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Distribution of Losses from Large Terrorist Attacks Under the Terrorism Risk Insurance Act

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Summary

Introduction

Following the 9/11 attacks and the substantial losses incurred, insurers questioned their ability to pay claims in future attacks and began to exclude terrorism coverage from commercial insurance policies. The fear that a lack of insurance coverage would threaten economic stability and growth, urban development, and jobs led the federal government to adopt the Terrorism Risk Insurance Act (TRIA) of 2002. TRIA's purpose is twofold: (1) protect consumers by addressing market disruptions and ensure the continued widespread availability and affordability of property and casualty insurance for terrorism risk; and (2) allow for a transitional period for the private markets to stabilize, resume pricing of such insurance, and build capacity to absorb any future losses.

Because TRIA sunsets at the end of 2005, policymakers need to assess how TRIA, as currently written, will respond to the losses that might result from different modes and magnitudes of terrorist attacks. In particular, in assessing TRIA, policymakers must decide if TRIA's likely effects on the distribution of losses resulting from a terrorist attack are satisfactory and, if not, what changes to TRIA, including its termination, would be needed to improve its performance.

Because there have been no large terrorist attacks in the United States since TRIA came into effect, policymakers have little empirical data on which to base an assessment of the likely effects of TRIA. This study is designed to provide policymakers with empirical estimates of TRIA's likely effects on the distribution of losses resulting

from a terrorist attack. We generate a database by simulating the expected losses for different sizes and modes of terrorist attack scenarios—in particular, crashing a hijacked aircraft into a major building, releasing anthrax within a major building, and releasing anthrax outdoors in a major urban area—and then examine the effects of the insurance system and TRIA on the ultimate distribution of the losses under different circumstances.

Estimating Losses from a Large Terrorist Attack

To provide an accurate basis on which to determine the effects of TRIA, we simulate the expected losses and the distribution of losses across insurance lines for a number of attack scenarios of each of the three attack modes noted above. The attack modes selected represent feasible attacks and indeed were chosen because they involve methods (aircraft impact) or materials (anthrax) that have been used in previous terrorist attacks. They also represent a range of potential outcomes and, therefore, can provide some information on the robustness of TRIA.

Tables S.1 and S.2 illustrate the estimates generated from the simulations in terms of casualty distributions and losses by insurance line, respectively, for the three example scenarios. Table S.1, which categorizes by casualty type, shows that an outdoor anthrax attack leads to the largest number of casualties (more than two million), with over 36,000 deaths. This extreme catastrophic scenario exceeds the size of the other two scenarios by an order of magnitude; as such, the scenario is useful in illustrating the performance of TRIA in an attack far larger than 9/11. The indoor anthrax attack leads to the smallest number of casualties, although with greater severity: Serious injuries and fatalities both exceed the aircraft impact attack.

Table S.2 shows that the distribution of losses among insurance lines varies across the three example scenarios. Property losses account for 13 percent of the total loss in the indoor anthrax scenario, 58 percent of the total in the outdoor anthrax scenario, and 67 percent of

Table S.1
Casualty Distributions for Terrorist Attack Scenarios

Casualty Type	Aircraft Impact (Major Office Building)	Indoor Anthrax (Major Office Building)	Outdoor Anthrax (Major Urban Area)
Medical only	35,524	5,500	1,901,476
Temporary total disability	641	1,500	19,960
Permanent partial disability—minor	561	—	—
Permanent partial disability—major	401	—	—
Permanent total disability	430	4,500	59,881
Fatal	2,632	2,750	36,594
Total	40,188	14,250	2,017,911

Table S.2
Allocation of Losses by Insurance Line for Terrorist Attack Scenarios
(in millions of dollars)

Insurance Line	Aircraft Impact (Major Office Building)	Indoor Anthrax (Major Office Building)	Outdoor Anthrax (Major Urban Area)
Property	$4,482	$1,061	$100,414
Workers' compensation	$1,522	$6,115	$43,472
Group life	$307	$323	$2,472
Individual life	$235	$247	$2,109
Accidental death and dismemberment	$121	$208	$1,483
Health	$1	$10	$22,354
Total	$6,668	$7,964	$172,304

the total in the aircraft impact scenario. Workers' compensation shows a complementary variation, accounting for 77 percent of the losses in indoor anthrax, 25 percent in outdoor anthrax, and 23 percent in aircraft impact. Life and health lines entail 10 percent in the indoor anthrax and aircraft impact scenarios and 16 percent in the outdoor anthrax scenario.

## The Distribution of Terrorism Attack Losses Under TRIA

TRIA requires primary insurers to make terrorism coverage available to commercial policyholders. In return for making coverage available, TRIA limits the amount that insurers are responsible for paying by means of a risk-sharing formula. In this formula, a primary insurer is responsible for paying losses it insured up to an annual deductible and for a co-payment of all losses above the deductible. Insured losses above the deductible and co-payment are paid by a surcharge on all commercial insurance policyholders and by taxpayers.

TRIA applies to commercial property and casualty policies only; it does not apply to life or health policies or to personal lines such as auto or homeowners' insurance. In addition, TRIA is restricted to certified foreign terrorist attacks only; TRIA does not apply to domestic terrorist attacks. Finally, TRIA allows insurers to exclude property losses from chemical, biological, radiological, and nuclear (CBRN) incidents from policies as long as the exclusion is also applied to losses arising from events other than acts of terrorism. Workers' compensation losses cannot be excluded from any terrorism insurance policy. Losses from a CBRN attack that are insured are eligible for the risk-spreading provision of TRIA.

Figure S.1 illustrates TRIA's general features. Certain parameters of TRIA change from year to year; the figure shows TRIA's 2005 parameters.

The left part of the figure shows the distribution of initial payouts under TRIA. Target insurers who have paid claims on policies that include terrorism coverage and are in lines eligible for TRIA coverage (here referred to as TRIA-covered losses) are responsible for payouts up to an annual deductible equal to 15 percent (in 2005) of the insurer's group's annual direct-earned premium on TRIA-eligible lines the previous year. A target insurer is also responsible for a co-payment of 10 percent of all losses above the deductible. The remaining 90 percent of losses above the deductible are reimbursed to the insurer by the federal government. This formula is applied for aggregate annual insured losses in TRIA-eligible lines up to $100 bil-

Figure S.1
Summary of Initial and Final Payouts Under TRIA
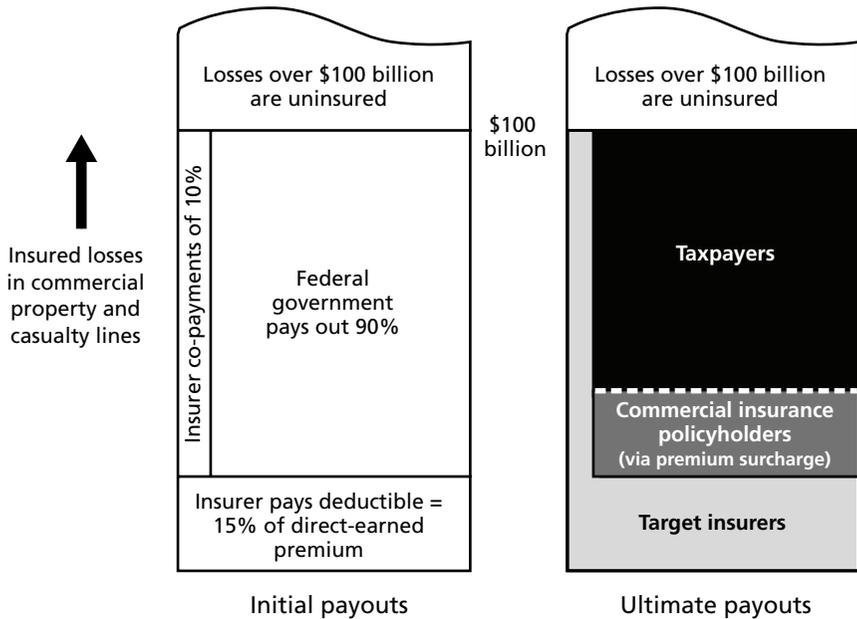
lion. TRIA specifies that insurers are not responsible for TRIA-covered losses above $100 billion, but it does not explicitly specify who would be responsible for insured losses in excess of $100 billion.

TRIA also requires that the federal government recoup the difference between an "insurance marketplace aggregate retention amount" ($15 billion in 2005) and the sum of insurer deductibles and co-payments for that year. Recoupment is collected through a surcharge of up to 3 percent per year on all commercial insurance policies in the United States. The right part of the figure shows the ultimate distribution of payouts after recoupment.

TRIA formally distributes the losses resulting from a terrorist attack among five groups: (1) people and businesses who lack coverage for terrorism losses and must, therefore, bear the losses themselves (here referred to as "uninsured"); (2) insurers of losses covered by policies in insurance lines not eligible for TRIA coverage (here referred to as "life and health insurers"); (3) insurers of losses covered

by policies in commercial insurance lines that are eligible for TRIA coverage (here referred to as "target insurers"); (4) all commercial insurance policyholders in the country, from whom the federal government recoups all or part of its initial payout (here referred to as "commercial policyholders"), and (5) taxpayers. Five provisions of the law—insurance availability and take-up, TRIA eligibility, deductibles and co-payments, insurance marketplace retention, and the ceiling on insurers' responsibility—determine how the losses resulting from a terrorist attack are redistributed among these five groups.

Figure S.2 shows how cumulative annual losses resulting from each mode of attack would generally be distributed under TRIA. Total losses for single attacks from the three example scenarios discussed above are indicated by an arrow on the horizontal axis for each of the three attack types in Figure S.2. Distributions are shown as a function of cumulative annual losses because target insurers' deductible and co-payment under TRIA are applied to annual losses. If an insurer suffers losses from multiple events in a single year, these losses are combined to determine when the TRIA deductible has been met. Each curve in Figure S.2 shows the portion of the total annual loss that would be paid by various stakeholders, assuming current take-up values.

Uninsured losses, which represent a constant fraction of the total loss in all cases, vary considerably with the attack mode, but they would be substantial in all cases, ranging from 13 percent of the total loss for indoor anthrax attacks to 57 percent of the total loss for outdoor anthrax attacks. Less than 3 percent of commercial policyholders purchase CBRN coverage for property losses. However, in the indoor anthrax case, the majority of losses come from workers' compensation, for which CBRN coverage is mandatory; so the overall uninsured loss fraction is relatively small. By contrast, the outdoor anthrax scenario would have a much higher proportion of property losses; hence, the low take-up for these lines would result in a high fraction of the loss going uninsured.

Figure S.2
TRIA Loss Distributions for Cumulative Annual Losses Resulting from Different Types of Terrorist Attacks
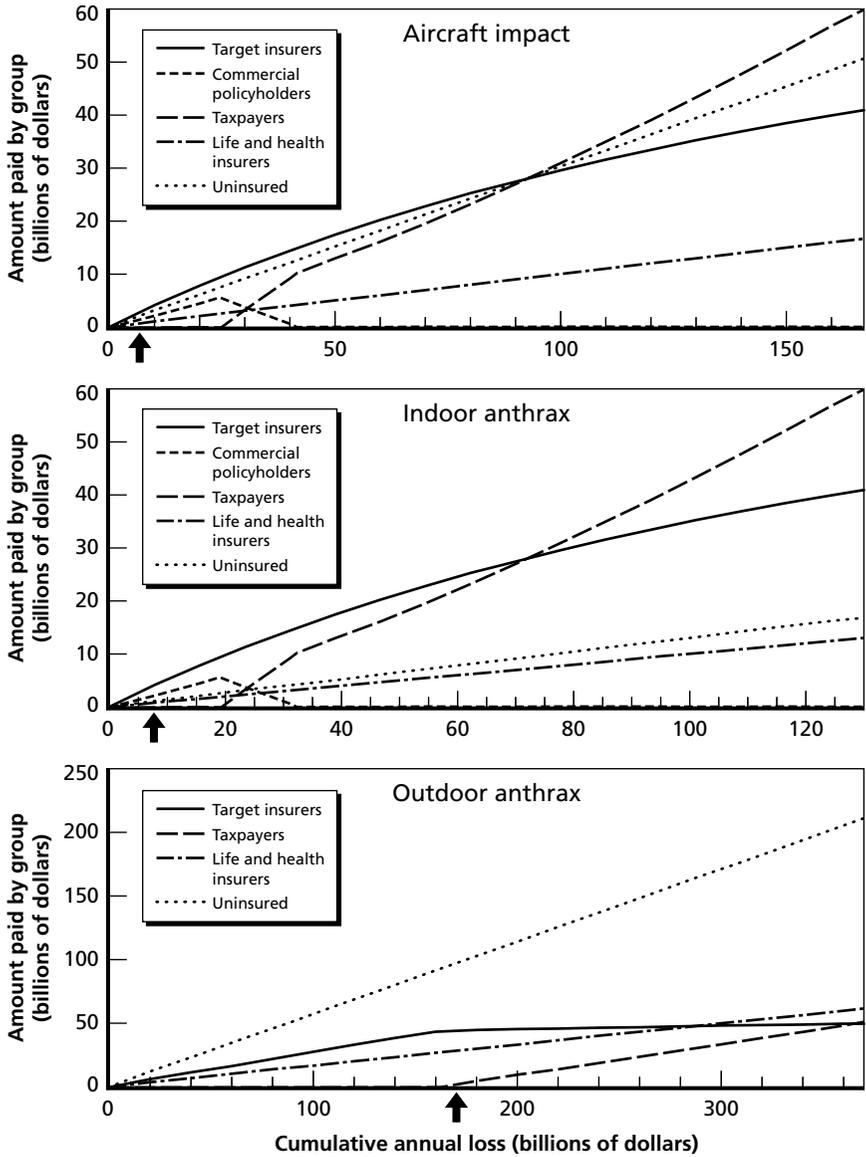
Losses for life and health insurers represent a constant fraction of the total loss, ranging from 10 percent in the aircraft impact and indoor anthrax scenarios to 16 percent in the outdoor anthrax scenario. Because they are not eligible for TRIA, losses in life and health lines would be the insurers' responsibility.

Losses to property insured against terrorism and workers' compensation losses qualify for the risk-spreading provisions of TRIA and would be shared by target insurers, commercial policyholders, and taxpayers. Because aircraft impact and indoor anthrax attacks would be concentrated around a single target building, while losses in an outdoor anthrax attack would be dispersed over hundreds or even thousands of sites, loss distributions in aircraft impact and indoor anthrax attacks have different characteristics than the distribution in an outdoor anthrax attack.

In the aircraft impact and indoor anthrax scenarios, target insurers would pay the largest share of losses (through the aggregate deductible and co-payment) up to a total loss of approximately $75 billion–$95 billion. For a $50 billion annual loss, target insurers would pay $17 billion for aircraft impact attacks and $21 billion for indoor anthrax attacks. TRIA's loss-sharing formula is such that TRIA-covered losses beyond the target insurers' share are paid by commercial policyholders up to a total loss of $25 billion–$30 billion and by taxpayers above that (see Figure S.2). Above a total loss of $75 billion–$95 billion, taxpayers pay the largest share of the loss.

The loss distribution for outdoor anthrax releases is very different. There, the insured losses are expected to be spread among the vast majority of property/casualty insurers in the country. This assumption, in conjunction with the low fraction of losses that would be insured, leads to a situation in which target insurers receive no reimbursement for claims payments until the total loss exceeds $164 billion. At this point the TRIA-covered loss equals the total commercial insurance industry-wide deductible of $44 billion. For total losses greater than $164 billion, all target insurers will have met their deductibles and taxpayers would begin to contribute. TRIA-covered losses paid by target insurers in an outdoor anthrax attack would exceed the insurance marketplace retention; there would be no sur-

charge and general commercial policyholders do not contribute to the losses. Losses would be shared entirely by target insurers and taxpayers.

A significant finding is that taxpayers would pay nothing in a single attack for any of the scenarios examined. In the aircraft impact and indoor anthrax scenarios, taxpayers would pay nothing because the loss ($6 billion–$8 billion; see arrows on the horizontal axes in Figure S.2) would be within the loss range under which the federal government recoups all its initial payout through the commercial policyholder surcharge. In fact, even the World Trade Center attacks would not have required a taxpayer contribution had TRIA been in place. In general, for attacks concentrated on a single target, which would include bombs, aircraft impacts, or indoor biological or chemical attacks, at least three to four very large attacks would need to occur in a year before taxpayers would begin to contribute.

In the outdoor anthrax release scenario, taxpayers would pay nothing because losses would be spread among so many target insurers that few would meet their deductible; hence, the federal government would never even make an initial payout. Note, however, that the total loss in our example simulation is just below the point at which taxpayers would begin to contribute.

Our results show that the ultimate distribution of losses under TRIA depends on the attack mode and cumulative annual losses. The results shown in Figure S.2 illustrate that TRIA creates multiple regimes that differ in terms of the parties' relative shares of terrorism losses—regimes that are summarized in Table S.3.

Uninsured building and business owners and life and health insurers pay part of any loss and so contribute over the entire loss interval. TRIA does not take effect until the TRIA-covered losses reach $5 million, so insurers on sites incurring losses (target insurers) pay the entire loss up to this point. Assuming current terrorism insurance take-up, we estimate that TRIA-covered losses will reach $5 million when total losses in aircraft impact attacks reach $8.5 million or total losses in indoor anthrax attacks reach $6.5 million.

Table S.3
TRIA Loss Distribution Regimes

Who Pays		Total Loss Interval (at current take-up)		
		Aircraft Impact	Indoor Anthrax	Outdoor Anthrax
Uninsured + life and health	Target	$0–$8.5M	$0–$6.5M	$0–$164B
	Target + commercial	$8.5M–$25B	$6.5M–$20B	—
	Target + commercial + taxpayer	$25B–$43B	$20B–$33B	—
	Target + taxpayer	$43B–$167B	$33B–$130B	$164B–$370B
	Unspecified	>$167B	>$130B	>$370B

NOTES: Uninsured = people and businesses who lack coverage for terrorism losses; life and health = insurers of losses in life and health lines, which are not eligible for TRIA coverage; target = insurers of losses covered by policies in commercial insurance lines eligible for TRIA coverage; commercial = all commercial policyholders in the country. M = millions. B = billions.

When total losses exceed these respective values, commercial policyholders begin contributing. Commercial policyholders do not contribute in the outdoor anthrax case and target insurers pay the entire loss up to $164 billion.

In the aircraft impact and indoor anthrax cases, taxpayers begin to contribute once the TRIA-covered loss reaches the $15 billion insurance marketplace aggregate retention amount. We estimate that, on average, this would occur at a total annual loss of about $25 billion ($20 billion) for aircraft impact (indoor anthrax) attacks.

Commercial policyholders cease to contribute once the aggregate deductible plus co-payment reaches the $15 billion retention. We estimate that, on average, deductibles and co-payments would reach the retention at a total loss of about $43 billion ($33 billion) for aircraft impact (indoor anthrax) attacks.

Finally, the responsibility for payment of TRIA-covered losses above the $100 billion program cap are unspecified. This corresponds

to total losses of \$167 billion (\$130 billion) for aircraft impact (indoor anthrax) attacks and \$370 billion for outdoor anthrax attacks.

Loss Distributions Under Potential Modifications to TRIA

Some observers might object to one or another aspect of the distributions accomplished by TRIA, believing that some group could be allocated an inappropriate share under certain circumstances, such as particular modes or sizes of terrorist attacks. Others might believe that the distributions accomplished by the current TRIA might fail to achieve TRIA's objective of maintaining a viable terrorism insurance market. In either case, TRIA would have to be modified to change the loss distribution.

To help elucidate the effects of various possible modifications to TRIA on the overall loss distribution, we estimate the loss distribution that would result when the different provisions of TRIA are changed. In each case, we begin with a loss distribution goal and then estimate the effect through simulation of some possible modifications to TRIA in achieving this goal. Table S.4 summarizes the results, which are described below. The key point is that losses are fixed. This means that any attempts to shift distribution goals will not reduce losses; they will simply shift the burden from one group to another group or groups.

Reduce Uninsured Losses

By design, TRIA helps reduce uninsured terrorism losses in two ways: by mandating that insurers offer coverage for certain losses resulting from terrorist attacks and by limiting the amount that insurers are responsible for paying, thereby allowing premiums to be lower than they would be without TRIA. Two possible modifications that may help further reduce the uninsured losses in a terrorist attack are extending the "make-available" requirement for terrorism insurance to include CBRN coverage and making terrorism insurance coverage

Table S.4
Distribution of Losses Under Possible Modifications to TRIA

Loss Distribution Goal	Possible Modifications	Where Losses Are Transferred
Reduce uninsured losses	Mandate CBRN coverage availability Make terrorism insurance coverage mandatory	Target insurers, commercial policyholders, and taxpayers
Reduce burden on target insurers	Decrease insurer deductibles	Commercial policyholders or taxpayers
Reduce burden on commercial policyholders	Increase insurer deductibles Decrease insurance marketplace retention	Target insurers Taxpayers
Reduce burden on taxpayers	Increase the deductible and/or insurance marketplace retention Decrease TRIA ceiling	Target insurers or commercial policyholders Unknown

mandatory in commercial insurance policies. Reductions in uninsured losses will result in increased losses to target insurers, commercial policyholders, and taxpayers.

A potential drawback of requiring insurers to offer CBRN coverage is that it could leave individual target insurers more vulnerable to losses that exceed their payment capacity. The principal concern among insurers is that damage from a CBRN attack could span a very large geographic area and a long time duration. This concern is exacerbated by the limited availability of reinsurance for terrorism. While the loss-sharing provision of TRIA acts as reinsurance, TRIA provides less flexibility for an insurer to tailor the amount of reinsurance it obtains in different markets (e.g., different geographic areas or insurance lines) than does commercial reinsurance.

Reduce Burden on Target Insurers

If a goal was to reduce the burden on the target insurers, the insurer deductible or co-payment must be reduced. Because in most situations an insurer's deductible will be much greater than its co-

payment, a decrease in the deductible has a greater effect than an equivalent percentage decrease in the co-payment. Decreasing the insurer deductible was proposed by Chalk et al. (2005) to reduce terrorism insurance premiums and increase coverage take-up without increasing the burden on taxpayers. This could be a viable approach, but the burden on taxpayers would be unchanged only for losses below the insurance marketplace retention amount. For a loss above the retention amount, any reduction in losses for target insurers is offset by increased losses to taxpayers.

Reduce Burden on Commercial Policyholders
The burden on taxpayers can be reduced by increasing the deductible and/or the insurance marketplace retention. Either will shift losses from taxpayers to target insurers or commercial policyholders or both, depending on the size of the loss. The burden on taxpayers could also be reduced by decreasing the aggregate ceiling on TRIA loss sharing. A reduction in the ceiling will reduce taxpayers' responsibility for extremely large losses. However, the law, as currently written, leaves open the determination of whether TRIA-covered losses in excess of $100 billion will be paid and, if so, by whom. Consequently, it is not known who would become responsible for losses shifted from taxpayers.

Reduce Burden on Taxpayers
The burden on taxpayers can be reduced either by increasing the deductible and/or the insurance marketplace retention or decreasing the aggregate ceiling on TRIA loss sharing. Either can shift losses from taxpayers to target insurers or commercial policyholders or both, depending on the size of the loss. A reduction in the ceiling will reduce taxpayers' responsibility for extremely large losses. However, the law, as currently written, leaves open the determination of whether TRIA-covered losses in excess of $100 billion will be paid and, if so, by whom. Consequently, it is not known who would become responsible for losses shifted from taxpayers.

Conclusions and Implications for TRIA

In terms of the conclusions, we focus on four areas: (1) the taxpayer role under TRIA, (2) uninsured losses under TRIA, (3) target insurer subsidy, and (4) the renewal of TRIA.

Taxpayer Role Under TRIA

Based on our analysis, we concluded that, overall, the role of taxpayers is expected to be minimal in all but very rare cases, such as serial large attacks on major buildings, highly effective large outdoor anthrax releases, or nuclear detonations. An important conclusion from this finding is that TRIA is not primarily a taxpayer bailout of the insurance industry.

An implication of this conclusion is that alternatives to TRIA need not focus on protecting taxpayers. Thus, alternatives designed to reduce the burden on taxpayers (increasing the deductible and/or the insurance marketplace retention and decreasing the TRIA ceiling) do not need to be high priorities. In addition, deliberations over other TRIA alternatives should discount potential adverse effects on taxpayers, as long as the alternatives do not significantly decrease the point at which taxpayers begin to contribute.

It should also be noted that, even in cases where taxpayers ultimately pay nothing under the TRIA loss distribution formula, there is some indirect effect on taxpayers. First, some fraction of the surcharge on commercial insurance policyholders will likely ultimately be borne by the general public. Second, even when the federal government recoups 100 percent of its initial payout, taxpayers effectively provide an interest-free loan to the target insurers because recoupment occurs in the year(s) after the event. However, the magnitude of these indirect effects would not decrease if the formal taxpayers' share were reduced; in fact, in some cases, the magnitude would increase.

Uninsured Losses Under TRIA

TRIA helps reduce uninsured terrorism losses by making coverage available and by limiting target insurers' exposure. However, our

analysis shows that, even with TRIA in place, a high fraction of losses would go uninsured in each of the attack scenarios examined. Uninsured fractions range from 13 percent of the total loss in the indoor anthrax scenario to 57 percent in the outdoor anthrax scenario.

Above we discussed two options for reducing the expected uninsured losses: (1) extending the "make-available" provision of TRIA to include CBRN attack coverage and (2) making terrorism coverage mandatory. Analysis of the former option shows that it would significantly reduce uninsured losses in the two anthrax scenarios, assuming take-up rose from the current 3 percent to 40 percent. As for the latter option, it could sharply reduce or eliminate uninsured losses, but it faces a host of impediments.

Another alternative that would reduce uninsured losses is to decrease insurer deductibles or co-payments. While the Treasury Secretary has stated that "[t]he Administration would accept an extension [of TRIA] only if it . . . increases the dollar deductibles and percentage co-payments" (Snow, 2005), that concern is based on the desire to minimize the government's financial responsibility under TRIA—a concern that is largely unwarranted based on our analysis. In fact, reducing uninsured losses may ultimately reduce taxpayer liability. As demonstrated most recently with Hurricane Katrina, governments often feel compelled to compensate uninsured victims after a disaster. As such, the expectation of post-disaster assistance can actually undermine the demand for insurance against future catastrophes. Thus, facilitating the purchase of insurance may decrease the ultimate taxpayer burden.

Target Insurer Subsidy

A core element of TRIA is its risk-spreading formula that limits the exposure of target insurers in a terrorist attack. After target insurers pay claims, they are partially reimbursed for their losses by funds that ultimately derive from general commercial insurance policyholders and from taxpayers. The fact that primary target insurers' losses are subsidized has been identified as a potentially serious flaw of TRIA. According to some arguments, by subsidizing target insurer losses, TRIA crowds out development of some reinsurance markets, impedes

efforts to price premiums accurately and to link premium prices to risk-reduction measures, and delays the development of private capacity to absorb any future losses. In effect, the argument states that the design of TRIA actually undermines its own objective of facilitating the development of a private terrorism insurance market.

While our analysis does not provide any insight into the effect these subsidies may have on the development of a private terrorism insurance market, it does provide quantitative estimates of their magnitude, an important first step toward addressing this issue. We find that, for aircraft impact and indoor anthrax attacks, the subsidy increases from 30 percent of target insurers' loss at a low total loss to 60 percent of target insurers' loss at the TRIA cap of $100 billion in TRIA-covered losses.

At the same time, resolving this issue and ultimately developing a private market will require additional research about the risk of different types of terrorist attacks and about what types of preparedness measures are available to the private sector and how effective they would be. While policyholders could take steps to reduce their risk, options are very limited for some types of attacks, such as an aircraft impact. More generally, however, even if the risk reduction realized from some steps could be quantified, the absolute risk of most terrorist attacks, or even the relative risk in the context of other types of disasters, remains highly uncertain, making premium pricing very difficult.

The Renewal of TRIA

While our analysis is not intended to be a comprehensive analysis of the decision about whether to renew TRIA, our analysis does provide information that bears on the decision. First, to the extent that taxpayer involvement is not a concern for most terrorist attacks, budgetary considerations do not seem relevant as a motivation for allowing TRIA to sunset. We note that TRIA comprises more than a provision for a taxpayer subsidy and hence the lack of a taxpayer role does not mean that TRIA has no influence on the terrorism insurance market. Target insurers still receive substantial subsidies from the surcharge on commercial insurance policyholders, and TRIA makes property

insurance for conventional terrorism available to policyholders, both of which act to make terrorism insurance more available and affordable.

Second, since allowing TRIA to sunset will likely increase terrorism insurance premiums and reduce take-up, at least initially, the failure to renew TRIA will likely contribute to the problem of uninsured losses instead of reducing it.

Finally, while one of the arguments against the renewal of TRIA is that the subsidy of target insurer losses discourages efforts to price terrorism insurance and develop a private terrorism insurance market, the relationship between this subsidy and the development of a functional market is quite controversial; as such, determining the validity of the argument will require further study.