insuring Losses from Terrorist and WMD Terrorist Attacks

Prior to September 11, coverage for conventional terrorism attacks was readily available from property and casualty, workers compensation, and life insurance firms; acts of war and WMD events, however, were commonly excluded from standard property and casualty policies. Most insurers simply did not consider the possible losses from conventional terrorist attacks to be a significant cost element (Laster and Schmidt 2005). A further factor that motivated terrorism coverage on

commercial structures—office buildings, shopping centers, factories and warehouses, and so on—was that most lenders required that “all risks” coverage be maintained on the mortgaged structures, and it was customary to include conventional terrorism as part of an “all-risks” policy. For workers compensation insurance, a further factor motivating supply was that all states required (and still require) that firms maintain workers compensation coverage and that this coverage even include WMD terrorist risks (GAO 2006e). State laws also generally required the inclusion of terrorism risks in insurance policies.

On the day following the September 11 attack, most major insurers announced they would no longer offer terrorism coverage on any new property and casualty policies. The insurers also announced that they wanted to exclude terrorism risks from workers compensation. However, this would have required changing the state laws and has not occurred to date. No concerted efforts were made to exclude terrorism risks from life insurance policies, in part because most life insurers maintained geographically diversified books of business, and in part because such an exclusion would have also required changes in state laws (GAO 2006e).

The exit of insurers from terrorism coverage on September 12 created a panicked reaction in the construction and mortgage markets, where participants feared that most new activity would end if terrorism insurance were not available.⁹ This created an immediate call to the federal government to provide coverage, one way or another. Interestingly, it took more than fourteen months to enact federal legislation. In the intervening period, commercial mortgage lending and construction slowed down, but so did economic activity in many sectors of the economy.¹⁰ The somber predictions of major economic disaster never transpired, which is one reason Congress was able to take its time in settling on a response. Another helpful factor was that the existing policies, most of which had one-year duration, all stayed in force until they expired (on average six months later). A third factor was that some insurers allowed policy holders to renew, but at much lower coverage limits, and mortgage lenders accepted this as a temporary expedient in anticipation of a forthcoming federal plan. Finally, some states, including New York and California, required insurers to continue offering terrorism coverage.

9.2.1 The Terrorism Risk Insurance Act of 2002 and Its Extensions

The promised federal response finally occurred in the form of the Terrorism Risk Insurance Act (TRIA) of 2002, which became law on November 26, 2002. TRIA had a sunset expiration planned for year-end 2005. However, congress passed an extension, the Terrorism Risk Insurance Extension Act 2005 (TRIEA), two weeks before TRIA expired. TRIEA has the same basic concept but changed some of TRIA’s parameters. Although TRIEA was also viewed as a temporary (two year)

arrangement, Congress passed a further extension, the Terrorism Risk Insurance Program Reauthorization Act (TRIPRA), in 2007. This extended government presence in the industry through 2014.

While the details of government support have evolved from TRIA to TRIEA to TRIPRA, the program's essential features have remained the same. Here we describe the current TRIPRA scheme, although we refer to the combined legislation as TRIA for brevity. (A fuller discussion of these terms with detailed references to the legislation can be found in Russell and Thomas 2008.)

- *Definition of terrorism* An act of terrorism is any violent act causing damage to the United States or to a U.S. flag vessel or air carrier as certified by the Secretary of the Treasury. TRIPRA removed the requirement in prior legislation that the act be committed on behalf of foreign interests. Acts of domestic and foreign terrorism are now treated on an equal footing.

- *Insurer obligations* Insurers¹¹ are required to “make available property and casualty insurance coverage for insured losses that does not differ materially from the terms, amounts, and other coverage limitations applicable to losses arising from events other than acts of terrorism” (TRIA §103.C.1.b). This clause was interpreted as requiring insurers to continue offering terrorism coverage as was standard before September 11. The “make available” clause generally did *not* apply to WMD terrorism coverage, since that coverage was rarely offered prior to September 11. However, TRIA's benefits (see below) would apply equally well to an insurer who chose to offer WMD terrorism coverage.

- *Government reinsurance* TRIA provides insurers with government reinsurance, whereby a part of certain terrorism losses would be reimbursed by the U.S. Treasury. As of 2007, the key features were as follows: (1) Losses must exceed a \$100 million “trigger” before TRIA coverage is activated.¹² (2) Each insurer has a deductible limit equal to 20 percent of its total property and casualty insurance premiums earned in 2006. The deductibles for the largest insurers now exceed \$1 billion (CBO 2007). (3) For amounts above an insurer's deductible, the government will reimburse the insurer for 85 percent of its terrorism losses. (4) The liability of the U.S. government and insurers combined is capped at \$100 billion. It is presumed that Congress would take further action were losses above the cap to occur. (5) Insurers pay no premiums or fees for their government-provided reinsurance. This feature limits the incentive of insurers to quote risk-based premiums, which in turn limits the mitigation benefits that can be expected from TRIA. (6) The government must recover 133 percent of any TRIA payments it makes up to \$27.5 billion, which is called the *industry retention* level, by imposing a surcharge on all applicable property and casualty policies. For government payments that exceed the \$27.5 billion

threshold, the Secretary of the Treasury has the right to impose continuing surcharges until all government payments are recovered.

The U.S. insurance industry has generally and strongly supported TRIA and its extensions, which is perhaps surprising for two reasons: (1) the industry quickly exited terrorism insurance after the September 11 attack, and (2) as a result of TRIA's deductible formula, the industry is exposed to significant losses for events up to the September 11 scale (Dixon et al. 2007; CBO 2007).

One possible explanation for the industry's support is that it has sufficient resources to cover conventional terrorism losses up to September 11 levels; after all, all of the insurance claims from September 11 were paid. Indeed, given that the reinsurance benefits under TRIA apply equally well to conventional and WMD terrorism risks, insurers might also be willing to offer WMD terrorism coverage, even though TRIA does not require them to do so. In fact, very little WMD terrorism coverage has become available under TRIE and TRIEA (GAO 2006e).¹³ GAO (2006d) references two special factors, beyond large size and hard-to-compute costs, that might persuade insurers not to offer WMD terrorist coverage: (1) that the insurers already have substantial WMD exposure from state laws that require such coverage in Workers' Compensation policies, and (2) the possibility that the full extent of WMD losses might not be determined until years after the event.

Ibragimov, Jaffee, and Walden (2008) offer an alternative explanation for the industry's endorsement of TRIA, namely that each insurer is prepared to offer terrorism coverage as long as it knows that all other insurers will do the same. (This is exactly the form of TRIA's “make available” clause for conventional terrorism risks). The fact that TRIA's “make available” clause does not apply to WMD terrorism then explains why insurers may not be willing to offer WMD terrorism coverage.¹⁴

9.2.2 WMD Terrorism Insurance

Even though TRIA does not require insurers to make WMD terrorism coverage available, the question still arises as to why insurers would not voluntarily offer this coverage, given that TRIA provides free Treasury reinsurance for WMD losses on the same terms as conventional terrorism losses. To answer this, we return to the question of why certain risks are deemed “uninsurable.” Earlier, we pointed out that the two main issues for the provision of all forms of catastrophe risks by private insurers are (1) the potentially large size of the risks, and (2) the difficulty of quantifying the actuarial costs. We first focus on the potentially enormous losses that could be created by a WMD terrorist attack, based on four separate analyses of the potential losses.

Table 9.4
Potential losses from WMD attacks, \$ billions

	Property damage	Workers compensation	Total losses
Sarin gas attack (1,000 kg ground dispersal)	21	7	28
Dirty bomb (15,000 curies of Cesium-137)	62	0.2	62
Anthrax attack (1 kg anthrax slurry)	35	26	61
Anthrax attack (10 kg anthrax slurry)	112	59	171
Anthrax attack (75 kg anthrax slurry)	266	74	340
Sabotage attack on nuclear power plant	202	15	217
Nuclear bomb (1 kt)	140	100	240
Nuclear bomb (5 kt)	250	200	450

Source: Risk Management Systems (2005)

Estimates from Risk Management Solutions Inc. Table 9.4 provides estimates of potential insured losses from specific CBRN attacks by Risk Management Solutions Inc. (RMS), a firm that specializes in estimating expected losses from catastrophic events for the insurance industry.

The RMS estimates range from a \$25 billion sarin gas attack to a \$450 billion tactical nuclear bomb. Property damage represents the larger part of all total losses, although workers compensation losses are also significant in almost all cases. It should also be recognized that the RMS results exclude two other sources of losses. First, the RMS estimates exclude insured losses on business interruption and life insurance risks. Second, the estimates exclude any “multiplier” costs that would arise from economic disruptions across the full economy (chapter 14). Earlier, we noted that the economic losses created by September 11 far exceeded insured losses; similarly, the economic losses of the London subway bombing in July 2005 are put at \$4 to \$6 billion, even though insured losses were minimal (RMS 2005).

Estimates from the American Academy of Actuaries Table 9.5 provides an alternative set of projections from a study by the American Academy of Actuaries (2006) of insured losses from possible CBRN incidents.

In New York City, a large CBRN event could cost as much as \$778 billion, with insured losses for commercial property at \$158 billion and for workers compensation at \$483 billion. In comparison, we earlier noted that the total industry capital currently available to cover terrorism losses is about \$185 billion. In addition to New York, three other cities were included in the analysis: Washington, D.C., San

Table 9.5
Insured loss projections from WMD terrorist attacks, \$ billions

Type of coverage	New York	Washington	San Francisco	Des Moines
Group life	\$82.0	\$22.5	\$21.5	\$3.4
General liability	\$14.4	\$2.9	\$3.2	\$0.4
Workers comp	\$483.7	\$126.7	\$87.5	\$31.4
Residential property	\$38.7	\$12.7	\$22.6	\$2.6
Commercial property	\$158.3	\$31.5	\$35.5	\$4.1
Auto	\$1.0	\$0.6	\$0.8	\$0.4
Total	\$778.1	\$196.8	\$171.2	\$42.3

Source: American Academy of Actuaries, Response to President’s Working Group

Table 9.6
Allocation of insured losses by insurance lines from anthrax attacks, \$ billions

	Indoor attack	Outdoor attack
Property	\$1.1	\$100.4
Workers’ compensation	\$6.1	\$43.5
Group life	\$0.3	\$2.5
Individual life	\$0.2	\$2.1
Accidental death/dismemberment	\$0.2	\$1.5
Health	\$0.0	\$22.4
Total	\$8.0	\$172.3

Source: Rand (2005b)

Francisco, California, and Des Moines, Iowa. Clearly a CBRN attack could cause insured losses on an unprecedented scale.

Anthrax Release Estimates from the RAND Corporation The RAND Corporation in conjunction with RMS has carried out an extensive analysis of the possible losses that would be inflicted by anthrax attacks (Carroll et al. 2005).¹⁵ The RAND study evaluates two different anthrax attack scenarios, one within a single large building, the other an outdoor release that is widely disbursed. Table 9.6 summarizes the study’s major quantitative results. For the indoor anthrax attack, the estimated total insured losses are about \$8 billion, including over \$6 billion of workers compensation claims and over \$1 billion of property damage claims (primarily the

estimated costs of decontaminating the building, including the possibility that the building and its content would need to be replaced). The total insured losses from an outdoor anthrax attack are estimated to be over \$172 billion, more than twenty-five times as large as the indoor attack. Here the largest component, over \$100 billion, is property damage, reflecting the large number of buildings affected and the large costs of decontaminating them. The next component, \$43 billion, is workers compensation claims.

The RAND study also evaluates who would be responsible for paying these claims under the 2002 TRIA act. For the indoor anthrax attack, the firm(s) insuring the building would pay all the claims, since it is expected that their losses would be less than their TRIA deductibles. In other words, given the relatively small total insured losses of \$8 billion, there would be no payments from the U.S. Treasury.¹⁶ As noted earlier, the insured losses would have to exceed the September 11 scale for any significant U.S. taxpayer liability to accrue under TRIEA.

Interestingly, individual insurers are not expected to reach their company-specific deductibles for the outdoor anthrax attack either, assuming that the affected buildings were relatively small and insured by a diverse set of firms. As a result, the insurers would pay all claims from their own resources. Thus, even though the losses created by the outdoor anthrax attack are twenty-five times as great as the indoor attack, U.S. taxpayers still have no liability because losses are dispersed across many insurers.

The Nuclear Threat: Lessons from Nuclear Reactor Accidents A nuclear terrorist attack could be expected to take one of three basic forms: (1) the dispersal of radioactive material sprayed from an airplane or through a conventional chemical explosion—a so-called dirty bomb; (2) an attack on a nuclear reactor, also with the goal of dispersing radioactive material; and (3) the detonation of a nuclear bomb.

No such attack has occurred to date, and therefore no data are available to measure its effects. However, approximately 443 nuclear reactors exist worldwide, including 104 in the United States. These reactors all face the risk of an uncontrolled nuclear chain reaction, leading to a core meltdown, and quite possibly to extensive radioactive emissions. Such a failure did, in fact, occur at Chernobyl's Reactor no. 4 in 1986. The effects of a core meltdown and radioactive emissions from a nuclear reactor could reasonably parallel the effects of terrorist attacks (1) and (2) above. Nuclear reactors, fortunately, provide no parallel to a terrorist nuclear bomb attack, since nuclear reactors are incapable of creating a nuclear explosion. A nuclear bomb attack is also widely considered to be technically the most difficult, and therefore the least likely. In any case, in this section we analyze the available evidence on the

effects of radioactive release from a nuclear reactor and how insurance markets and governments have responded to this risk.

In 1982, Sandia National Laboratories prepared a study of the effects of a core meltdown and radioactive release at one of the two Indian Point nuclear power plants north of New York City on the Hudson River. The study estimated 50,000 near-term deaths from acute radiation and 14,000 long-term deaths from cancer. A much more recent study, Lyman 2004 estimates 44,000 near-term deaths and as many as 518,000 long-term cancer deaths within fifty miles of the plant. The latter study simulates 140,000 different weather combinations and then employs a Value At Risk (VaR) methodology, with the above results based on the 95th percentile among the worst outcomes. The varying results can be traced to the use of different input parameters, a newer computer simulation, and population growth since 1982.

Heal and Kunreuther (2007) provide some rough estimates that translate the losses from a nuclear reactor meltdown into dollar amounts. They project business losses in the \$50 to \$100 billion range, and as much as \$300 billion dollars in human death costs. This total is within the range of the estimates provided in tables 9.4 and 9.5.

Even as the first U.S. nuclear reactor was planned, private insurers anticipated the enormous meltdown costs and refused to offer coverage. Domsday meltdown scenarios were easy to put forward, and of course it was impossible to counter these with a historical record of safe performance. In addition, anytime the word *nuclear* is used, special alarm bells sound.¹⁷ As a result, private firms were unwilling to construct or manage nuclear reactors, since they feared that, in the absence of insurance, the losses created by an accident could lead to bankruptcies.

The specific solution that was developed to insure nuclear reactor risks is also useful in analyzing the more general problem of insuring CBRN terrorism risks. The key step for nuclear reactors was the 1957 Price Anderson Act (hereafter PA Act), which limited the liability of the nuclear reactor industry. Further discussion can be found in Heal and Kunreuther 2007. Like TRIA, the PA Act was viewed as a temporary measure, providing what was thought would be enough time (ten years) to enable the private insurance markets to assess and price this risk. In actuality, the Act was renewed repeatedly. The most recent extension in 2005 extends the Act through 2025.

The original 1957 PA Act placed a \$560 million ceiling on the potential liability of nuclear power plant operators. Below that limit, the private insurance industry was to insure \$60 million, with the federal government insuring the next \$500 million. The role of the federal government as direct insurer was phased out in 1977. Under the current Act, private insurers are required to provide \$300 million in insurance and the nuclear power industry itself provides further coverage up to a total

of \$10 billion. No liability claims can be brought against nuclear reactor operators above this \$10 billion limit, although in the event of a major accident Congress could decide to offer additional indemnification, perhaps in a manner similar to the Federal Victims Compensation Act following the September 11 attack.

It is intriguing that despite cries of uninsurability, private capital now provides \$10 billion of insurance to the nuclear reactor industry. The first \$300 million of this is provided by an insurance pool, American Nuclear Insurers (ANI), half of which is reinsured with Lloyds. The remainder is provided through a contract administered by ANI, in which the operators of nuclear plants guarantee payments of \$100.6 million per reactor per accident payable in annual assessments of \$15 million (inflation adjusted) per operator per year for ten years. In effect, the nuclear reactor industry has been required to create a mutual insurance pool in which each operator is obligated to contribute funds if and when a loss occurs.¹⁸

By arranging for ex post assessments, this scheme overcomes the need to hold large amounts of capital ex ante, one of the major impediments to writing catastrophe insurance (Jaffee and Russell 1997). To be sure, as Heal and Kunreuther (2007) point out, \$10 billion in coverage is well short of the estimated \$100 billion plus in losses that would be caused by a reactor meltdown in a populous state. Nevertheless, an examination of the PA Act establishes a point sufficiently important that we might consider it a general principle of catastrophe insurance: *No matter how large the aggregate loss, private capital can be induced to flow into any line of insurance so long as the price is right and individual company losses can be limited.*

Heal and Kunreuther (2007) also suggest that the U.S. government would likely intervene if losses exceeded the \$10 billion coverage limit. The annual actuarial cost to the government of extending this additional coverage represents an implicit subsidy from U.S. taxpayers to the nuclear reactor industry.¹⁹ Heyes and Heyes (2000) estimate that the annual subsidy per nuclear reactor is about \$2.3 million, or an aggregate annual subsidy (for 104 reactors) of \$239 million. It is also worth noting that the PA Act does not try to apply risk-based pricing, and thus provides no incentive for operators to invest in mitigating nuclear reactor risks. To be sure, the U.S. Nuclear Regulatory Commission (NRC) sets standards and monitors U.S. reactors for safe operation, so that additional financial incentive might be irrelevant. Heal and Kunreuther, however, suggest that the NRC inspections are inadequate and that price incentives through risk-based insurance would be valuable. More generally, Heal and Kunreuther conclude that more of the nuclear reactor risk “could surely be met through the private sector.” Nevertheless, Geoffrey Rothwell (2002), a longtime observer of the PA Act, has observed that—despite its failings—no better alternatives were readily available.

9.2.3 Estimating the Likelihood of a WMD Terrorist Attack

The insurance industry cites imprecision in the estimated likelihood of a WMD attack as a second reason why these risks are uninsurable. For example, former Senate Majority Leader William Frist suggested in 2005 that a biological attack in the next ten years was all but certain.²⁰ On the other hand, there are experts who point out that such extreme estimates have little scientific underpinning. For example, Mueller (2007) points out:

Even with the September 11 attacks included in the count, however, the number of Americans killed by international terrorism over the period [1975–2003] is not a great deal more than the number killed by lightning—or by accident-causing deer or by severe allergic reactions to peanuts over the same period. In almost all years the total number of people worldwide who die at the hands of international terrorists is not much more than the number who drown in bathtubs in the United States—some 300–400.

The absence of objective analysis is of particular concern given human beings’ well known tendency to overestimate the probability of easily imagined events. As Tversky and Kahneman (1973) have noted, decision makers are frequently subject to an “availability bias,” which causes them to link ease of imagining with a higher judged probability, even when there is no actual correlation. (See also Sunstein 2003.) For example, the effects of a terrorist nuclear bomb attack are readily imagined based on film footage of actual nuclear bombs. To overcome this availability bias, data that quantify the objective likelihood of such attacks must be obtained and analyzed. Such data would measure both the desire of terrorists to obtain such weapons and their ability to do so.²¹ Similarly with respect to bioterrorism, Leitenberg (2004, 2005) has noted that an analysis of bioterrorist risks must evaluate the actual ability of terrorists to mass deliver a toxic agent.²²

Clearly, as economists, we do not possess the expertise to sort through these various viewpoints. But, then, neither do private insurance companies. This means that the risk is not amenable to precise probability calculation and becomes “ambiguous” in the sense of Ellsberg 1961. It is well known that insurers are “ambiguity averse” (Hogarth and Kunreuther 1989; Kunreuther, Hogarth, and Meszaros 1993), preferring to insure risks with known actuarial probabilities compared to risks where it is difficult to determine the likelihoods.²³ When we add to this the fact that insurance executives may also suffer from availability bias and overestimate the likelihood of attack, insurers’ claim that CBRN risks are uninsurable becomes more understandable.

9.2.4 Uninsurability Revisited

These facts make the insurers’ case for excluding WMD risk appear plausible, but, at a deeper level, it is far from clear what principle of profit-driven insurance makes

this particularly ambiguous and large risk uninsurable. After all, private insurers currently underwrite conventional terrorism risk, and although the federal government does backstop the largest losses, a private insurer such as AIG still has exposure to terrorist loss in excess of \$3 billion.

It is particularly puzzling why any individual insurer would cite aggregate maximum loss as an argument for not taking at least some part of the risk. Profit driven insurance companies are free to limit their total exposure on any one class of risk to any amount they wish. In addition (up to state regulatory constraints) they are free to raise the quoted premium to any level that they feel compensates them for any ambiguity in the underlying probability. This suggests that private insurers should be willing to underwrite at least some amount of WMD terrorism risk. To be sure, the total supply available from the private sector may still fall short of total demand, but the standard reaction of private insurers has been to exclude all WMD terrorism risk, not just to limit the insured amount. We have already noted that the pattern of complete withdrawal from the catastrophe lines of insurance following a large loss is well established and is certainly not unique to WMD coverage.

9.3 Policy Options for Creating Viable WMD Terrorism Insurance in the United States

The discussion so far has documented the important value that derives from making insurance available to cover the losses that could be created by either conventional or WMD terrorist attacks. It has also shown that the U.S. property and casualty insurance industry is firmly set against providing coverage for even conventional terrorism risks in the absence of government support, not withstanding the view of the current authors and other commentators that terrorism risks should be insurable by the private U.S. industry.

Given that TRIPRA has extended government presence in this industry through 2014, it seems reasonable to ask what the most effective form of this intervention might be. We focus in particular on the most effective means for the government to support a private market for insuring WMD terrorist risks, a coverage that is basically unavailable today. Our discussion begins with the evidence showing that, given a choice, private insurance markets are generally preferable to government programs. We then consider two specific concerns with government programs, namely that they may crowd out private market activity and that they provide limited mitigation benefits. We also consider the potential for funding private markets for terrorism insurance with financial market capital. Finally, we describe and evaluate a variety of alternative strategies that government could use to support private terrorism insurance markets.

9.3.1 Private vs. Government Insurance Markets

The risk-sharing benefits of insurance intrinsically require a social undertaking if not by private groups then with the government. Thus, when private insurance markets fail, individuals and firms are quick to petition the government to fix the failure, even if this means that the government becomes the insurer. But there are also long-standing objections from economists who point out that government insurance is likely to be less efficiently provided than comparable private coverage (Priest 1996). We now review some key aspects of this debate in the context of WMD terrorism insurance.

In broad outline, insurance markets must provide contract design, premium setting, policy sales and marketing, claims adjustment, and reinsurance. We can look to existing government insurance programs to evaluate how well the government succeeds in carrying out these various functions. The specific government programs we consider are the California Earthquake Authority, the Florida Hurricane Fund, the Federal Housing Administration mortgage loan program, the National Flood Insurance program, and finally TRIA.

Contract Design The government generally performs poorly when it designs insurance contracts. For example, the California Earthquake Authority (CEA) was created to provide coverage for homeowners after many insurers withdrew their coverage in the aftermath of the Northridge earthquake.²⁴ Prior to Northridge, about 36 percent of California homeowners elected the optional earthquake coverage that must be offered in the state. Now, after more than 10 years under the CEA plan, about 12 percent of California homeowners maintain earthquake insurance with the CEA (Zanjani 2006). Homeowners commonly cite high deductible limits and other limitations as reasons for passing up CEA policies. To be sure, other factors are also at work here, including the common perception that the premiums are too high, but all of them point to overall contract design and marketing failures by CEA.

Premium Setting Most government insurance plans are required to set “actuarially determined” premiums, with the intent that premiums should be risk-based so that the plans should at least break even over time. This is true, for example, of the California Earthquake Authority (CEA), the National Flood Insurance program (NFI), and the FHA mortgage insurance plan. The terrorism risk plan, TRIA, is actually an exception in that reinsurance is provided free of charge. Nevertheless, the CEA, NFI, and FHA programs have all failed to reach the goal of actuarial- and risk-based premiums. The problem is that political reality inevitably intrudes, creating pressure both to subsidize premiums and to eliminate any risk-based variations. As an

example of subsidized premiums, the National Flood Insurance program recently required a congressional appropriation in excess of \$20 billion as a result of its Katrina losses, an amount about equal to the premiums (net of operating expenses) collected by the program in the approximately fifty years of its prior existence. We have already pointed out that the TRIA program, which provides terrorism reinsurance at no cost, also fails to create risk-based premiums.

Policy Sales and Marketing Government insurance plans can perform acceptably well in policy sales and marketing, but only because they outsource this function to private market agents. This is necessarily the case for the TRIA and Florida Hurricane reinsurance plans, where the retail insurance policies are sold by the market's primary insurers. But it is also true for the California Earthquake Authority, National Flood program, and FHA mortgage plan where the government is the primary insurer: in each case, policies are sold by authorized private market agents, who then transfer the risk to the government plan.

Claims Adjustment The situation here is the same as policy sales, namely that most government plans outsource this function to private market insurers.

Reinsurance Reinsurance might be considered the least intrusive of government insurance activities, since the programs become active only when claims are filed, which should be an infrequent event. And indeed, no claims have been registered under TRIA. The Florida Hurricane Fund, however, has been less fortunate: as shown in table 9.3, Florida has suffered three of the most costly natural disasters in U.S. history since 2004: Hurricanes Katrina, Wilma, and Charley. These disasters wiped out the fund's reserves, forcing Florida to use public money to cover the losses. Once again, a government plan has ended up subsidizing insurance costs, especially in the most disaster-prone coastal areas.

9.3.2 Will Government Terrorism Insurance Crowd Out Private Markets?

The TRIA legislation provides free reinsurance with respect to both conventional and WMD terrorism risks. This has raised concern that TRIA will crowd out any attempts to create a viable and independent private market for terrorism insurance. In fact, the 2002 TRIA legislation anticipated this issue and was explicitly designed to be temporary:

The United States Government should provide temporary financial compensation to insured parties, contributing to the stabilization of the United States economy in a time of national crisis, while the financial services industry develops the systems, mechanisms, products, and programs necessary to create a viable financial services market for private terrorism risk insurance (§101.a.6).

However, when the 2002 Act reached its sunset date in December 2005, it was extended for two years by TRIEA, and has now been extended for a further seven years. Given that it is no longer viewed as a temporary program, it seems appropriate to evaluate the concern that TRIA and similar reinsurance legislation will continue to crowd out private activity, thus making a return to a private system of terrorism insurance impossible.

To demonstrate a claim of crowding out, it must be shown that the private market would have operated in the absence of the government action, and that the private market fails when the government program is present. With respect to the former factor, it seems clear that private industry was simply unwilling to provide terrorism coverage from the September 11 attack continuing through the passage of TRIA in November 2002. Moreover, as just indicated, TRIA was explicitly cast as a temporary measure, with the clear goal of stimulating the private market's recovery. For this reason, there is no basis for a charge of crowding out during this period. TRIEA, which extended TRIA in December 2005, raised more serious concerns. Here too, however, careful studies by the U.S. Treasury, General Accountability Office, and Congressional Budget Office all supported a general conclusion that the private market for terrorism was still not viable, and that the TRIA extension was in the public interest.

The extension of the legislation through 2014, however, amounts to a de facto recognition that, at least for the foreseeable future, there is no hope for a sustainable, purely private, terrorism insurance industry. This raises the question of how much of this market failure is due to TRIA itself. Here, the most worrisome aspect for crowding out is that the government reinsurance is provided gratis. There is no way, of course, that private reinsurance markets can compete with a free government program, and in this sense the government program is creating a self-fulfilling basis for its own existence—a hallmark of crowding out. On the other hand, TRIA's deductible and coinsurance requirements still force private industry to hold a substantial part of the first-loss components of the overall terrorism risk. For this reason, crowding out has at least been avoided in the lower tier of terrorism risk. It is very important, however, that this private market activity be sustained in future government programs.

9.3.3 Capital Market Resources to Fund Catastrophe Insurance

After the failures of the Florida hurricane insurance market in 1992 and the California earthquake insurance market in 1994, it became evident that financial markets could potentially revive private catastrophe insurance markets by providing a direct and dependable source of capital for both primary insurers and reinsurers. Indeed, since one of the primary purposes of reinsurance is to provide capital to direct

insurers, it is even possible that capital from financial markets could replace reinsurance firms—who had proven unreliable partners exactly when they were most needed—completely. It was also hoped that the financial markets would prove a deep source of capital, since even catastrophic losses of \$100 billion should be manageable when compared to a stock market in which daily losses of a trillion dollars are not uncommon. Finally, it was noted that catastrophe risks are not correlated with the macroeconomic and financial risks that dominate investor portfolios and that financial market investors would see this as a particularly valuable feature.

Markets have responded to these arguments by developing *insurance linked securities*, with *catastrophe bonds* the most active example for catastrophe risks. The concept is modeled on securitization as first developed in the U.S. mortgage markets, and has now expanded to cover business and consumer loans as well as a wide range of corporate risks. The first step is to transfer risks to a special purpose vehicle (SPV). The SPV in turn transfers risks to financial market investors like hedge funds. These investors earn an annual fee for bearing the risk (comparable to the premium paid to a reinsurance firm), but must indemnify the issuer for the losses created if and when the catastrophic event occurs. (There are, of course, many details, but this is the main idea. Interested readers should consult Guy Carpenter & Co., and MMC Securities 2007, as well as Helfenstein and Holzheu 2006 for further discussion.)

Figure 9.2 shows the expansion in the catastrophe bond market since 1997. While growth has been steady, the about \$8.5 billion in outstanding bonds through year-

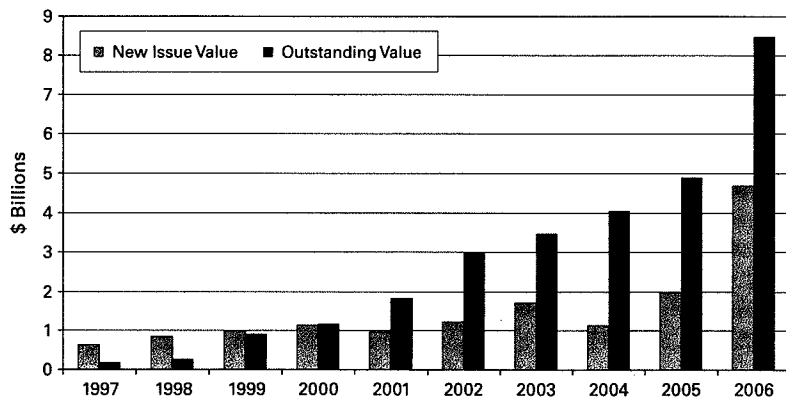


Figure 9.2
Catastrophe bonds: New issues and outstanding

end 2006 represented only about six percent of the corresponding volume of traditional reinsurance. The main reason is that, based on the relatively low level of natural disaster losses after the early 1990s (compare figure 9.1 prior to Katrina), reinsurers have steadily returned to the market with competitive coverage offers.

Figure 9.2 also shows that new issues of catastrophe bonds expanded rapidly in 2005 and 2006, as insurers used the financial markets to replace exiting reinsurers as a source of capital. This new capital, however, came at a price. Figure 9.3 shows that the cost of this capital, measured as the interest rate paid relative to LIBOR,²⁵ rose dramatically in 2005 for wind related risks. This suggests that the reinsurance industry remains a fickle source of catastrophe risk capital: when times are good, reinsurers are active; but when major disasters strike, they withdraw, leaving the financial market as the principal, albeit costly, capital source for the primary insurers.

Of all the insurance-linked securities and catastrophe bonds measured in figures 9.2 and 9.3, only one is directly related to terrorism and a second set covers mortality risk of which terrorism is one possible source (the rest only cover natural disaster risks). The direct terrorism bond was called Golden Goal Finance and covered cancellation risk for the 2006 FIFA World Cup football tournament from terrorism and

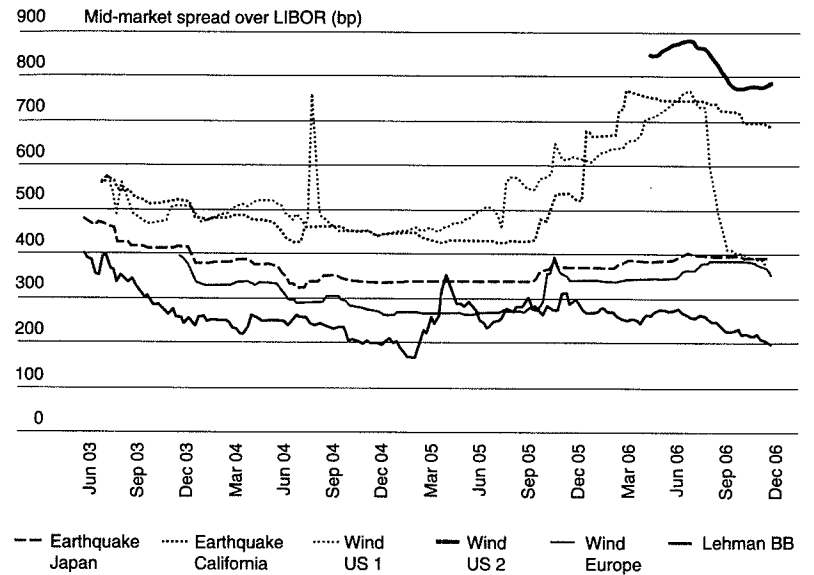


Figure 9.3
Catastrophe bond yields relative to LIBOR

some lesser hazards. The second set is a series of three bonds issued by Swiss Re (Vita Capital I, II, and III), which cover excess mortality risk from pandemics along with terrorism and natural catastrophes. No securitizations issued so far have covered terrorism risks to U.S. property.

Thus, despite fifteen years of quite positive experience with funding natural disaster risks, capital market investors remain wary of investing in conventional, not to mention WMD, terrorism risks. The primary issue seems to be informational, i.e., that capital market investors feel even less secure than primary insurers and reinsurers in evaluating the expected losses from the various conventional and WMD terrorism risks. Additionally, investors may expect terrorism attacks to have greater negative effects than natural disasters on the stock market and macroeconomy, so that terrorism risks offer investors smaller diversification benefits compared to natural disaster risks.²⁶ There is, furthermore, limited demand by the insurers and reinsurers to transfer conventional terrorism risks, and essentially no demand to transfer WMD terrorism risk (since almost no coverage is being offered in the primary markets in the first place). The demand to transfer conventional terrorism risks could, however, rise as more coverage is provided by the primary insurers and as TRIA deductibles and coinsurance rise over time. And were new legislation to require insurers to “make available” WMD terrorism coverage, then the demand to transfer WMD risks would also rise, perhaps dramatically.

9.3.4 Government Terrorism Insurance and Mitigation Activity

We noted at the outset of this chapter that mitigation incentives were a primary benefit of insurance, assuming that the insurance is provided on the basis of risk-based premiums. We now focus on how providing insurance for WMD terrorist risks affects the incentives for private parties to mitigate the likely losses from such attacks. For a variety of reasons, the picture is mixed.

Risk-Based Premiums Insurers set the premiums charged to policyholders based on their expected losses, including the cost of reinsurance. Reinsurance under TRI-PRA, however, offers no incentive for risk-based pricing, since the government’s coverage is provided without charge on all risks. Private insurers and reinsurers, on the other hand, do use risk-based pricing to the extent that their expected losses differ across properties and coverage. Risk-based pricing provides an incentive for policy holders to mitigate their risks, although their ability to do so may be limited (see the next items).

Building Size and Location Large trophy buildings in the centers of major cities are likely to be the favored terrorism targets, but it is clearly not possible to change

the size or location of existing structures.²⁷ New construction will respond to the incentive to create a less tempting target, but given the extended durability of existing structures, it will take decades to achieve a pervasive effect. The CBO (2007) also points out that moving business activity out of central city locations will eliminate the benefits of agglomeration, which was a common reason for forming cities in the first place. In other words, moving activity to smaller buildings away from the center city has its own costs.

Mitigation Actions Beyond size and location, all structure owners can take actions to reduce the likelihood of a terrorist attack or else to reduce losses if an attack occurs. For example, checking the bags of all who enter a building, and similar precautions, may reduce the likelihood of a successful bomb attack. Similarly, better air circulation and purification systems may reduce the effects of various biological, chemical, and radiation attacks. To the extent that insurers use risk-based insurance premiums, landlords would have an incentive to carry out such mitigation. However, no amount of private mitigation may be able to provide protection against extreme WMD attacks like a nuclear bomb. Both Carroll et al. (2005) and CBO (2007) also comment that the cost of carrying out terrorism risk mitigation often exceeds the likely savings from lower premiums.

The Social and Private Benefits of Mitigation Risk-based insurance premiums give landlords a private incentive to mitigate. However, this private benefit can exceed the social benefit. The problem is that terrorists are strategic, and will redirect their attacks to the least protected structures. Thus, while landlord A may act to reduce the losses from an attack on her building, her actions may raise the likelihood of an attack on the building of landlord B. Of course, this will raise the incentive of landlord B to mitigate, and so on throughout the city. Because landlord A does not internalize the costs imposed on landlord B, this leads to too much mitigation from society’s standpoint. In practice, of course, other factors—notably the free reinsurance provided by the TRIA program—limit incentives to mitigate. For this reason, it is not clear whether the current overall system creates too much or too little mitigation.²⁸

Liability as an Alternative to Insurance as an Incentive to Mitigate A recent study by Lakdawalla and Talley (2006) discusses landlord liability as a mechanism for encouraging mitigation that is separate and distinct from risk-based premiums.²⁹ The basic idea is simple enough: if negligent landlords expect to be held liable for losses that their tenants suffer in an attack, then they will invest in an appropriate level of deterrence. However, the resulting system of awards turns out to be

counterintuitive, often prescribing damages payments from seemingly unlikely defendants to equally unlikely plaintiffs. For example, an individual walking past a building suffering a terrorist attack might be required to pay damages to the landlord if the volume of nearby street traffic helped make the building a target. The authors therefore conclude that the tort system is an unlikely mechanism for implementing mitigation incentives and end by endorsing insurance, perhaps coupled with direct compensation to victims, as a more effective mechanism.

The impact of the tort system can be seen in two cases we discussed earlier, the nuclear reactor industry and the development of ultralarge oil tankers. In the former case, the perceived liability was so large that the industry was unwilling to build and operate reactors until government passed legislation creating an insurance pool and capping overall liability. In the latter case the insurance premiums required to cover possible environmental claims exceeded the benefits of larger tankers, which were then cancelled.

9.3.5 Alternative Strategies for Government Intervention

We now consider some alternative policies for stimulating the provision of private WMD terrorism insurance in the United States. We start with a discussion of the permanent renewal of a TRIA-based policy, in which the government continues to provide reinsurance for the top tiers of the terrorism risks, but with a proposed expansion of the "make available" requirement to include WMD terrorism risks. Although this is the most likely form for congressional action, at the end of this section we also survey alternative policy options that have been proposed and appear worthy of continuing consideration.

Extend TRIA and Expand the "Make Available" Clause to WMD Terrorism The most immediate strategy for creating a viable supply WMD terrorist coverage in the United States is to rewrite TRIPRA so that the "make available" clause applies to conventional and WMD terrorism risks alike. This solution, however, is strongly resisted by the insurance industry. For example, the Aon Corporation made the following key points as part of a lengthy contribution to the U.S. Treasury and President's Working Group on Terrorism Insurance:

- WMD losses present "a potential for insured loss exposure in excess of the TRIA annual aggregate reinsurance capacity of \$100 billion."
- WMD losses threaten to expand "deductible and coinsurance exposures."
- The (re)insurance industry views WMD event exposure as a "company killer" (Aon Group 2006).

Because Aon's viewpoint is so typical, it is worth examining in more detail. In the first place it is difficult to see why the addition of WMD risks poses a risk of expo-

sure beyond the \$100 billion cap. Under current TRIPRA provisions, the maximum for a private insurer's losses is equal to the company's deductible plus 15 percent of its aggregate losses up to \$100 billion. This is true whether the loss is due to a conventional or a WMD terrorist attack, so adding WMD coverage cannot increase insured losses above the \$100 billion limit.

On the second point, Aon is right to note that the addition of WMD liability would raise the probability of loss, and hence the company's expected loss, below the \$100 billion cap. On the other hand, insurers would presumably charge additional premiums to cover the expected additional risk. This means that net expected profits could be higher when WMD coverage is provided.

In any case, it would not be difficult to craft legislation to address industry's specific concerns. For example, new legislation could recognize two forms of terrorist attack, conventional and WMD. If the attack was certified to have used WMD, then it could be assigned lower deductible and coinsurance requirements than for a conventional attack. Such changes would moderate the industry's maximum loss from a WMD terrorist event, and allow a satisfactory apportionment of risk between the public and private sectors.³⁰

Since 2001, the financial situation of insurers has improved markedly, their protests to the contrary, so that requiring them to cover WMD risk with a \$100 billion cap (\$65 billion after taking the deductibility of losses for tax purposes) would be a far less burdensome task today than it was when TRIA was enacted. Indeed, private workers compensation insurers already provide WMD terrorism coverage and are supported by the TRIEA backstop. We turn now to the special issues raised by this line of insurance.

The Special Problem of Workers' Compensation The workers' compensation line of insurance raises special issues with regard to WMD attacks. The problems are unrelated to insurance principles, but instead reflect the special history of workers' compensation insurance in the United States (Moss 2002). In the early twentieth century, the number and intensity of work stoppages in response to on-the-job injuries were becoming ruinous for management and workers alike. This led to a compromise solution in which workers gave up the right to sue employers for job-related injury, while employers accepted a duty to purchase workers compensation insurance without any exclusions.

The absence of exclusions for workers' compensation has forced private insurers to provide WMD terrorism coverage, notwithstanding their claims that such risks are "uninsurable." As table 9.5 shows, the exposure to this line is significant: workers' compensation losses in an attack on New York City could amount to \$483 of the total projected \$778 billion loss, and in all four cities workers' compensation would account for more than 50 percent of the total loss. Conventional

and WMD terrorist attacks would also distribute losses quite differently between personal lines (such as workers' compensation and life insurance) on the one hand and business and property damage on the other. For example, as shown in table 9.2, less than 9 percent of the total losses from the conventional September 11 attack were related to the personal lines. WMD attacks, in contrast, would be expected to create exceptionally large losses for the personal lines including life insurance and workers' compensation.

The size of workers' compensation WMD exposure is not small. If a company in the District of Columbia (where the death benefit is worth approximately \$1.8 million) were to lose 300 employees as a result of a terrorist attack, the total claim would reach \$500 million (NCCI 2006). However, not all of this falls on the private sector. In four states and two territories,³¹ workers' compensation insurance is provided by a state-run monopoly, and in thirteen other states a not-for-profit state enterprise competes with the private sector.³² Still the private sector's exposure is significant. In California, for example, the share of the risk taken by private insurers rose rapidly between 2005 and 2006 (from 58 to 69 percent) and the state is actively campaigning to expand the private market even further.

Since private insurers voluntarily accept their exposure to WMD risk in the workers' compensation line, extending future TRIA legislation to expand the "make available" requirement would appear feasible.

Government Pricing of Terrorism Insurance An important criticism of the TRIA legislation is that the terrorism reinsurance is provided without charge.³³ A common response is that pricing terrorism risk is a difficult task for private insurers and well beyond the ability of the government. Priest's (1996) analysis, however, suggests a more realistic answer, namely that government insurance invariably becomes subsidized insurance. Nevertheless, it behooves proponents of risk-based pricing of government insurance to provide a reasonable mechanism.

Lewis and Murdoch (1996) and Cummins, Lewis, and Phillips (1999) offer a solution in which the government would auction a fixed amount of reinsurance contracts to private market insurers and reinsurers. The contracts would obligate the government to indemnify the insured party for any losses created by the insured event. The experience gained in designing catastrophe bonds (section 9.3.3), would provide a practical template for such contracts. The proposed auction would identify the proper market price for the reinsurance coverage, and would also ensure that the contract was awarded to the entities for which it had the greatest value, that is, the highest bidders. The program would also be self-financing in the sense that the premiums determined in the auction should equal the expected losses. Of course, the actual losses in any year could exceed the expected losses, but good for-

tune should be equally likely and the government should break even over time. Finally, the mechanics for such government auctions could be readily developed by following, for example, the methods already used to auction Treasury bills and bonds.³⁴

Lender (Not Insurer) of Last Resort TRIA and related proposals that provide a government backstop for terrorism insurance basically enlist the government as the *insurer of last resort*. However, the fundamental market failure that requires government intervention occurs in the *financial*, not the *insurance* markets. That is, the primary concern of insurers is how they can access sufficient capital to pay for catastrophic losses if and when they occur. Obtaining access to capital is fundamentally a financial problem: indeed, we have seen under TRIA that industry proceeds rapidly and efficiently with the work of an insurer—that is, designing contracts and underwriting policies—as soon as it is confident of a capital backstop. This suggests that government could quite possibly backstop terrorism insurance markets by acting as the lender, instead of the insurer, of last resort.

Acting as the lender of last resort, of course, has been the core activity of central banks for hundreds of years. Central banks adopted this method to stop bank runs and thereby protect the stability of the commercial banking system. The need for central banks to provide liquidity to the financial system is long established, although it should be recognized that it reflects a financial market failure; otherwise, a bank in need of liquidity would just sell some of its assets to the "market," and there would be no need for the government/central bank to intervene.

In this sense, problems caused by a liquidity crisis in the banking system and catastrophe insurance disruptions have a common source, namely a lack of ready capital. Of course, there are differences. A solvent bank facing a bank run has a balance sheet with sound, pledgeable, assets such as bonds and loans. The existence of these assets allows the central bank to act as the lender of last resort without putting itself at any serious financial risk. An insurer, however, having paid out its reserves after a catastrophe, has no such accumulated assets to discount. This difference, however, is one of degree and not kind. Just as certain events create a flight to quality among potential providers of liquidity to banks, so do certain events create a liquidity crisis for catastrophe insurers. Though made in the context of banking, the following recent statement by a former chairman of the Federal Reserve System applies equally to catastrophe insurance:

Policy practitioners operating under a risk-management paradigm may, at times, be led to undertake actions intended to provide insurance against especially adverse outcomes. . . . When confronted with uncertainty, especially Knightian uncertainty, human beings invariably attempt to disengage from medium to long-term commitments in favor of safety and

liquidity. . . . The immediate response on the part of the central bank to such financial impositions must be to inject large quantities of liquidity (Greenspan 2004).

The lender of last resort scheme discussed here has many details requiring further attention, but it is of some interest that a scheme with many of these features has recently been instituted by the state of Florida. (Interested readers should consult Jaffee and Russell 2007b.)

9.3.6 Global Responses to the WMD Problem

Terrorism is a global problem and some form of government support for terrorism insurance exists in many countries. Prior to September 11, countries such as the United Kingdom, Israel, South Africa, and Spain had already experienced terrorism attacks, and in these countries, government programs were already in place to support private markets. The attack on September 11 caused many other countries—for example, France, Germany, and Australia—to put in place their own government programs. (Interested readers can find a review of these programs in Guy Carpenter & Co 2007.) WMD risk is handled in different ways in different countries. Here is a brief list:

United Kingdom In the United Kingdom, the government-supported terrorism reinsurance pool, Pool Re, makes no distinction between conventional and WMD risk (a nuclear exclusion was deleted in 2002). The UK also has a sizable private market in which WMD risk is typically excluded.

France In France the government terrorism insurance scheme GAREAT excluded nuclear attacks until 2006. Today, WMD risk is treated no differently from conventional terrorism.

Germany In Germany WMD risk is excluded from the government terrorism scheme Extremus.

Australia In Australia the government run reinsurance pool ARPC includes chemical and biological loss but excludes nuclear.

As this list shows, experience with WMD risk varies from country to country, but as the UK and French examples show, several public programs currently include WMD risk.

9.4 Conclusion

Although experts disagree on how close terrorists are to having a WMD capability, there is no disagreement on how avidly such weapons are sought. And if they were available, there is little doubt that they would be used. For this reason, the continued exclusion of WMD risks from property insurance contracts under TRIPRA is

a matter of significant concern. It is not credible to argue, as many insurers do, that WMD risk is “uninsurable” when, as we have seen, providers of workers compensation routinely provide this insurance. The workers compensation insurers must find the government backstop sufficiently reassuring to continue to offer this coverage.

The problem is property casualty insurance. Even though, as we have seen, the total after-tax loss to the property insurance industry under TRIA cannot exceed \$65 billion, and even though total reserves exceed \$500 billion, the industry continues to claim that adding WMD risk would threaten it with bankruptcy. But as we have seen, this argument can always be addressed by adding special provisions that reduce the industry’s burden. Requiring insurers to add WMD risk would seem by far the simplest fix.

Going forward, the TRIA arrangement has been renewed for another seven years despite the fact that insurance companies have had ample time to recover from September 11 and the likelihood that free reinsurance will only induce further dependence on government largesse. Congress’s failure to include CBRN events in the “make available” requirement, however, means that special attention must be paid to the WMD issue, particularly as it relates to workers compensation. Removing the loss cap could force private workers compensation insurers to abandon the line. This, in turn, would force government to intervene so that the burden still fell on the public sector. Including WMD risks in future government schemes can avoid this result.

In concluding, we propose a simple rule the government could adopt as a guide to providing efficient and effective terrorism insurance: *When intervening in terrorism insurance markets, government plans should mimic as closely as possible what operative private markets would have done.* Following this rule would encourage the designers to resist government subsidies and to endorse risk-based premiums.

Notes

1. Technically, a CBRN attack need not be massive; for example, in 1984 members of the Rajneeshsee cult poisoned a few salad bars in Oregon. However, the focus of this chapter—and most of the CBRN insurance literature—is on massive attacks. It has also been suggested that a nuclear attack is of a different kind compared with the other CBRN modes; we address special issues associated with nuclear attacks in what follows.

2. The events were Hurricane Andrew in 1992, the Northridge earthquake of 1994, and the September 11, 2001, terrorist attack. The private market for flood insurance in the United States broke down after disastrous floods along the Mississippi River in 1927 and a federal program has provided most U.S. flood insurance since then.

3. Arrow (1965) shows that deductibles, in which insured parties are indemnified only for losses above some limit, represent the optimal form for partial insurance. Deductible policies are preferable to coinsurance policies, in which the insured party is indemnified for a fixed percentage of all losses, because they allow full recovery above the deductible limit. This is the same range of losses in which insurance provides the greatest benefit.
4. The incentive for a firm to purchase insurance is reduced, and may vanish, when the firm is owned by a large number of individual investors, each of whom owns an infinitesimal share of the firm and holds a diversified portfolio of such securities (Smith 2005). In practice, concern with the costs of bankruptcy, the incentives of managers (as opposed to those of shareholders), and tax effects combine to cause most firms to purchase insurance against a wide range of risks (Jaffee and Russell 2006).
5. A related problem is that catastrophe losses tend to be geographically concentrated and to have a simultaneous impact on several insurance lines. This makes it difficult for insurers to maintain a diversified risk portfolio (GAO 2006e). Furthermore, the large fixed costs of entry into a catastrophe line—to create underwriting skills, marketing ability, and claim resolution facilities—make it uneconomic for an insurer to maintain a diversified portfolio by taking on just a small amount of risk in each catastrophe market.
6. However, Warren Buffett, whose firm Berkshire Hathaway now owns a range of insurance and reinsurance firms, has taken a different tack. Buffett's firm has at least twice put its sizeable capital at risk to take on catastrophe risks, once taking on earthquake risk after the Northridge earthquake and more recently, in 2006, taking on hurricane risk the year after Katrina. In both cases, Berkshire Hathaway prospered because the insured events did not occur.
7. There is a well developed literature on "ambiguity aversion" which shows that, in practice, individuals shy away from taking gambles when the true odds of the events are hard to determine. See Ellsberg (1961) for the behavioral evidence and Hogarth and Kunreuther (1989) for an application to insurance markets.
8. The private market for flood insurance in the United States broke down even earlier; most U.S. flood risks have been covered by the federal National Flood Insurance (NFI) program since 1968. The NFI program faced a \$20 billion deficit following Hurricane Katrina. Flood insurance is similarly a government responsibility in most other developed countries, although it appears that England has maintained a unique public/private partnership for insuring floods (Jaffee 2006).
9. Anecdotes also circulated concerning policy terminations or enormous premium increases on policy renewal. For example, it was reported that prior to September 11, O'Hare airport in Chicago paid a \$125,000 annual premium for \$750 million of terrorism coverage. When it renewed after September 11, it was required to pay \$6.9 million for just \$150 million of coverage (Zanetti, Schwartz, and Lindemuth 2007). Other entities, including NFL football teams, could not obtain any coverage at all. Tenants in landmark buildings also found reason to move into less likely targets as their leases ran out. Abadie and Dermisi (2006), for example document how vacancy rates in three Chicago trophy buildings, including the Sears Tower, rose relative to other Chicago office buildings.
10. The value of U.S. nonresidential construction did fall by about \$100 billion (at annual rates) or about 6 percent from 2001-Q2 to 2002-Q3. Nonresidential construction activity,

however, had fully recovered by 2002-Q4 while residential construction activity rose steadily throughout the period. GNP also rose steadily over this period, albeit at a relatively slow rate.

11. TRIA relates only to specific lines, including most commercial property and casualty insurance and workers compensation. It does not relate to health, life, malpractice, commercial auto insurance, or various other lines.
12. The \$100 million TRIEA trigger avoids a strategic gambit in which an operating company could create its own "captive" insurer to obtain low-cost TRIA indemnification if the firm were attacked. The \$100 million loss trigger is meant to preclude indemnification if an attack were to occur against just one such firm.
13. Losses due to fire following a WMD attack would be covered by fire insurance policies in certain states.
14. In the 2007 renewal of TRIA, the question of how best to deal with WMD risks was left for further study. The pros and cons of permanent government intervention in this industry have been extensively debated (Dixon et al. 2007; Doherty et al. 2005; and Jaffee and Russell 2006).
15. In fact, anthrax has been publicly released at least twice, once in 1979 in the Soviet city of Sverdlovsk and again in the 2001 U.S. mailings.
16. The RAND study assumes that all of the buildings are fully insured against an anthrax attack. In fact, the U.S. Treasury (2005) reports that only about three percent of buildings actually have CBRN coverage. This reinforces the RAND study's conclusion that no U.S. taxpayer funds would have been spent to pay TRIA claims from such an event.
17. In his economics Nobel Prize acceptance speech, Schelling (2005) explains the nonuse of nuclear weapons after World War II in part by the concern that the word *nuclear* brings to strategic war analysis. Also note that private insurers had no problem providing Union Carbide with insurance to cover its fertilizer manufacturing plants in India, even though the 1984 Bhopal gas tragedy caused approximately 3,800 deaths and several thousand other permanent and partial disabilities. The final settlement for the disaster totaled \$470 million, of which private insurers paid \$200 million.
18. The result actually recreates an old form of insurance called an "assessable reciprocal mutual."
19. Interestingly, the Nuclear Energy Institute published a fact sheet titled "Price-Anderson Act Provides Effective Nuclear Insurance at No Cost to the Public" in June 2006. The "No-Cost" statement presumably refers to Tiers 1 and 2 that, indeed, are funded by the industry. The article, however, makes no reference to the Tier 3 exemption from any claims above the \$10 billion limit. These will be paid by the "public" either by the individuals directly affected or through government payments funded by U.S. taxpayers.
20. William Frist is quoted as saying that "an inevitable bio-terror attack" would come "at some time in the next ten years." Views like this persuaded the United States to spend more than \$33 billion on bioterrorism countermeasures between 2002 and 2006 (Agence France Presse 2005).
21. Osama bin Laden's desire for such a device has been noted frequently. See, for example, the testimony of Jamal Ahmad al-Fadl, a native of Sudan and ex-bin Laden associate, in the trial of the earlier World Trade Center bombing (*United States of America v. Usama bin*

Laden, et al., 2001). On the other hand, it is clear that even committed nation states such as Iran and North Korea face significant, though as Langewiesche (2007) notes not insurmountable, obstacles in developing and delivering the weapons.

22. For example, the Aum Shinrikyo Tokyo subway gas attack achieved very little, although it was four years in the planning with a generous budget and virtually no monitoring by the Japanese police.

23. It is also sometimes suggested that terrorists are strategic in their choice of targets and that this complicates the process of computing event probabilities (Willis et al. 2005). However, if we can decipher the specific strategy employed by terrorists, then this should actually facilitate the determination of event probabilities. Or, if we cannot decipher the specific strategy, then the distribution of actual events should be observationally equivalent to the types of stochastic processes that Mother Nature employs in creating natural disasters.

24. See Zanjani 2006 for a recent analysis of the California Earthquake Authority.

25. LIBOR stands for The London Interbank Offered Rate. This interest rate is commonly used as the standard against which other interest rates are measured.

26. In technical terms, natural disasters might be considered "zero beta" or "low beta" risks, since they tend to be uncorrelated with other factors that influence stock prices. According to the capital asset pricing model, investors should be willing to pay premium prices to obtain securities with low or zero betas. This argument would not, however, apply to terrorism risks to the extent that they are considered more likely to affect the stock market and macro-economy.

27. The owners of trophy buildings in city centers will face higher premiums for their terrorism insurance, and may also be forced to accept lower rents, in order to keep their tenants from choosing safer locations in buildings that are smaller and/or further removed from the city center.

28. Kunreuther and Heal 2003 discuss a case in which the benefits of mitigation require simultaneous group action, so that if one party fails to carry out his share, the group as a whole has less incentive to mitigate.

29. An even more direct mechanism would be to hold the terrorists liable, but the paper assumes this is not possible.

30. Such an arrangement was part of the House version of TRIPRA (HR 2761) but was dropped from the final legislation.

31. North Dakota, Ohio, Puerto Rico, the U.S. Virgin Islands, Washington, and Wyoming.

32. Arizona, California, Colorado, Idaho, Maryland, Michigan, Minnesota, Montana, New York, Oklahoma, Oregon, Pennsylvania, and Utah.

33. This could only happen in the United States, since comparable plans in European countries all charge a fee. There is an explanation: gratis government reinsurance could be interpreted as an export subsidy, which European Union rules prohibit.

34. A scheme in this general form was proposed in the U.S. House of Representative as H.R. 846, the Homeowners Insurance Availability Act of 2005, but did not pass.