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Authors
Jaffee, Dwight M.
Russell, Thomas

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Responding to WMD Terrorism Threats:

The Role of Insurance Markets

Dwight Jaffee
Haas Business School
U.C. Berkeley
jaffee@haas.berkeley.edu

and

Thomas Russell
Leavey School of Business
Santa Clara University
trussell@scu.edu

1. <u>Introduction</u>

Insurance offers three important benefits that can help an economy deal with the catastrophic losses that arise from both natural disasters and man-made events: risk sharing, mitigation and price discovery. <u>Risk sharing</u> 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 Part 2 of this chapter that insurance plays as important a role in sharing the economic risks created by terrorists attacks using weapons of mass destruction as it is does with the daily risks of automobile driving

<u>Mitigation</u> is a second benefit of insurance, whereby the insurance premiums paid create an incentive for insured parties to take actions to reduce the losses that result from the event. The incentive to mitigate is created by <u>risk-based premiums</u>, whereby each insured party pays a premium commensurate with the risk created. For example, when insurers charge property owners lower premiums if they protect their buildings from terrorist attacks, this provides the owners with an incentive to carry out such mitigation. In contrast, providing insurance <u>without</u> 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 Part 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 because the insurance industry efficiently aggregates 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, Swiss Re (2005, p. 18) notes that the decision to produce ultra-large oil carriers was reversed when insurers indicated the very large premiums that were required to insure the carriers 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 can insurance markets 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 1 shows the world-wide level of insured losses from each of the two categories of catastrophes as compiled by the reinsurance firm Swiss Re. The 9/11 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 us a useful benchmark for how insurance markets for terrorism risks might best operate.

Figure 1: Insured Losses from Catastrophes, Billions of 2006 Dollars
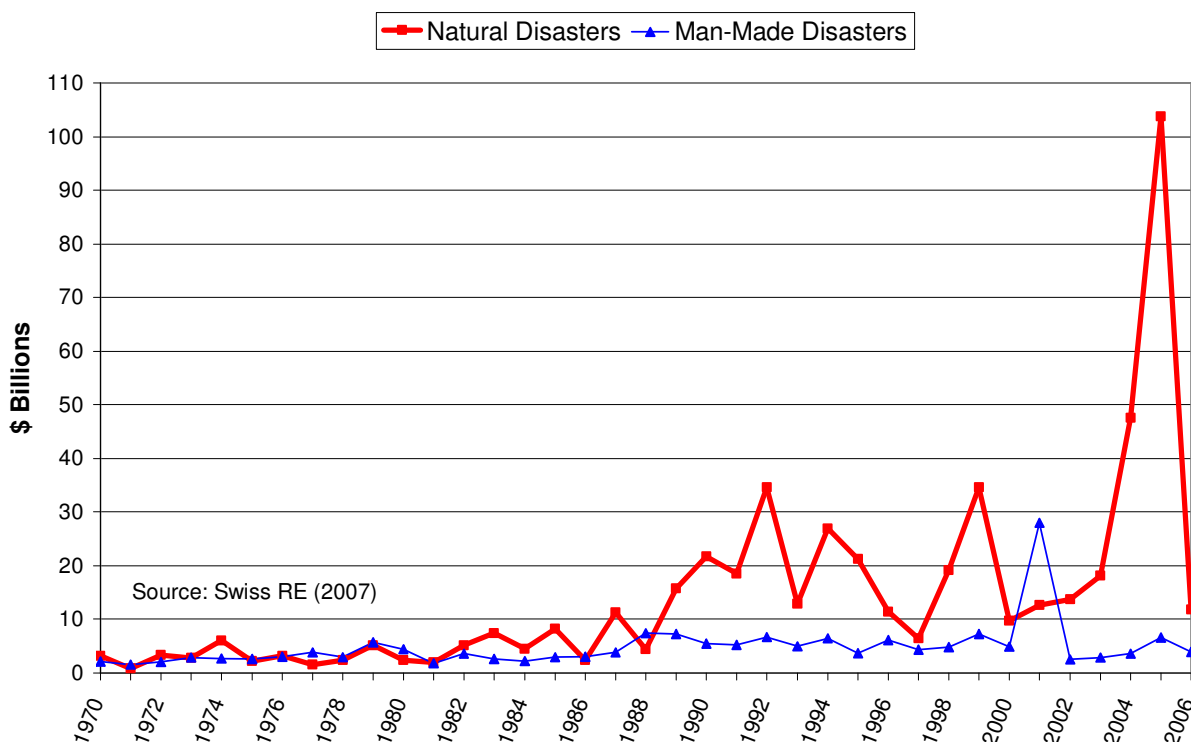
Table 1: Description of NBCR Weapons

Source: Government Accountability Office (2006, p. 5).

	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 of the weapon 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 atoms, or nuclear fusion of hydrogen isotopes.
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 size of the 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.

Notes: For weapon descriptions, see Rand Public Safety and Justice, *Individual Preparedness and Response to Chemical, Radiological, Nuclear, and Biological Terrorist Attacks* (Santa Monica, California: 2003). For examples of biological and chemical agents, see GAO, *Combating Terrorism: Need for Comprehensive Threat and Risk Assessments of Chemical and Biological Attacks*, GAO/NSIAD-99-163 (Washington, D.C.: Sept. 14, 1999). For examples of radiological agents that can be used in dirty bombs, see GAO, *Nuclear Security: DOE Needs Better Information to Guide Its Expanded Recovery of Sealed Radiological Sources*, GAO-05-967 (Washington, D.C.: Sept. 22, 2005).

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 NBCR risks: nuclear, biological, chemical, and radiation. Table 1 provides a summary description of NBCR weapons complied by the General Accounting Office (2006). 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 NBCR attacks.[1]

While insurance is particularly valuable for catastrophic risks, catastrophic risks also raise special issues which often preclude a viable and dependable supply from private insurance providers. In fact, while the U.S. economy once had functioning private insurance markets for earthquakes, hurricanes, and conventional terrorism risks, each of these private markets broke down within the last 15 years 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 the 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 U.S. The chapter is organized as follows. Part

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[1] Technically, a NBCR attack need not be massive; terrorists could poison a single salad bar. However, the NBCR insurance literature is mainly concerned with <u>massive</u> NBCR attacks, which is also the focus of this paper. It has also been suggested that a nuclear attack is really of a different kind compared with the other NBCR modes; we recognize this distinction in the text discussion of the special issues associated with nuclear attacks.

[2] The events were the Andrew hurricane of 1992, the Northridge earthquake of 1994, and the September 11, 2001 terrorist attack. The private market for flood insurance in the U.S. actually broke down as early as 1927 as a result of Mississippi River floods, and a federal program has long provided most U.S. flood insurance.

2 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. Part 3 describes the range of governmental solutions that have been tried or are currently proposed for insuring terrorism risks. Part 4 provides our analysis of the issues and our evaluation of the best means for providing viable WMD terrorism insurance for individuals and firms. Part 5 provides a summary of our conclusions.

2. A Survey of Insurance Principles in the Context of WMD Terrorist Attacks

2.1 The 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% chance of losing $10,000 ($100 = .01 x $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 expect value of the loss; see 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 our text example, 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

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[3] Arrow (1965) shows that deductibles represent the optimal form for partial insurance, whereby the insured parties are indemnified only for those losses that exceed the deductible limit. Coinsurance, whereby the insured party is indemnified for a fixed percentage of all losses, is not optimal. A deductible contract dominates coinsurance because a deductible allows full recovery of all losses above the deductible limit, which is the range of losses where insurance provides the greatest benefit.

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]

2.2 <u>The Costs of the September 11 Attack</u>

Terrorist attacks inflict losses on various insurance lines, including property and casualty, workers compensation, and life insurance. Part A of Table 2 shows how the total insured losses from the 9/11 attack 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 9/11 attack 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 2 shows the support provided by the various forms of federal disaster assistance after the 9/11 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 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 the 9/11 event approach $200 billion.

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[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; see 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; see Jaffee and Russell (2006).

Table 2: Estimated Costs of the September 11, 2001 Attack		
Part A: Insured Losses Source: Hartwig (2006)		
Insurance Category	**Cost, $ Billions, 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%
Total Insured Losses	$35.9	100.0%
Part B. Federal Disaster Assistance Source: Congressional Budget Office (2007)		
Assistance Category	**$ Billions**	**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 & Rescue, Debris Removal	$2.6	8.5%
Total Federal Assistance	$30.5	100.0%
Part C: Total Economic Costs Source Hartwig (2006)		
Geographic Area	**$ Billions**	**Percent of U.S. Total**
New York City Alone	$90	45.0 %
Total U.S.	$200	100.0%

2.3 <u>**The Structure of Insurance Markets**</u>

In insurance markets, policy holders contract directly with <u>primary insurers</u> 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.

<u>Reinsurers</u> are insurance firms that accept and diversify the risks transferred by various primary insurers for a fee. Most of the world's largest reinsurers reside outside the U.S., 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 9/11 attack were paid by reinsurance firms; see Insurance Information Institute (2007a). However, just as the primary insurers exited the terrorism risk line immediately following the 9/11 attack, so did the reinsurers. Indeed, the exit of the reinsurers was the proximate cause of the overall market failure, and therefore any resolution must reactivate the reinsurance market or provide a substitute for it; see American Academy of Actuaries (2006, pp. 4-5 and 12-13).

Capital market investors represent a second set of counterparties to whom primary insurers can transfer those risks that they chose not to hold themselves. <u>Insurance linked securitization</u> (ILS) is the primary mechanism though which both primary insurers and reinsurers transfer their catastrophe line risks to capital market investors. We provide more details on ILS below in Part 4. To date, however, ILS has not succeeded in offsetting the main supply side problems that face the provision of terrorism insurance; see Wharton (2005, Part 10.2).

2.3 <u>The Supply of Catastrophe Insurance</u>

Even facing continuing and 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.

2.3.1 <u>Large Losses Could Bankrupt Insurers and Reinsurers</u>

Catastrophic risks are created by low probability, high consequence, events. Table 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 Swiss Re (2007), when business interruption losses are included, the insured losses from Katrina reach $66 billion, and the total damage created by Katrina is estimated 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.

Table 3: The Most Costly Natural Disasters and Terrorist Acts, by Insured Property 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 U.K., 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 (2007b) and (2007c).			

Among the terrorists acts shown in Table 3, only the losses from the World Trade Center attack of 9/11 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 shall 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% of the total loss. While in principle, insurance companies can accumulate reserves to cover even the worst outcome, a variety of tax, accounting, and profit issues make it uneconomic for them to do so; see Jaffee and Russell (1997).

As of year-end 2006, all property and casualty insurers held $487 billion in capital to cover losses, of which it is estimated that 38 percent or $185 billion could have been transferred to pay terrorism losses; see Insurance Information Institute (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

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[5] A related problem is that catastrophe losses tend to be geographically concentrated and to have a simultaneous impact on several insurance lines, making it difficult for insurers to maintain a diversified portfolios of risks; see GAO (2006). 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.

American Academy of Actuaries (2006, p. 5) estimates that reinsurers currently maintain at most $9 billion in reserves to backstop all terrorism risks, while CBO (2007, p. 20) 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 by 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 (2006), that most insurance managers are unwilling to offer catastrophe coverage because they perceive that taking on such risks exposes their firm to a serious chance of bankruptcy. The obvious desire to avoid bankruptcy is reinforced for those multiline insurance firms that earn a significant share of their profits from non-catastrophe 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 firm.

There may also be a principal-agent conflict between the managers of insurance firms and their shareholders with regard to catastrophe risks. 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, as well as creating losses in the value of any shares and options they hold in their firms. The following quote from Edward Liddy, President of Allstate Insurance, in the <u>Wall Street Journal</u>, September 6, 2005 illustrates this concern:[6]

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[6] An alternative tact, however, has been taken by Warren Buffett, whose firm Berkshire Hathaway now owns a range of insurance and reinsurance firms. 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.

"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."

A final factor for why insurers avoid catastrophe risks is that they face the prospect that rating agencies may downgrade the firm; see GAO (2006, p. 12-13).

2.3.2 <u>The Difficulty of Ascertaining Actuarially Fair Premiums</u>

For catastrophe lines, where by definition the 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. Insurers can still set premiums using the evidence from comparable events, or from models of the risks, but the managers are aware they that they might underestimate the risk, and therefore they 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 the catastrophe insurance lines, it is not uncommon for consumers and the regulators who represent them to feel that the premiums charged exceed the level supported by the actuarial risk and a fair profit. Where they have the power, the regulators may place a ceiling on the allowed premiums.[8] 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.

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[7] There is a well developed literature on "ambiguity aversion," in which it is demonstrated in practice that 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] Interestingly, H.R. 2761, a bill now before Congress to extend the current federal terrorism reinsurance program, provides for a temporary federal override of the power of state insurance commissioners to regulate premiums on WMD terrorism coverage.

2.4 <u>Insurable and Uninsurable Risks</u>

Most insurance providers have long excluded the risks created by acts of war, as well as most nuclear, chemical, biological, and radiation (NCBR) risks, from their policies; see GAO (2006, pp. 15-19). 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 15 years, coverage was readily available for earthquake and hurricane risks as well as conventional terrorist risks. But since then, each of these three major catastrophe lines suffered a major event, following which the supply of coverage from the private market broke down. The events were the Andrew Hurricane of 1992, the Northridge earthquake of 1994, and the September 11, 2001 terrorist attack.[9] 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 following the event; furthermore, for all three lines, the coverage that is available today is primarily the result of government intervention. The lessons from the three examples are very similar; our discussion in the next part focuses on the topic of primary interest here, the availability of WMD terrorism insurance following the 9/11 attack.

3. <u>Insuring Losses from Terrorist and WMD Terrorist Attacks</u>

The day before the terrorist attack of September 11, 2001 and earlier, 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

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[9] The private insurance market for flood insurance in the U.S. 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 just faced a $20 billion deficit as a result of the flood claims arising from Hurricane Katrina. Flood insurance is also a government responsibility in most other developed countries, although it appears that England has maintained a unique public/private partnership for insuring floods; see Jaffee (2006).

possible losses from conventional terrorist attacks to be a significant cost element; see Swiss Re

(2005, p. 10). A further factor that motivated terrorism coverage on commercial structures—

office buildings, shopping centers, factories and warehouses, etc.— was that most lenders

required that "all risks" coverage be maintained on the mortgaged structures, and the convention

was 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; see General Accountability Office (GAO) (2006). State laws also generally

required the inclusion of terrorism risks in insurance policies.

On the day following the 9/11 attack, most major insurers announced they would no longer

offer terrorism coverage on any new property and casualty policies. The insurers also announced

their goal to exclude terrorism risks from workers compensation, although this would have

required changing the state laws, changes which have 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; see GAO (2006).

The exit of insurers from terrorism coverage on September 12 created a panicked reaction in

the construction and mortgage markets, as the participants feared that most new activity in these

markets would end if terrorism insurance were not available.[10] This created an immediate call to

the federal government to provide coverage, one way or another. Interestingly, it took more than

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[10] Anecdotes also circulated concerning policy termination or of enormous premium increases upon policy renewal. For example, it was reported that prior to 9/11, O'Hare airport in Chicago paid a $125,000 annual premium for $750 million of terrorism coverage. At renewal after 9/11, it had to pay a $6.9 million annual premium for just $150 million of coverage; see Swiss Re (2007a, p.6). Other entities, including NFL football teams, simply could not obtain coverage. Tenants in landmark buildings also were motivated to move into less likely targets as their leases ran out. Abadie and Dermisi (2006), for example document how the vacancy rates rose in three Chicago trophy buildings, including the Sears Tower, relative to the changes in vacancy rates in other Chicago office buildings.

14 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. [11] 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 6 months later). A third factor was that some insurers allowed policy holders to renew, but at much lower coverage amounts, which the mortgage lenders accepted as a temporary expedient in anticipation of a forthcoming federal plan. Finally, some states, including New York and California, required insurers to continue to offer terrorism coverage.

3.1 The Terrorism Risk Insurance Act (TRIA) of 2002 and Its Extension (TRIEA)

A response did occur with the Terrorism Risk Insurance Act (TRIA) of 2002, which became law on November 26, 2002, with a sunset expiration planned for year-end 2005. Two weeks before TRIA expired, an extension was passed with the same basic concept but changes in some of the parameters; the Terrorism Risk Insurance Extension Act (TRIEA) has its own sunset set for December 2007. The details of TRIA and TRIEA are complex, but the main points are clear (we quote here the TRIEA values applicable in 2007, but for brevity refer to the combined legislation as TRIA):

1) An act of terrorism, as certified by the Secretary of the Treasury, must have:
   a) been committed on behalf of a foreign entity with the goal to coerce the U.S.;
   b) created damage within the U.S, or at a U.S. government location, plane, or vessel abroad.

   Importantly, TRIA does not apply to "domestic" acts of terrorism.

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[11] The value of U.S. nonresidential construction did fall by about $100 billion (at annual rates) from 2001-Q2 to 2002-Q3, which represented about 6 percent of the activity as of 2001-Q2. Nonresidential construction activity, however, fully recovered by 2002-Q4, and residential construction activity rose steadily throughout the period. The gross national production also rose steadily over this period, albeit at a relatively slow rate.

2) TRIA (Section 103.C.1.b) required that insurers: [12]

> "shall 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."

This clause was interpreted as requiring that insurers continue to offer terrorism coverage as had been the standard prior to September 11, 2001. The "make available" clause generally did <u>not</u> apply to WMD terrorism coverage, since that coverage was rarely offered prior to 9/11. However, if an insurer chose to offer WMD terrorism coverage, then the benefits of TRIA (see below) would equally well apply to this coverage.

3) TRIA provides insurers with government reinsurance, whereby a part of certain terrorism losses would be reimbursed by the U.S. Treasury. As updated, the key features for 2007 are:

a) Losses must exceed a $100 million "trigger" before TRIA coverage is activated.[13]

b) 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; see CBO (2007, p.12).

c) For amounts above an insurer's deductible, the government will reimburse the insurer for 85 percent of its terrorism losses.

d) 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.

e) 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.

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[12] TRIA relates only to specific lines, including most commercial property and casualty insurance and workers compensation. It does not relate to health, life, malpractice, or commercial auto insurance among others.

[13] The $100 million TRIEA trigger avoids a strategic gambit in which an operating company could create its own "captive" insurer as a means 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.

f) The government must recover any TRIA payments it makes up to $27.5 billion, which is called the <u>industry retention</u> level, by imposing a surcharge (of up to 3% annually) 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 (up to 3% annually) until all government payments are recovered..

Overall, based on the deductible and coinsurance clauses, TRIA provides significant aid to the insurance industry only if terrorism losses exceed the level that resulted from the 9/11 attack; see Rand (2005b, p. xxv) and CBO(2007, p. 13). Perhaps surprisingly in view of the rush to exit the terrorism line after the 9/11 attack, the industry has generally supported TRIA.

One possible explanation for the industry support is that it has sufficient resources to cover conventional terrorism losses up to the level of the 9/11 attack; after all, all the insurance claims from 9/11 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; see GAO (2006, pp. 15-20).[14] GAO (2006) references two special factors, beyond large size and hard to compute costs, that might motivate insurers not to offer WMD terrorist coverage: (i) that the insurers already have substantial WMD exposure due to the state laws that require such coverage on workers compensation policies, and (ii) the possibility that the full extent of WMD losses might not be determined until years after the event.

Ibragimov, Jaffee, and Walden (2007) 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 is knows that all other insurers will be doing the same (which is exactly the form of TRIA's "make available" clause for conventional terrorism risks). It also then becomes understandable

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[14] Losses due to fire following a WMD attack would be covered by fire insurance policies in certain states.

why insurers may be unwilling to offer WMD terrorism coverage, since TRIA's "make available" clause does not apply to WMD terrorism. TRIEA itself expires in December 2007, and there are many proposals for how to shape the successor, including the possibility of expanding the "make available" clause to include WMD terrorism risks. We discuss these policy issues in Section 4.[15]

3.2 <u>WMD Terrorism Insurance</u> [16]

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 (i) the potentially large size of the risks, and (ii) 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.

<u>Estimates from Risk Management Systems Inc. (RMS)</u>

Table 4 provides estimates of potential insured losses from specific NBCR attacks by Risk Management Systems Inc. (RMS), a firm that specializes in providing estimates of the 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 damages represent 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.

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[15] A bill currently before congress, H.R. 2761, would expand and extend TRIEA for 10 years. The pros and cons of permanent government intervention in this industry have been extensively debated; see for example, Rand (2007), Wharton (2005), and Jaffee and Russell (2006).

[16] Some material in this section appears in similar form in a companion study Jaffee and Russell (2007).

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. Earlier, we noted that the economic losses created by 9/11 far exceeded the 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; see RMS (2005a).

Table 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 (battlefied, 1 kt)	140	100	240
Nuclear bomb (tactical, 5 kt)	250	200	450
Source: Risk Management Systems (2005), Table 2.			

Estimates from the American Academy of Actuaries

Table 5 provides an alternative set of projections from a study by the American Academy of Actuaries (2006) of the insured losses from possible NBCR incidents. In New York City, a large NBCR 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 Francisco, CA and Des Moines, IA. Clearly a NBCR attack could cause insured losses on an unprecedented scale.

Table 5: Insured Loss Projections, 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, Appendix II, April 26, 2006.				

Table 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/dismemberme	$0.2	$1.5
Health	$0.0	$22.4
Total	$8.0	$172.3
Source: Rand (2005b), Table S.2		

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 created from Anthrax attacks; see Rand (2005b).[17] The Rand study evaluates two different Anthrax attack scenarios, one within a single large building, the other an outdoor release which is widely disbursed. Table 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 25 times as large as the indoor attack. Here the largest component, over $100 billion, is property damage, reflecting the large number of buildings that become 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.[18] As noted earlier, the insured losses would have to exceed the size of the 9/11 attack before there would be any significant U.S. taxpayer liability under TRIEA.

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[17] 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.

[18] The Rand study assumes that the buildings are all fully insured against an Anthrax attack, whereas the U.S. Treasury (2005, P. 105) reports that only about 3 percent of buildings actually have NBCR coverage. This reinforces the Rand study conclusion that no U.S. taxpayer funds would have been spent to pay TRIA claims from this event.

For the outdoor Anthrax attack, assuming the affected buildings were relatively small and insured by a diverse set of firms, here too the individual insurers are not expected to reach their company-specific deductibles. 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 25 times as great as the indoor attack, because they are assumed to be disbursed across a large number of insurers, U.S. taxpayers continue to have no liability

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 disbursed through a spraying device (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.

3) The detonation of a nuclear bomb or so-call "improvised nuclear device."

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 U.S. 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, in fact, did 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.

Sandia National Laboratories prepared a 1982 study of the effects of a core meltdown and radioactive release at one of the 2 Indian Point nuclear power plants, north of New York City on the Hudson River. [19] 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 difference in results arise because a newer version of the computer code is used, populations have grown since 1982, and different input parameters were applied. [20]

Heal and Kunreuther (2007) (hereafter H&K) 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. The total would be within the range of the estimates provided earlier in Tables 4 and 5.

Even as the first U.S. nuclear reactor was planned, private insurers anticipated the enormous meltdown costs and refused to offer coverage. Doomsday 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, any time the word "nuclear" is used, special alarm bells sound. [21] As a

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[19] This is the so-called "CRAC2" study, based on a computer code (Calculation of Reactor Accident Consequences, or CRAC) that simulated alternative weather conditions. The study was done under contract to the U.S. Nuclear Regulatory commission. The study is known as "Technical Guidance for Siting Criteria Development;" see Sandia National Labs (1982).

[20] The Sandia National Laboratories updated the CRAC2 code in 1990, called "Melcor Accident Consequence Code System" or MACCS. The Lyman study used the most recent version, called MACCS2.

[21] In his economics Nobel prize acceptance speech, Schelling (2005) explains the non-use of nuclear weapons after World War II in part by the concern which 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 and cost private insurers $200 million as part of the final $470 million settlement.

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 create bankruptcies.

The specific solution that was developed to insure nuclear reactor risks is also useful in

analyzing the more general problem of insuring NBCR terrorism risks. The key step for the

nuclear reactors was the 1957 Price Anderson Act (hereafter PA Act), which limited the liability

of the nuclear reactor industry; see H&K (2007) for further discussion. Like TRIA, the PA Act

was viewed as a temporary measure, providing what was thought would be enough time (10

years) to enable the private insurance markets to assess and price this risk. In actuality, the Act

was renewed repeatedly, most recently in 2005, extending 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 2005 extension, private insurers are

now 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 the

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 9/11 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), with half of this being reinsured with Lloyds.

The remainder is provided through a contractual agreement administered by ANI, in which

payments of $100.6 million per reactor per accident are guaranteed by the operators of nuclear

plants, the payments to be collected by an annual assessment of $15 million (inflation adjusted) per operator per year for ten years. In effect, the nuclear reactor industry was required to create a mutual insurance pool, for which each operator was obligated to contribute funds if and when a loss occurred; this is actually an old insurance form, known as an "assessable reciprocal mutual".

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, see e.g. Jaffee and Russell (1997). To be sure, as H&K (2007) point out, $10 billion in coverage is well short of the $100 billion plus in losses which have been estimated to be the cost of a reactor meltdown in a populous state, but still 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.

H&K suggest that the U.S. government would likely intervene if losses exceeded the $10 billion coverage limit. The annual actuarial cost to the government in extending the additional coverage thus represents a subsidy from U.S. taxpayers to the nuclear reactor industry.[22] 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 noteworthy that the PA Act applies no risk-based pricing, thus providing the operators no incentive to make expenditures that would mitigate 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. H&K, however, suggest that the NRC inspections are inadequate

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[22] It is intriguing that the Nuclear Energy Institute published a June 2006 fact sheet titled "Price-Anderson Act Provides Effective Nuclear Insurance at No Cost to the Public". The "No-Cost" refers to the 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, which will be paid by the "public" either by the individuals directly affected or by government payments funded by U.S. taxpayers.

and that price incentives through risk-based insurance would be valuable. More generally, H&K

conclude that more of the nuclear reactor risk "could surely be met through the private sector".

Nevertheless, Geoffrey Rothwell, a long-time observer of the PAA, while noting the failings of

the PA Act, also observed that no better alternatives were readily available; see Rothwell (2002).

3.3 Estimating the Likelihood of a WMD Terrorist Attack

The insurance industry refers to the imprecision in estimates of the likelihood of a WMD

attack as a second reason why these risks are uninsurable. Indeed, there are commentators who

believe such attacks are inevitable, while there are others who believe that the risks are

exaggerated. For example, Senate Majority Leader William Frist has suggested that a biological

attack in the next ten years is all but certain.[23] On the other hand, there are experts who point out

that such extreme estimates have little scientific underpinning. For example, Mueller (2007, p.1)

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 the 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; also

see Sunstein (2003). For example, the effects of a terrorist nuclear bomb attack are readily

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[23] In Agence France Presse (2005), former U.S. Senate Majority Leader William Frist is quoted to state that "an inevitable bio-terror attack" would come "at some time in the next 10 years. Views such as this caused the U.S. to spend over $33 billion on bioterrorism countermeasures between 2002 and 2006.

imagined based on film footage of actual nuclear bombs.[24] 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.[25] Similarly with respect to bioterrorism, Leitenberg (2005, 2006) has noted that an analysis of

bioterrorist risks must evaluate the actual ability of terrorists to mass deliver the toxic agents.[26]

Clearly, as economists, we do not posses the expertise to sort through these various

viewpoints. But, then, neither do private insurance companies. Thus this 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," see Hogarth and Kunreuther(1989) and

Kunreuther et al (1995), preferring to insure risks with known actuarial probabilities compared to

risks where it is difficult to determine the likelihoods.[27] When we add to this the fact that

insurance executives may also suffer from availability bias and overestimate the likelihood of

attack, it is more understandable why insurers maintain that NBCR risks are uninsurable.

3.4 <u>Uninsurability Revisited</u>

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

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[24] Langewische (2007) notes of the Hiroshima Nagasaki bombs, "But the idea was to terrorize a nation to the maximum extent, and there is nothing like nuking civilians to achieve that effect." Also see Slovic (1986).

[25] 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.* (S(7) 98 Cr. 1023) prosecuted February-July 2001 in United States District Court (transcripts at http://cryptome.org/usa-v-ubl-dt.htm). 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 both in developing and delivering the weapons.

[26] For example, the Aum Shinrikyo Tokyo subway gas attack achieved very little, although it was 4 years in the planning with an open budget and virtually no monitoring by the Japanese police.

[27] It is also sometimes suggested that terrorists are strategic in their choice of targets and that this complicates the process of computing event probabilities; see Rand (2005c). 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 it would seem the distribution of actual events would be observationally equivalent to a stochastic process as employed by Mother Nature in creating natural disasters.

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 which 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 of these risks. 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.

4. Policy Options to Create Viable WMD Terrorist 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 been indicated that in the absence of government support, the U.S. property and casualty insurance industry is firmly set against providing coverage for even conventional terrorism risks, not withstanding the view of the current authors and other commentators that terrorism risks should be insurable by the private U.S. industry. Whatever the diverse views, at this writing it appears highly likely that the U.S. Congress will renew its support for terrorism insurance before the current legislation, TRIEA, expires in December 2007.

In this section, we take as given that there will be a government program in support of terrorism insurance, and ask the question what is the most effective form for that intervention. 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 currently. 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 modalities for government support of the terrorism insurance market.

4.1 Private Versus Government Insurance Markets

The risk-sharing benefits of insurance intrinsically require a social undertaking; self-insurance really means no insurance at all. 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 coverage by a private industry; see 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 carry 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. We shall use editorial

privilege in choosing the plans to illustrate the points, but we do not believe we have left out any

salient counterexamples.

Contract Design. The government generally performs poorly when it is required to design

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.[28] 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; see Zanjani (2006). Deductible limits that are too high and other

limitations in coverage are common reasons for why homeowners pass up CEA policies. To be

sure, other factors are also at work here, including the common perception that the premiums are

too high, but they all point to an overall failure of contract design and marketing at the CEA.[29]

Premium Setting. Most government insurance plans are required to set "actuarially determined"

premiums, with the intent that the premiums should be risk-based and 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 by law the 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,

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[28] See Zanjani (2006) for a recent analysis of the California Earthquake Authority.

[29] The Federal Housing Administration mortgage guarantee plan for low-income homeowners provides a similar example. The FHA has seen its market share of new mortgage originations decline from over 15 percent to under 5 percent in the last 4 years under the force of competition from private mortgage insurers, Fannie Mae and Freddie Mac, and a wave of innovated subprime contracts available only from private lenders. A fundamental reason for the lost in share is the inability of the FHA to provide innovative contrasts; see Jaffee and Quigley (2007).

creating pressure both to subsidize the 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 net premiums (net of operating expenses) collected by the program over the approximately fifty prior years of its existence. We have already pointed out the TRIA program, which provides its terrorism reinsurance at no cost, also fails to create risk-based premiums.

Policy Sales and Marketing. The 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, the 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. Indeed, no claims have been registered under TRIA. The Florida Hurricane Fund, however, has been less fortunate: as shown in Table 3, since 2004, Florida has suffered three of the most costly natural disasters in U.S. history, namely Hurricanes Katrina, Wilma, and Charley. The effect of these disasters was to wipe out the fund's reserves, forcing the state of Florida to use public money to cover the losses. The effect is, once again, to cause a government plan to subsidize the cost, and specifically to subsidize the most disaster-prone coastal areas.

4.2 The Crowding Out of Private Markets by Government Terrorism Insurance

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 (Section 101.a.6):

> "[T]he 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."

However, when the 2002 Act reached its sunset date in December 2005, it was extended by TRIEA with a new sunset date of December 2007. Now, as December 2007 approaches, it again appears that renewal is likely; indeed, H.R. 2761 is a proposal to extend government support of terrorism insurance for another 10 years. We now 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 substantiate a claim of crowding out, it must be demonstrated that the private market would have operated in the absence of the government action, and that the private market fails in the presence of the government program. Following the 9/11 attack and continuing through the passage of TRIA in November 2002, the private industry was simply unwilling to provide terrorism coverage, and thus there is no basis for a charge of crowding out. Moreover, as just indicated, TRIA was explicitly cast as a temporary measure, so the clear goal was to stimulate the recovery of the private market, not to crowd it out. The extension of TRIA in December 2005, TRIEA, raised more serious concerns whether it would crowd out a potential recovery of the private market. However, careful studies were carried out by U.S. Treasury, General

Accounting Office and Congressional Budget Office, with the general conclusion that the private market for terrorism was still not viable, and that the TRIA extension was in the public interest.

Writing now in the Fall of 2007, TRIEA is itself about to expire, and we again face the issue whether government support of the terrorism insurance market should be extended, and whether such an extension will crowd out a recovery of the private market. That decision has not yet been made, but the conditions now are quite similar to those in the Fall of 2005 when TRIEA was passed, so it seems that once again it will be concluded that the private market for terrorism insurance is not viable and that an extension will be enacted.

Looking over the longer term, the most worrisome aspect of TRIA for crowding out is that the government reinsurance is provided gratis. There is no way, of course, that private reinsurance markets could be established to 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 force the private industry to hold a substantial part of the first-loss components of the overall terrorism risk. Moreover, TRIEA raised the deductible and coinsurance requirements and it appears that a second extension will raise them still further. In this sense, the private industry holds a rising share of the lower tier of the terrorism risk, so that in this range crowding out is being avoided.

4.3 <u>Capital Market Resources to Fund Catastrophe Insurance</u>

Since the failures of the Florida hurricane insurance market following Andrew in 1992 and the California earthquake insurance market following Northridge in 1994, it has been evident that the financial markets might have the potential to provide a direct and dependable source of capital for both the primary insurers and the reinsurers, thus reviving the private markets for catastrophe insurance. In particular, capital from the financial markets could replace the

reinsurance firms, who had proven unreliable partners exactly when they were most needed. 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. Furthermore, catastrophe risks provide financial market investors with a particularly valuable feature, since catastrophe risks could be uncorrelated with the macroeconomic and financial risks that dominate investor portfolios.[30]

As a result, a market has developed for 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 the risks to a special purpose vehicle (SPV). The SPV in turn transfers the risks to financial market investors such as 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; see Guy Carpenter (2007) and Swiss Re (2006a) for further discussion.

Figure 2 shows the expansion in the catastrophe bond market since 1997. While growth has been steady, the about $8.5 billion in outstanding bonds at year-end 2006 represents only about 6 percent of the corresponding volume of traditional reinsurance. The main factor is that, based on the relatively low level of natural disaster losses once past the Andrew and Northridge events of the early 1990s (recall Figure 1, at least until Katrina), the reinsurers have steadily returned to the market with competitive offers of coverage for natural disaster events.

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[30] In technical terms, natural disasters are 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.

Figure 2: Catastrophe Bonds, New Issues and Outstanding

■New Issue Value ■Outstanding Value

Sources: Guy Carpenter (2007) and
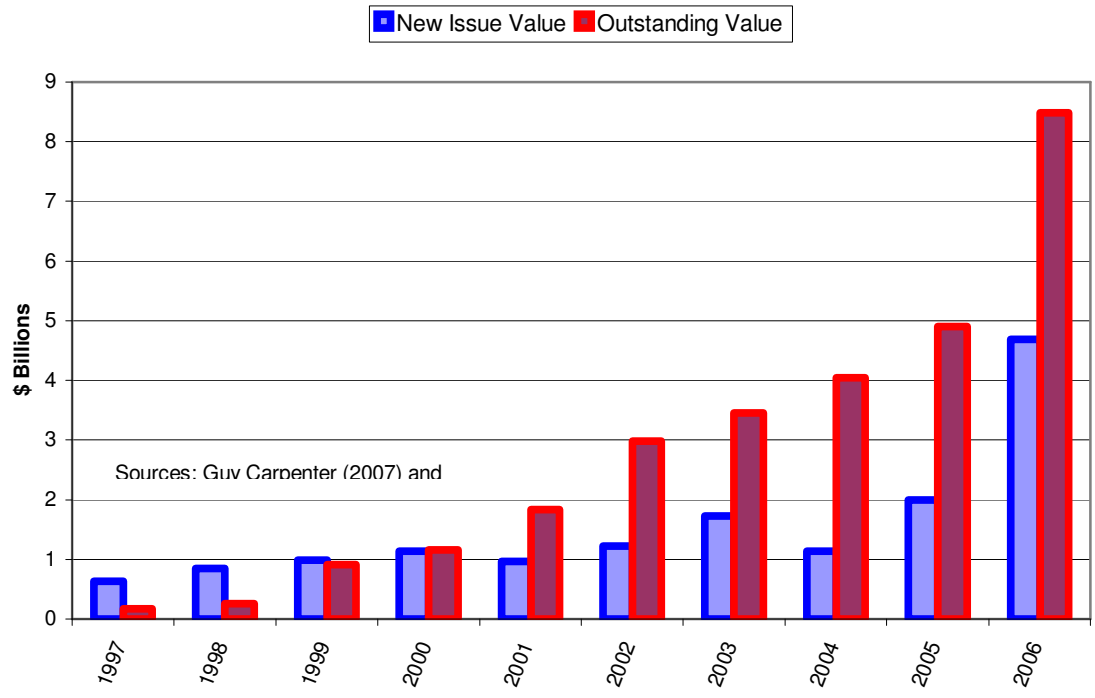
Figure 3: Catastrophe Bond Yields Relative to Libor
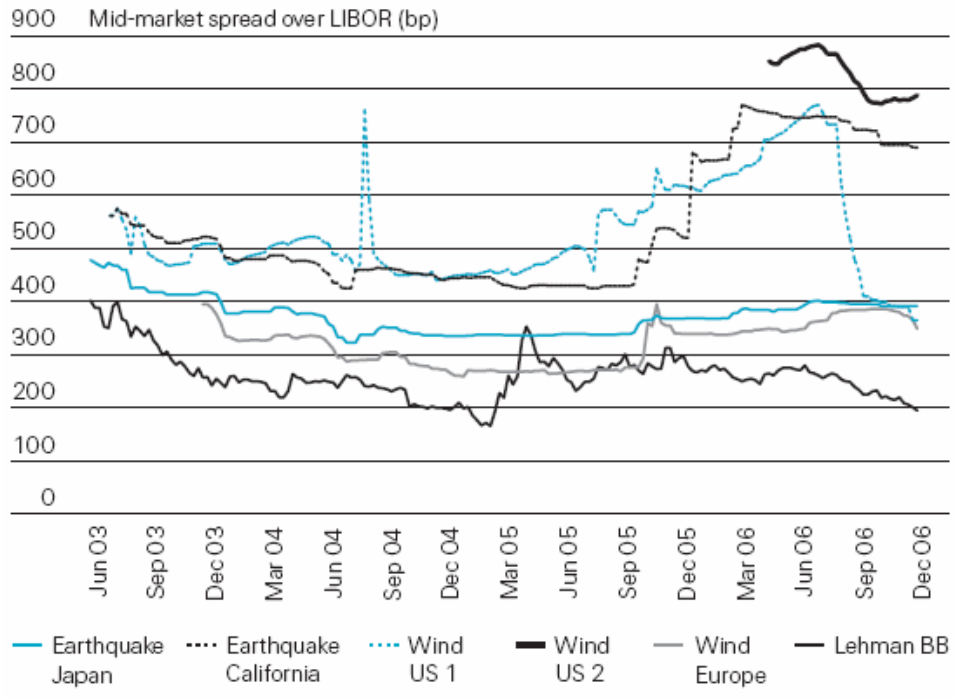
Source: Swiss Re Capital Markets

Figure 2 also shows that the value of new issues of catastrophe bonds expanded rapidly in 2005 and 2006, as insurers and reinsurers turned to the financial markets as a new source of capital. This new capital, however, comes at a price. Figure 3 shows that the cost of this capital, measured as the interest rate paid relative to Libor,[31] rose dramatically in 2005 for wind related risks. This is a signal that the reinsurance industry continues to be a fickle source of catastrophe risk capital: when times are good, the reinsurers are active, but when major disasters strike, they withdraw, leaving the financial market as the only possible funding source for the primary insurers.

Of all the insurance-linked securities and catastrophe bonds measured in Figures 2 and 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 was designed to cover the cancellation risk of the 2006 FIFA World Cup football tournament from terrorism and some lesser hazards. The second set is a series of 3 bonds issued by Swiss Re, described as Vita Capital I, II, and II, which cover excess mortality risk from pandemics as well as terrorism and natural catastrophes. No securitizations have been issued to date that would cover terrorism risks to U.S. property.

Thus even with 15 years of quite positive experience with funding natural disaster risks, capital market investors remain wary of investing in conventional terrorism risks, not to mention WMD terrorism risks. It seems the primary issue is informational, and that capital market investors feel even less secure than the primary insurers and reinsurers in evaluating the expected losses that underlie the various conventional and WMD terrorism risks. There is, furthermore, limited demand by the insurers and reinsurers to transfer conventional terrorism risks, and

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

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 rise as more coverage is provided by the primary insurers and as the 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.

4.4 <u>Government Terrorism Insurance and Mitigation Activity</u>

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 the provision of insurance for WMD terrorist risks affects the incentives for private parties to take actions to mitigate the likely losses from such attacks. For a variety of reasons, the picture is mixed as to whether terrorism insurance can or will provide a strong incentive for individuals and firms to mitigate the risks they face.

<u>Risk-Based Premiums</u>.

Insurers set the premiums charged their policy holders based on their expected losses, including the cost of reinsurance. The reinsurance under TRIEA, however, offers no incentive for risk-based pricing, since the government's coverage is provided without charge on all risks. In contrast, private insurers and reinsurers will use risk-based pricing to the extent that their expected losses differ across properties and coverage. Risk-based pricing provides the policy holders incentive to mitigate their risks, although they may have a limited in their ability to do so (see the next items).

Building Size and Location

Large trophy buildings in the center of major cities are likely to be the favored targets of terrorists, but clearly there is no possibility to change the size or location of existing structures.[32] 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 the cities in the first place. In other words, moving activity to smaller buildings away from the center city is not without costs of its own.

Mitigation Actions.

Beyond size and location, the owners of all structures can take actions to reduce the likelihood of a terrorist attack or to reduce the losses if such an attack does occur. For example, checking the satchels of all who enter the building, and similar precautions, may reduce the likelihood of a successful bomb attack. And better systems for air circulation and purification 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 level of private mitigation may able to provide protection against the more extreme WMD attacks such as a nuclear bomb. Both Rand (2005) and CBO (2007) also comment that the cost of carrying out terrorism risk mitigation often exceed any benefits a firm might receive in terms of lower risk-based insurance premiums.

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[32] The owners of trophy buildings in center cities will face higher premiums for their terrorist insurance, and may also be forced to accept lower rents, in order to deter their tenants from opting for a safer location such as a smaller building away from the city center.

<u>The Social and Private Benefits of Mitigation</u>.

Risk-based insurance premiums provide landlords a private incentive to mitigate; indeed, their private benefits may exceed the social benefits. 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. In other words, the mitigation action of landlord A has an externality which raises the incentive of landlord B to mitigate. Because landlord A does not internalize the costs imposed on landlord B, the result is that the net social benefits of mitigation are less than the net private benefits, leading to <u>too much mitigation</u>, at least when evaluated on the basis of social benefits and social costs. Of course, other factors limit the incentive to mitigate—such as the free reinsurance provided by the TRIA program—so it remains unclear whether the overall system creates too much or too little mitigation.[33]

<u>Liability as an Alternative to Insurance as an Incentive to Mitigate</u>.

A recent study by Lakdawalla and Talley (2006) discusses landlord liability as a mechanism to provide an incentive to mitigate that is separable from risk-based insurance premiums.[34] The basic idea is to derive an "optimal" liability regime that creates the desired level of mitigation. The problem, however, is that the system derived can be counterintuitive, often prescribing damages payments from seemingly unlikely defendants, directing them to seemingly unlikely plaintiffs. The authors therefore conclude that the tort system is an unlikely mechanism to

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[33] Kunreuther () discusses a case in which the benefits of mitigation require simultaneous group action, so if one party fails to carry out his share, the group as a whole has less incentive to mitigate. A specific example is the Pan Am Lockerbie bombing in 1988 where the bomb was in luggage that was transferred from a Malta Air flight for which the terrorists knew the luggage would not be scanned.

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

achieve the socially desired mitigation efforts, and thereby they return to insurance as a more effective mechanism, perhaps coupled with direct compensation to victims of terrorist attacks.

The impact of the tort system can be seen in two cases we discussed earlier, the nuclear reactor industry and the development of ultra-large oil carriers. For the nuclear reactors, the perceived liability was so large that the industry was unwilling to build and operate the reactors until the government passed the Price Anderson Act, creating an insurance pool and capping the overall liability. For the oil carriers, the insurance premiums for covering the possible environmental claims exceeded the benefits of the larger carriers, so the carriers were cancelled.

4.5 <u>Alternative Modalities for Government Intervention in WMD Terrorism Insurance</u>

We now consider some alternative policy formats that are available to stimulate the provision of WMD insurance in the U.S. We start with a discussion of the 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. While 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.

4.5.1 Extend TRIA and Expand the "Make Available" Clause to WMD Terrorism

The most immediate solution to create a viable supply WMD terrorist coverage in the U.S. is to rewrite TRIA so that the "make available" clause applies to conventional and WMD terrorism risks alike.[35] This solution, however, is strongly resisted by the insurance industry. For example, the Aon Corporation (2006) provided a lengthy contribution to the U.S. Treasury and President's Working Group on Terrorism Insurance, with the following key points

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[35] This is the approach taken in the currently pending House bill H.R. 2761.

1) WMD losses present "a potential for insured loss exposure in excess of the TRIA annual aggregate reinsurance capacity of $100 billion."

2) WMD losses threaten to expand "deductible and coinsurance exposures".

3) "Basically, the (re)insurance industry views WMD event exposure as a "company killer"…"

Because this 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 threat that $100 billion TRIEA cap will be exceeded. Under current TRIEA provisions, the maximum for a private insurer's losses equal 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 cause insured losses above the $100 billion limit.

On the second point, Aon is correct to note that the addition of WMD liability would raise the probability of loss below the TRIEA $100 billion threshold and that this is turn would affect the company's expected loss. However, there are two caveats that weaken this position: (i) Insurers would presumably charge additional premiums that would more than cover the expected cost of the additional WMD risk, so net expected profits should be higher when WMD coverage is provided; (ii) If the terrorists carried out a combined conventional and WMD attack, with each part creating losses more than $100 billion in insured loss, the additional WMD coverage would have no effect on expected loss.

In any case, it is not difficult to craft legislation to address the specific industry concerns. For example, the new TRIA legislation could recognize two forms of terrorist attack, conventional and WMD. If the attack is certified to be WMD, then it could be assigned a zero deductible. In that case, adding WMD coverage creates no marginal change in the deductible level, a desirable feature for the industry. Similarly, the industry's coinsurance requirement for WMD attacks could be set at a lower level, say 10%, again a desirable feature for the industry. With these

parameters, the maximum loss to the insurance industry is $10 billion on a $100 billion event, (less after tax) so that the apportionment of risk between the public and private sectors is coincidentally of the same order of magnitude as the private /public split for nuclear accidents under the Price Anderson Act.

Of course, these parameters are just examples. If it is believed that WMD attacks impose burdens on insurers which require special treatment, then other advantageous combinations of lower deductible limits and coinsurance requirements can be used to reduce the industry's costs of providing this coverage. This fact is recognized in a bill now before Congress, H.R. 2761. Under this bill, the "make-available" provision for conventional terrorism is extended to WMD losses. Moreover, once a loss is certified as being due to an WMD attack, the industry deductible becomes 7.5 percent (for conventional terrorism it is currently 20 percent) with a coinsurance requirement that steps down to a low of percent for losses above $60 billion (for conventional terrorism the coinsurance requirement is 15 percent).[36]

Since 2001, the financial situation of insurers has improved markedly, and their protests to the contrary, requiring them to cover WMD risk with a $100 billion cap ($65 billion after taking the deductibility of losses for tax purpose) is today a far less burdensome task than it was when TRIA was enacted in 2002. Indeed, with respect to WMD insurance under workers compensation, private insurers already provide such coverage and they are supported by the TRIEA backstop. We turn now to the special issues of workers compensation insurance.

4.5.2 The Special Problems of Workers Compensation

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[36] In addition, these new terms render moot the conclusion of Rand (2007) that if WMD risk were to be added to TRIEA on the same terms as conventional terrorism risk, premiums would need to be raised to such a level it would be the equivalent of letting TRIEA expire.

As currently written, H.R. 2761 rules out separate pricing and unbundling of the conventional and WMD terrorism risks. This seems counterproductive, since some parties may desire just one or the other form of coverage, and a party that desired both components could just purchase both components.

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 U.S.; see for example Moss (2002, Chapter 6). The number and intensity of work stoppages in response to on-the-job injuries reached the point at which management and workers sought a solution in which workers would give up the right to sue employers for job-related injury, while employers accepted the requirement to maintain workers compensation insurance and with no exclusions.

The absence of exclusions for workers compensation coverage requires insurers to provide WMD terrorism coverage, their claims of "uninsurable risks" notwithstanding. As Table 5 shows, the exposure to this line is not insignificant: workers compensation losses in NYC could amount to $483 of the total projected loss $778 billion, and in all four cities workers compensation accounts to more than 50% of the total loss. Conventional and WMD terrorist attacks are likely to distribute the 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 2 for the 9/11 attack using conventional weapons, less than 9 percent of the total losses were related to the personal lines. WMD attacks, in contrast, would be expected to create exceptionally large losses for the personal lines such as 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 equal $500 million, see NCCI (2006). However, not all of this falls on the private sector. In four states and two territories,[37]

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[37]North Dakota, Ohio, Puerto Rico, the U.S. Virgin Islands, Washington,, Wyoming.

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. [38] Still the exposure of the

private sector 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%) 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, it would appear feasible to expand the "make available" requirement to cover

WMD risks in a future extension of the TRIA legislation.

4.5.3 Government Pricing of Terrorism Insurance

An important criticism of the TRIA legislation is that the terrorism reinsurance is provided

without charge.[39] A common response is that pricing terrorism risk is a difficult task for the

private insurers and well beyond the ability of the government. The analysis in Priest (1996),

however, suggests a more realistic answer, namely that government insurance invariably

becomes subsidized insurance. Nevertheless, it behooves the proponents of risk-based pricing of

government insurance to provide a reasonable mechanism.

Lewis and Murdoch (1996) and Cummins, Lewis, and Phillips (1998) have offered 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, see the above discussion, would provide a practical template for the contracts.

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

[39] It could be said that this could only happen in the U.S., since comparable plans in European countries (reviewed below in Part 4.6) all charge a fee. There is an explanation: gratis government reinsurance could be interpreted to be an export subsidy, which is prohibited under European Union rules.

The auction process 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 should 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, creating a loss to the government. But good fortune should be equally likely and the plan should break even over time. Finally, the mechanics for such government auctions would be readily developing, following, for example, the method used by the U.S. Treasury to auction Treasury bills and bonds.

A scheme in this general form was most recently proposed in the U.S, House of Representative as H.R. 846, the Homeowners Insurance Availability Act of 2005, but it lacked sufficient support for passage.

4.5.4 Lender (not Insurer) of Last Resort

TRIA and related proposals that provide a government backstop for terrorism insurance basically enlist the government as the <u>insurer of last resort</u>. However, the fundamental market failure that requires government intervention occurs in the <u>financial markets, not the insurance markets</u>. That is, the primary concern of insurers is how they can access sufficient capital to pay their catastrophic losses if and when they occur. Obtaining access to capital is fundamentally a financial problem, not an insurance problem. Indeed, as we have seen under TRIA, once the industry is confident that there is a capital backstop, it then proceeds rapidly and efficiently to carry out the work of an insurer, designing contracts and underwriting policies. The bottom line is that the government could quite possibly backstop the market for terrorism insurance by acting as the lender of last resort, rather than as 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 need for the government/central bank to intervene.

In this sense, problems caused by liquidity crises 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 crises for catastrophe insurers. Though made in the context of banking, the following recent statement by the former chairman of the board of governors 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 implosions must be to inject large quantities of liquidity.
> —Alan Greenspan, 2004

Clearly a lender of last resort scheme as 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; for further discussion, see Jaffee and Russell (forthcoming).

4.6 <u>Global Responses to the WMD Problem</u>

Terrorism is a global problem. Some form of government support for terrorism insurance therefore exists in many countries. Prior to 9/11, countries such as the UK, 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 9/11 caused many other countries, e.g. France, Germany, Australia, to put in place their own government programs. For an overview of all programs see Guy Carpenter (2007). WMD risk is handled in different ways in different countries. Here is a brief list.

<u>UK</u>: In the UK, 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 and in this market WMD risk is typically excluded.

<u>France</u>: In France the government terrorism insurance scheme GAREAT originally excluded nuclear attacks, but in 2006, nuclear attacks were added so that in France WMD risk is treated no differently from conventional terrorism risk.

<u>Germany</u>: In Germany WMD risk is excluded from the government terrorism scheme Extremus

<u>Australia</u>: In Australia the government run reinsurance pool ARPC includes chemical and biological loss but excludes nuclear.

As this brief list shows, experience with WMD risk varies from country to country, but as the UK and French examples show, there are existing public programs which include WMD risk.

5. **Conclusion**

Although experts disagree on how close terrorists are to having 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. Thus continued exclusion of WMD risks under TRIEA in property insurance contracts is a matter of significant concern. It is not clear why insurers insist on this exclusion. It is not credible to argue that WMD risk is in principle "uninsurable" when, as we have seen, providers of workers compensation in fact provide this insurance. The workers compensation insurers must find the TRIEA backstop sufficiently reassuring to continue to offer this coverage.

The problem arises with regard to property casualty insurers. Even though, as we have seen, the total after tax loss to this industry under TRIEA cannot exceed $65 billion, and even though total reserves approach $500 billion, this industry alleges that the addition of WMD risk threatens the industry with bankruptcy. But as we have seen, this problem can always be handled by the addition of special provisions to TRIEA which lower the burden to the industry. Requiring insurers to add WMD risk would seem by far the simplest fix to the problem of the WMD gap.

Going forward, the point that insurance companies have had ample time to recover from 9/11 and that the provision of free reinsurance only induces further dependency on government largesse may lead to either non-renewal of TRIEA or to an increase in the share of risk placed with the private sector, for example by an increase in the $100 billion cap. But special attention must be paid to the WMD issue, particularly as it relates to workers compensation. If the loss cap were removed and private workers compensation insurers were to abandon this line, the government would have to intervene and the burden would still fall on the public sector. This crisis can be avoided by fully incorporating WMD risks within a future government plans.

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.

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