TRIA AFTER 2014

EXAMINING RISK SHARING UNDER CURRENT AND ALTERNATIVE DESIGNS

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EXECUTIVE SUMMARY

Overview of Terrorism Insurance

Despite the potential threat of terrorist attacks on American soil and in foreign countries for decades, the risk of terrorism in the United States was considered sufficiently low that insurance companies generally offered coverage for terrorism losses within their standard commercial insurance policies (outside of ocean marine) at no incremental premium over the standard fire premium, and coverage was widely available. The devastating coordinated attack by Al Qaeda on September 11, 2001 (9/11 hereafter) that resulted in record insured losses of nearly $44 billion (2014 dollars) quickly changed this view.

Faced with the sudden realization that terrorist attacks could be catastrophic, insurers and reinsurers (who covered approximately two-thirds of the insured losses from 9/11) began to exclude coverage for terrorism in the United States. When exclusions were prevented by law, as in the case of workers' compensation, insurers initiated plans to non-renew a significant number of commercial policies in high-risk metropolitan areas. As a result, most businesses operating in the United States found it increasingly difficult to purchase commercial property insurance that included the risk of terrorism. Premiums for workers' compensation insurance increased significantly, and real estate and commercial ventures were stalled because of an inability to obtain the requisite insurance coverage.

Current Design of TRIA

Given the retrenchment of the insurance and reinsurance markets for terrorism coverage and the demand by commercial enterprises for terrorism coverage to meet lending requirements or protect against the potential for future losses, the Terrorism Risk Insurance Act (TRIA) was passed in 2002 to stabilize the U.S. economy by establishing a public-private risk-sharing arrangement between the federal government, the insurance industry and commercial policyholders.

First, TRIA instituted a *mandatory offer requirement* whereby all U.S. primary insurance companies had to offer coverage against terrorism risk for specified commercial lines of insurance on the same terms and conditions as other perils provided by their commercial insurance policies. (Firms are not required to purchase this coverage unless mandated by state law, as is normally the case for workers' compensation insurance.)

At the same time, TRIA established a risk-sharing mechanism between the insurance industry, the federal government and all commercial insurance policyholders in the U.S. for covering insured losses from future terrorist attacks. TRIA was designed as a temporary program, but the continued absence of a viable private terrorism insurance market led to the Terrorism Risk Insurance Extension Act (P.L. 109-144) in 2005 and the Terrorism Risk Insurance Program Reauthorization Act (P.L. 110-160) in 2007 when the program was renewed for seven years. These Acts increased the portion of the risk covered by the insurance industry and commercial policyholders under TRIA.

Exploring Different Loss-Sharing Mechanisms for a Modified Renewed TRIA

TRIA is set to expire at the end of 2014. As we issue this report, the Senate and the House of Representatives are considering different TRIA extension bills, which if passed, would have to be reconciled in conference. The full Senate passed S. 2244 in July 2014; the House Financial Services Committee passed H.R. 4871 in June 2014. Each bill would renew TRIA for another seven and five years, respectively. These bills would modify the current program in different ways, which we discuss in this report. To inform the current renewal discussions on the structure of TRIA, this report provides an analytical examination of the impact of terrorism loss-sharing for the different stakeholders under the current program and alternative risk-sharing designs.

An Analysis of Deductible/Surplus (D/S) Ratio across the Insurance Industry

One measure of particular interest to insurers, regulators and rating agencies alike is the ratio of the insurer's TRIA deductible amount in relation to its surplus. A higher deductible/surplus (*D/S*) ratio implies that the insurer is more exposed to losses from a terrorist attack. While there is no specific threshold that applies to all insurers given their different portfolios, a *D/S* ratio greater than 0.15 is generally regarded as a high measure of relative exposure to terrorism.

Accessing market data from the rating agency AM Best, we were able to determine the *D/S* ratios of 764 insurance groups (hereafter, insurers or insurance companies) operating in the United States, and then calculate changes in the *D/S* ratio as the TRIA deductible percent (*D**) is varied from 15% (2005 level) to 20% (current level), to 25% (hypothetical) for each of the top 30, top 50, top 100 and top 450 insurers. We find:

- Among the top 30 insurers (that represent 67% of the market based on TRIA-line direct earned premiums), only 3 have a *D/S* ratio of 0.15 or greater when *D**=15%; this increases to 7 insurers under the current *D**=20%, and to 11 insurers should *D**=25%.

- For our sample of 450 insurers (that represent 99.8% of the market based on TRIA-line direct earned premiums), when *D**=15%, 95 insurers would have a *D/S* ratio greater than 0.15. When *D**=20%, 140 insurers would have a *D/S* ratio greater than 0.15. When D*=25%, 175 insurers (39% of the top 450 insurers) would have a *D/S* ratio greater than 0.15, and 69 insurers would have a *D/S* ratio greater than 0.3.

Our analysis reveals that a D/S ratio of 0.15 – considered an important exposure threshold by rating agencies – has already been reached or exceeded by a number of insurers under the current design of the TRIA program. Should the deductible level be increased again, some companies could face a significant risk of insolvency or financial distress after a severe terrorist attack because they will not have sufficient capital to pay their claims. Other insurers might stop selling insurance to some of their commercial clients to avoid having too high a concentration of terrorism exposure in one location (e.g., a large city).

Recouping Federal Expenditures Through a Mandatory Recoupment Mechanism

The federal government can recoup federal outlays made under TRIA by levying surcharges on all commercial insurance policyholders via a mandatory recoupment component and a discretionary one. More specifically, under the program's *mandatory recoupment mechanism*, the federal government is required to recoup **133% of its payments** below the *insurance industry marketplace aggregate retention* ("retention") and above the industry-wide insurer losses based on their individual deductible and coinsurance during the calendar year. Additional recoupment is at the discretion of the federal government.

Senate bill S. 2244 proposes an increased retention of $37.5 billion after five years; House bill H.R. 4871 introduces a variable retention based on the sum of insurers' deductibles under TRIA. The House bill would also increase the mandatory recoupment rate against all commercial insurance policyholders (whether they have purchased terrorism insurance or not) from the current 133% to 150%. As we show in our analysis this recoupment has not received the attention it deserves given the significant financial burden it could impose on businesses in America.

Analysis of the Impact of a Modification of the Program Trigger

If a certified act of terrorism occurs, no compensation is paid under TRIA unless aggregate insurance industry losses exceed a *program trigger* of $100 million. The program trigger was raised from $50 million to $100 million in 2007. Under the House bill, the program trigger would be incrementally raised to $500 million for conventional terrorist attacks [i.e., non- chemical, biological, radiological or nuclear (CBRN)] while it would remain at $100 million in the Senate bill. Of the 764 insurance groups in the AM Best database, 58 groups currently have a TRIA deductible that is already in excess of the $100 million trigger, effectively invalidating the impact of the TRIA trigger in determining loss-sharing by the federal government for these larger firms. Our analysis shows that the program trigger is more of a potential concern for small insurance firms who may not have been able to achieve an acceptable spread of risk, possibly due to geographic restrictions, lack of reinsurance or limited risk management actions.

Economic Impact (including Property, Business Interruption and Workers' Compensation Loss) of Plausible Attacks

For this report, the modeling firm Risk Management Solutions (RMS) constructed three specific attack mode scenarios: (a) a 10-ton truck bomb; (b) 1-ton Sarin gas release; and (c) 1-kiloton nuclear detonation bomb. Key high-profile targets were identified in the central business districts of four major cities: Chicago, Houston, Los Angeles and New York. We quantify the economic impact of these three attack scenarios by distinguishing losses by two lines of insurance: property (including business interruption) and workers' compensation.

Who Will Pay after a Terrorist Attack? Analysis of Loss Sharing under Different TRIA Designs

We undertake a series of analyses to assess the impact of varying four TRIA design parameters: (a) insurers' deductibles; (b) level of the sharing arrangement (i.e., coinsurance) between insurers and the federal government; (c) insurance industry marketplace aggregate retention that determines what portion of the insured losses paid by the federal government will be mandatorily recouped against all commercial policyholders in the U.S.; and (d) percentage rate of the mandatory recoupment against all commercial policyholders.

Note: These analyses assume that firms that suffer losses from a terrorist attack will not receive compensation from the federal government for the uninsured portion of their loss. However, past experience from 9/11, the financial crisis and recent natural disasters suggests that the government might assist firms suffering uninsured losses.

Findings

As an illustration, should an attack occur in New York City:

- Under the **current design** of TRIA, **American taxpayers** will not be responsible for any payments after mandatory recoupment **until the total commercial losses** (insured and uninsured) from a terrorist attack **exceed $40 billion**.

- **Commercial policyholders** will always have to pay a portion of the cost of a terrorist attack under the current TRIA program if the total insured loss to all firms is **less than $80 billion**. We feel the significant exposure of commercial policyholders has not been widely discussed.

Based on **Senate bill S. 2244** [insurers' deductible remains at the current level of 20%; insurers' share of losses above their deductible (i.e., coinsurance) increases to 20%; insurance industry retention incrementally increases to $37.5 billion over five years and the recoupment rate against commercial policyholders remains at the current level of 133%], we find:

- **American taxpayers** will not be responsible for any payments after mandatory recoupment by the federal government **until the total commercial losses from a terrorist attack** (insured and uninsured) **exceed $59 billion**.

- **Insurers will always pay more than the federal government** after the mandatory recoupment has been levied **even when total commercial insured and uninsured losses are as high as $100 billion**. When damage reaches this level, insurers will be responsible for $33 billion in payments, the federal government almost $31 billion, commercial policyholders over $5.7 billion and the remaining $30 billion would be paid by the uninsured firms that suffer the loss. The federal government has the option to recover its almost $31 billion in outlays by a discretionary recoupment levied against commercial policyholders.

- Under the mandatory recoupment of 133%, **commercial policyholders would always pay more than $10 billion** when total losses from terrorist attacks are in the $38 billion to $82 billion range. The maximum they would pay – $17.9 billion – is reached when total losses are $54 billion.

Based on the **proposed House bill H.R. 4871** [insurers' deductible remains at the current level of 20%; insurers' share of losses above their deductible (i.e., coinsurance) increases to 20% for non-CBRN attacks on which our analysis focuses; insurance industry retention is determined by the sum of insurers' deductibles that can vary over time; recoupment rate against commercial policyholders increases to 150%], we find:

With a retention of $32 billion:

- **American taxpayers** will not be responsible for any payments after mandatory recoupment by the federal government **until the total commercial losses from a terrorist attack** (insured and uninsured) **exceed $52 billion.** (The difference from the $59 billion in the Senate bill is due to the House bill's lower insurance industry retention used to determine the mandatory recoupment mechanism, based on 2012 data.)

- **Insurers will pay more than the federal government** after the mandatory recoupment has been levied, **until total insured and uninsured losses reach $91 billion.**

- **At $100 billion loss**, **insurers will be responsible for the same $33 billion** as they would under the Senate bill, but **commercial policyholders will not pay anything** under the mandatory recoupment mechanism because the insurance industry retention of $32 billion is below the insurers' aggregate payments. Hence, the government recoups nothing from the policyholders and pays the entire $36.84 billion unless it elects to exercise its authority to levy a discretionary recoupment against commercial policyholders.

- Despite the higher 150% recoupment rate, at a retention rate of $32 billion, **commercial policyholders would be less exposed to the mandatory recoupment under the proposed House bill** compared to the Senate bill. They would always pay more than $10 billion when losses from terrorist attacks are in the $36 billion to $59 billion range. The maximum they would pay – $15.3 billion – is reached when losses are $46 billion.

With a retention of $44 billion:

- **American taxpayers** will not be responsible for any payments after mandatory recoupment by the federal government **until the total commercial losses from a terrorist attack** (insured and uninsured) **exceed $74 billion.**

- **Insurers will always pay more than the federal government** after the mandatory recoupment has been levied, **even when total commercial insured and uninsured losses are as high as $100 billion**.

- **At $100 billion loss, insurers will be responsible for the same $33 billion** as they would under the Senate bill, but **commercial policyholders will now pay $16.26 billion** (i.e., $44 billion minus $33 billion multiplied by 150%). **Taxpayers would pay over $20.58 billion.**

- **With the higher 150% recoupment rate and a retention of $44 billion, commercial policyholders would typically be much more exposed to the mandatory recoupment under the proposed House legislation**; they would always pay more than $10 billion when losses from terrorist attacks are in the $36 billion to over $100 billion range. The maximum they would pay – $26.8 billion – is reached when losses are $63 billion.

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SECTION 1.

U.S. TERRORISM INSURANCE BEFORE AND AFTER 9/11: AN OVERVIEW

1.1. Terrorism Insurance Before 9/11

Terrorism has been a persistent threat in many parts of the world for decades. The first major terrorist attack in the United States, however, occurred in February 1993, when the terrorist organization Al Qaeda detonated a large truck bomb in the garage of the North Tower of the World Trade Center (WTC) in New York City, closing Tower 1 for six weeks and Tower 2 for four weeks. Although the building did not collapse (as the terrorists planned), the attack killed six people and caused over $750 million in insured losses (Kunreuther and Michel-Kerjan, 2004).

In April 1995, Timothy McVeigh detonated a bomb outside the Alfred Murrah Federal Building in downtown Oklahoma City, killing 168 people and injuring another 700. The attack damaged 324 buildings within a sixteen-block radius and resulted in about $650 million worth of damage. The federal government owned the building and self-insured against potential losses. The importance of the Oklahoma City bombing was that it demonstrated that the threat of terrorism could also come from domestic sources and that a successful attack could be carried out with readily available materials and not a great level of sophistication to inflict massive losses.

Despite these two terrorist attacks on U.S. soil, and several other costly attacks outside of the U.S.,[1] the threat of terrorism in the U.S. was still deemed to be quite small and not catastrophic in nature throughout the 1990s. Reflecting this view, insurance companies offered most businesses full coverage for terrorism losses within their standard commercial insurance policies (outside of ocean marine) at no incremental premium over the standard fire charge (Wharton Risk Center, 2005).

The devastating coordinated attack by Al Qaeda on the WTC in New York City, the Pentagon in Washington, DC and in Pennsylvania on September 11, 2001 (9/11 hereafter) changed this view.

1.2. Terrorism Insurance After 9/11

The 9/11 attacks killed over 3,000 people and injured another 2,250 from many different nationalities and resulted in record insured losses of nearly $44 billion (in 2014 dollars) (Wilkinson and Hartwig, 2010). Due to the international nature of insurance and reinsurance markets, these losses were paid by nearly 120 insurers and reinsurers, many of them headquartered outside of the United States. Without this financial protection, affected firms would have had to bear the losses on their own with many facing severe liquidity challenges and many others likely facing bankruptcy unless the government responded with significant disaster relief.

In addition to reimbursements provided by insurers, the Federal Victims Compensation Fund, established by Congress in the aftermath of 9/11, provided over $9 billion (2014 prices) to 9/11 civilian and first responder victims' families (Congressional Budget Office, 2005; Dixon and Stern, 2004). Philanthropic charitable donations also reached an unprecedented level of $4 billion for victims of the attacks (2014 prices) (Renz et al., 2003; The Foundation Center, 2004).

Faced with the sudden realization that terrorist attacks could be catastrophic, insurers and reinsurers (who covered approximately two-thirds of the insured losses from 9/11[2]) started excluding coverage for terrorism in the United States. When terrorism exclusions were prevented by law as in the case of workers' compensation or for "fire following" commercial property coverage in jurisdictions that adopted the standard New York Statutory Fire Policy but do not allow terrorism exclusions (e.g., California, Georgia, Illinois, New York), insurance companies initiated plans to non-renew a significant number of commercial policies, especially in high-risk metropolitan areas.[3, 4]

As a result, most businesses operating in the United States found it increasingly difficult to purchase commercial property insurance that included the risk of terrorism. Premiums for commercial property and workers' compensation insurance increased significantly and real estate and commercial ventures were stalled because of an inability to obtain the requisite insurance coverage.[5]

1.3. The Passage of TRIA in 2002

Responding to these concerns, Congress passed and President George W. Bush signed into law the Terrorism Risk Insurance Act (TRIA) of 2002 to serve as a temporary measure to increase the availability of risk coverage for terrorist acts (U.S. Congress, 2002). TRIA was designed to share losses between the insurance industry, policyholders and the federal government.

To ensure that terrorism coverage was available for commercial firms, TRIA instituted a *mandatory offer requirement* whereby all U.S. primary insurance companies were required to offer to cover the risk of terrorism on the same terms and conditions as coverage for other perils provided by their commercial insurance policies. That is, the stated coverage limits and deductibles for the peril of terrorism must be the same as coverage terms for other perils covered by the insurance policy.[6] In the same way, if there are restrictions or coverage exclusions on a standard commercial insurance policy for other perils, then terrorism coverage also can apply these exclusions to the peril of terrorism. For example, a significant portion of the loss associated with a terrorist attack using chemical, biological, radiological and nuclear (CBRN) weapons would likely fall under standard nuclear and pollution and contamination exclusions in commercial property policies. As such, only a portion of the property losses from a CBRN attack actually may be insured and subject to TRIA coverage.[7] **Note:** Firms are not required to purchase this terrorism insurance unless mandated by state law as is the case with workers' compensation.

In addition to the mandatory offer requirement, TRIA established a risk-sharing mechanism between the insurance industry, the federal government and all commercial insurance policyholders in the U.S. (whether or not they are insured against terrorism) for financing any losses associated with a future terrorist attack.[8] TRIA was originally intended to be a temporary measure until the private market developed the means to insure the risk of terrorism; however, TRIA was extended and modified in 2005, and then again in 2007 due to the absence of a viable private terrorism insurance market. The Terrorism Risk Insurance Extension Act (P.L. 109-144) was passed in 2005 and modified in 2007 through the Terrorism Risk Insurance Program Reauthorization Act (P.L. 110-160). These Acts increased the portion of the risk assumed by the insurance industry

in the public-private partnership as we discuss in more detail in the next section. The current legislation is set to expire on December 31, 2014 unless renewed by Congress and President Barack Obama.

1.4. Focus of the Report

As we issue this report, the United States Senate passed S. 2244, and the House Financial Services Committee passed H.R. 4871 (henceforth referred to as the "Senate bill" and "House bill").[9] Both bills would renew TRIA (for seven and five years, respectively) but each bill proposes different modifications to the current program. This report examines the loss-sharing mechanisms for the different stakeholders under the current program and alternative designs, including those two bills.

In this report, we address the following questions:

- **Under the current design of TRIA, how does the terrorism exposure of the 764 insurance companies operating in the United States compare to their risk-bearing capacity as measured by capital or surplus?**

- **What would be the direct losses to two distinct lines of business – property (including business interruption) and workers' compensation – in the wake of plausible scenarios of terrorist attacks in Chicago, Houston, Los Angeles and New York?**

- **How would the loss distribution change between insured and non-insured commercial policyholders, insurers and the federal government (i.e., taxpayers) under modifications of certain provisions in TRIA, compared to its current design?**

The analysis provided in this report complements recent publications on terrorism risk terrorism insurance,[10] several Congressional hearings that took place in the House and the Senate in 2012, 2013 and 2014, insurance industry reports such as those regularly produced by leading insurance brokers Marsh (2013) and Aon (2013) on the take-up rates and terrorism pricing based on their portfolio of clients, the President Working Group's[11] reports (2010, 2014) and other government publications (e.g., CRS (2013), CBO (2014), GAO (2014)) as well as Conference Proceedings and publications by the Organization for Economic Development and Cooperation (OECD), which has taken a leading role in bringing together international decision makers concerned with terrorism risk insurance to collaborate and improve their respective national solutions (OECD 2005; 2010).

This report focuses on how certain modifications of TRIA's current design would impact insurers' exposure and the loss-sharing across different stakeholders should another large-scale attack occur. It is organized as follows:

- **Section 2** outlines the current structure of the TRIA partnership between the federal government, insurers and commercial policyholders, and loss sharing arrangements after an attack.

- **Section 3** analyzes the ratio between an insurer's deductible under TRIA and its surplus (the net worth of the company) for 764 insurers doing business in the United States with a more detailed analysis for the top 30 insurers under current and modified designs of TRIA. We also examine the impact on the balance sheets of large and small insurers in the wake of a terrorist attack if the program trigger for TRIA is increased from its current level of $100 million (as proposed in the House bill that would raise it to $500 million).

- **Section 4** characterizes three types of terrorist attack scenarios – one conventional and two non-conventional – and estimates likely losses by the modeling firm Risk Management Solutions (RMS). These data are then used to examine the impact of the current version of TRIA and proposed changes.

- **Section 5** determines the loss distribution across stakeholders under different scenarios, loss levels and locations of the attack. We focus on four major cities in four different states across the U.S.: Chicago, Illinois; Houston, Texas; Los Angeles, California; and New York City, New York. This section also compares the current design of TRIA with risk-sharing alternatives currently being discussed by Congress to reduce the federal government's exposure to future losses.

- **Section 6** poses a set of questions for consideration as Congress modifies its current legislative proposals.

SECTION 2.

CURRENT STRUCTURE OF THE TRIA PARTNERSHIP

Under TRIA's current design, events certified as terrorism by the federal government and resulting in over $100 million in insured losses in TRIA-eligible lines of business would be shared as follows:

- Commercial policyholders would be responsible for paying any losses within their standard insurance policy deductibles.

- Commercial insurance companies would then provide coverage for all losses in excess of these policy deductibles, provided that total insurance industry losses did not exceed $100 billion (often referred to as the TRIA "program cap").

- The federal government would then reinsure the commercial insurer's terrorism losses in excess of a TRIA deductible percent (D^*), with the deductible annually set equal to **20% of that company's prior year's direct earned premium (DEP) for the lines covered under the program**. D^* has increased from 1% in 2002 to 20% since 2007.

- Losses in excess of each insurer's deductible (D) would be shared **15%-85%** between the insurance company and the federal government.

- Should total insurance industry losses exceed $100 billion, primary insurers are responsible for reimbursing policyholders **only for their proportionate share of losses up to $100 billion**[12] and Congress shall determine the procedure and source of any payments for the uninsured losses.[13]

- The federal government recoups its payments under TRIA by levying surcharges on all commercially insured policyholders. More specifically, under a *mandatory recoupment mechanism*, the federal government is required to recoup **133% of its payments** below the *insurance industry marketplace aggregate retention* ("retention") – an amount currently set at $27.5 billion – and above the aggregate insurers' uncompensated outlays (i.e., insurer losses within the deductible and coinsurance) during the calendar year.[14] In the event that uncompensated insurer outlays across the insurance industry exceed $27.5 billion, the U.S. Treasury has the option to recoup any and all federal payments through a discretionary recoupment mechanism.

Figure 2.1 depicts the public-private loss sharing for a representative insurer covering terrorism for its commercial policyholders (either through workers' compensation or property insurance) under the current TRIA arrangement when total insured losses are less than $100 billion.[15] If a terrorism loss incurred by an insurance company (i) is less than its TRIA deductible amount (D_i), as determined as a percentage of its prior year Direct Earned Premium (DEP) in TRIA-eligible lines, the insurer does not receive any reimbursement from the federal government. This situation is illustrated by an insured loss of L_1 where the insurer's payment is represented by the oblique lines on the left side of Figure 2.1.

When the insured loss from a certified terrorist attack exceeds the program trigger and is above the insurer's deductible, as depicted by L_2 in Figure 2.1, the insurer pays the entire claim and the federal government reimburses the insurer for 85% of the losses above its deductible. Hence the insurer ends up paying 15%. The horizontal lines on the right side of the figure represent the federal payment. D_i plays an important role in determining loss sharing between insurers and the federal government and can amount to very large sums for many insurers. Should a terrorist attack occur in 2014, insurers will be responsible for losses equal to 20% of their DEP in 2013.
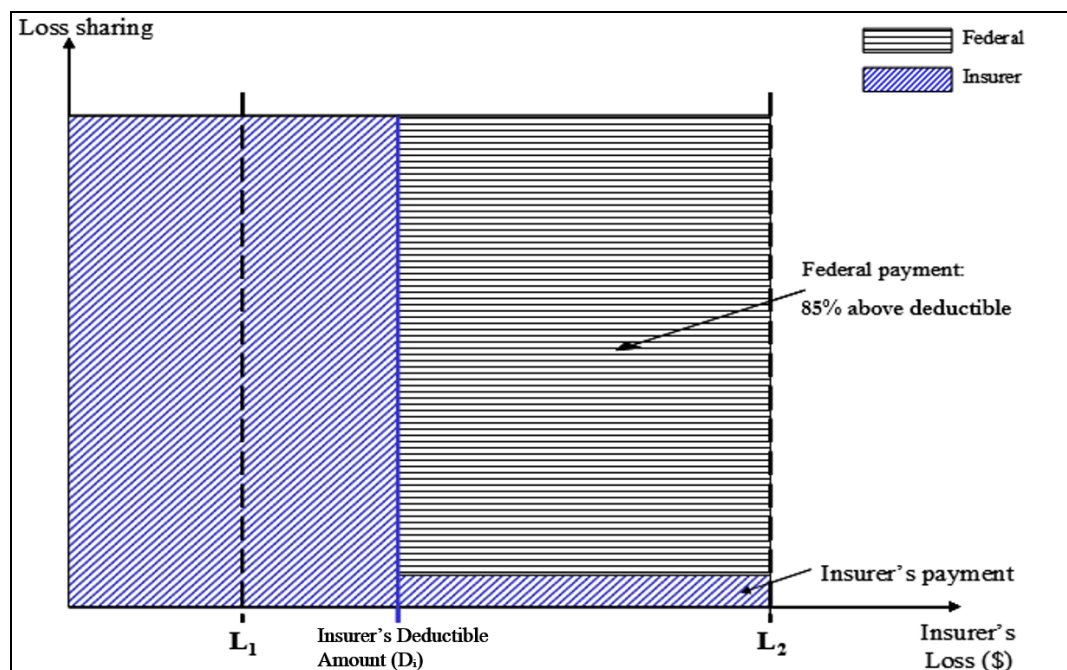

FIGURE 2.1: LOSS SHARING UNDER TRIA BETWEEN AN INSURER AND THE FEDERAL GOVERNMENT

If the entire insurance industry suffers terrorism losses on their U.S. portfolio that requires the government to cover a portion of their claims, then these outlays shall be fully or partially recouped *ex post*, as described above. Insurers levy this surcharge against all commercial property and casualty policyholders, whether or not they had purchased terrorism insurance, and transfer the collected funds to Treasury.

Figure 2.2 depicts the repayment schedule in 2014 between all the insurers whose policyholders suffer an insured terrorist attack (the area depicted by oblique lines), all commercial policyholders (solid area) and the taxpayers (area depicted by horizontal lines) after the federal government has reimbursed all insurers for 85% of their claims payments above their individual TRIA deductible level. In the example considered here, since the total insured loss L for the entire insurance industry is greater than $27.5 billion but total losses retained by insurers within their deductibles and coinsurance requirements are below the market aggregate retention of $27.5 billion, a portion of the federal outlays are subject to the mandatory recoupment. Should the federal government elect to exercise its authority to levy a discretionary recoupment surcharge against commercial policyholders to fund federal outlays not covered by the mandatory recoupment mechanism, there would be a 1-for-1 reallocation of loss from taxpayers to commercial policyholders. For the remainder of our analysis, we do not allocate losses to the discretionary recoupment mechanism as it reflects one of many alternatives by which the federal government could fund uncompensated federal outlays.
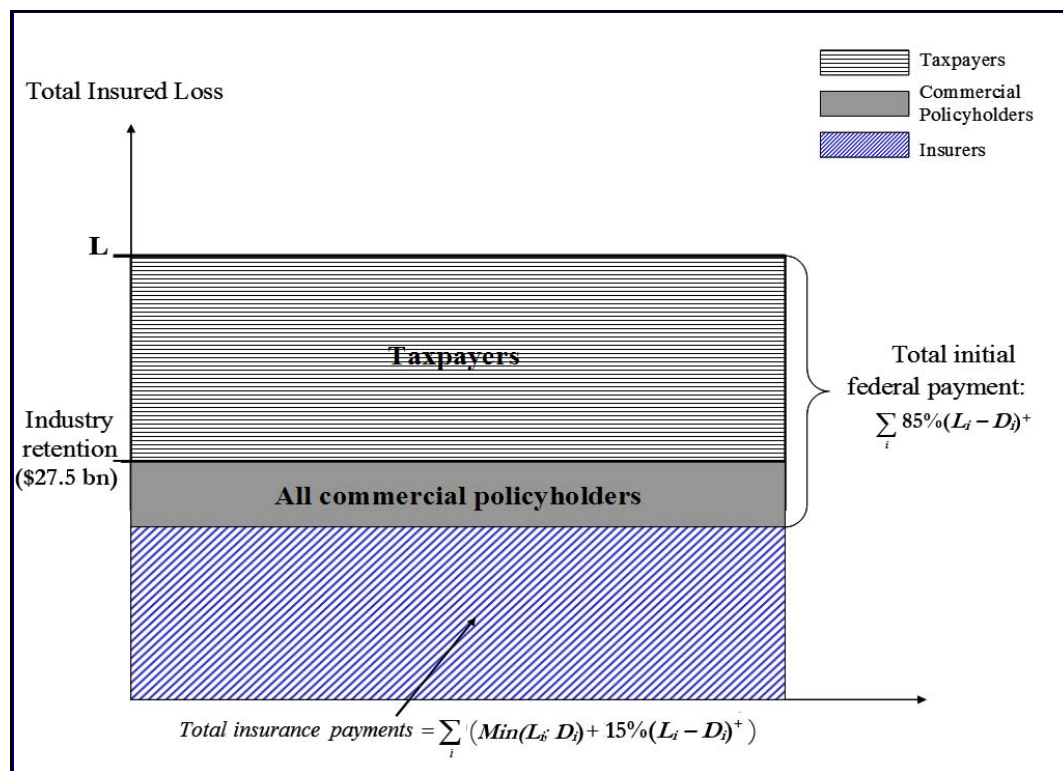

FIGURE 2.2: OVERALL LOSS SHARING UNDER TRIA IN 2014

SECTION 3.

INSURERS' EXPOSURE IN PROVIDING TERRORISM INSURANCE

Evaluating the risk of terrorism for any given insurance company generally involves constructing terrorism attack scenarios and assessing the magnitude of simulated losses from these attacks relative to each company's surplus. This structured scenario approach, while standard practice by most insurers, requires a detailed understanding of the impact of each scenario on the exposure level based on the portfolio of terrorism coverage for each insurer. Not having this level of information for every insurance company's line of business, we obtain a proxy of an insurer's exposure to terrorism by evaluating its deductible (D_i) under TRIA. Given the obligation of insurers under TRIA to offer terrorism coverage to all their commercial policyholders, the amount of loss that an insurer will eventually bear is indeed largely determined by its deductible. Since an insurer will have to pay 100% of its deductible before it shares any losses with the federal government, D_i, provides a good approximation of its exposure to terrorism risk.

If insurance industry losses from terrorism are less than the program trigger (currently $100 million), then there is no loss-sharing arrangement with the federal government. In this case, small insurers in particular may be concerned with the impact that suffering a relatively large loss from a terrorist attack will have on their surplus. We examine how increasing the program trigger from $100 million to $500 million could impact on insurers' exposure to terrorism risks.

3.1. An Analysis of Insurers' Deductible/Surplus Ratios

Of particular interest to insurers, regulators and rating agencies alike is the ratio of an insurer's deductible amount (D), determined by the TRIA percent deductible of DEP (D^*), to its surplus (S) that reflects insurer's risk-bearing capital to pay all its losses.[16] If an insurer wishes to take on more risk, it must have the risk-bearing capacity in the form of capital to support that risk or purchase reinsurance to cover part of the loss. Insurance regulators and rating agencies, in their efforts to assure policyholders that insurers will be able to pay their losses, devote significant effort towards evaluating the adequacy of each insurer's capital relative to the amount and types of risk it is taking on. Holding an adequate amount of capital or purchasing private reinsurance is critical to the continued viability of an insurer. Throughout the remainder of this paper, we will evaluate insurers' exposure to terrorism in terms of their total surplus or total risk-bearing capacity.

Of course, an insurer's capital or surplus exists to support all lines of business and all forms of risk, not just the risk of terrorism.[17,18] As a result, regulators, rating agencies, and risk professionals typically look to limit how much exposure any one risk contributes to an insurer's risk portfolio. As we discuss below, for the risk of terrorism, this threshold tends to be between 10-15% of surplus, above which insurers have to consider taking additional actions to reduce their exposure through portfolio management actions (e.g., non-renewal of policies).

The higher an insurer's deductible/surplus (*D/S*) ratio, the more exposed the insurer is to losses from a terrorist attack. Our interest is in determining how vulnerable insurers are to the possibility of suffering a large loss relative to their surplus. While insurers differ in portfolio composition, a *D/S* ratio greater than 0.15 for terrorism insurance is considered to be a relatively high level of exposure to terrorism by rating agencies, regulators and insurers. Insurers with large deductible amounts (*D*) relative to their surplus (*S*) are the ones most at risk if they are providing terrorism coverage to most of their policyholders.

The *D/S* ratio could overstate the terrorism exposure of any given insurance company if the insurer were able to purchase reinsurance against terrorism losses, as reinsurance is not captured in the *D/S* measure, or if individual insurer's take-up rates were very low. However, the availability of reinsurance for terrorism risk is estimated to be only in the range of $6-10 billion for the U.S. market, as compared to $90-120 billion for natural catastrophe risk,[19] so we do not believe the failure of the *D/S* ratio to capture reinsurance materially changes our conclusions. At the same time, the *D/S* ratio may understate an insurer's exposure to terrorism, as it fails to capture each insurer's exposure to terrorism losses from non-TRIA-eligible lines of business (e.g., commercial automobile, group benefits) some of which were dropped in prior iterations of the legislation. Although the *D/S* metric is an important exposure measure, it is not intended to capture each insurer's exposure to any given event as this will also depend on the insurer's underwriting acumen and risk management capabilities.

Accessing market data from rating agency AM Best, we were able to determine the *D/S* ratios of 764 insurance companies operating in the United States and then calculate changes in the *D/S* ratio for the top 30, top 50, top 100 and top 450 insurers when one applies different deductible levels under TRIA. Table 3.1 characterizes our estimates of the top 30 insurers' *D/S* ratio based on company surplus *(S)* at the end of 2012 for the U.S. statutory companies for each insurance group for *D**=20% and 25%. In measuring surplus, we did not adjust for any potential capital or financial support that may be available outside of the United States for internationally active insurance groups (e.g., Allianz, Zurich). While the potential for such external capital is an important consideration in evaluating the *D/S* ratio, we focus our analysis on the capital domiciled within the U.S. statutory entities given our focus on domestic capital adequacy for U.S. regulated entities.

TABLE 3.1: *D/S* ANALYSIS FOR TOP 30, 50, 100, 450 AND 764 INSURERS (2012 DATA)

Insurers	Surplus (in $ billion)	Direct Earned Premiums in TRIA Eligible Lines (in $ billion)	20% TRIA Deductible (in $ billion)	*D/S* Ratio (20% Deductible)	*D/S* Ratio (25% Deductible)
1. Liberty Mutual Insurance Companies	$16.8	$12.0	$2.39	14.26%	17.82%
2. Travelers Group	$19.3	$10.9	$2.18	11.29%	14.12%
3. American International Group	$29.2	$10.4	$2.08	7.14%	8.93%
4. Zurich Financial Services NA Group	$7.7	$6.7	$1.35	17.57%	21.97%
5. Hartford Insurance Group	$14.2	$5.8	$1.17	8.22%	10.28%
6. Chubb Group of Insurance Companies	$13.8	$4.9	$0.98	7.10%	8.87%
7. CNA Insurance Companies	$10.0	$4.6	$0.92	9.23%	11.54%
8. Nationwide Group	$13.8	$4.5	$0.89	6.45%	8.06%
9. ACE INA Group	$5.7	$4.1	$0.82	14.41%	18.02%
10. State Farm Group	$65.3	$3.1	$0.62	0.95%	1.19%
11. Allianz of America Companies	$3.6	$3.0	$0.61	16.93%	21.17%
12. FM Global Group	$7.5	$3.0	$0.60	7.99%	9.98%
13. W. R. Berkley Insurance Group	$4.7	$2.7	$0.54	11.64%	14.55%
14. Assurant P&C Group	$1.4	$2.7	$0.53	38.09%	47.61%
15. Farmers Insurance Group	$5.6	$2.6	$0.53	9.33%	11.66%
16. Philadelphia Ins Cos/Tokio Marine US	$4.2	$2.3	$0.46	11.00%	13.76%
17. QBE Americas Group	$2.3	$2.2	$0.44	19.08%	23.84%
18. Cincinnati Insurance Companies	$3.9	$2.1	$0.43	10.90%	13.63%
19. Berkshire Hathaway Insurance Group	$106.7	$1.9	$0.38	0.35%	0.44%
20. Fairfax Financial (USA) Group	$5.2	$1.9	$0.38	7.24%	9.05%
21. NY State Insurance Fund WC Fund	$3.1	$1.9	$0.38	12.01%	15.01%
22. Old Republic Insurance Group	$2.8	$1.8	$0.35	12.77%	15.96%
23. Auto-Owners Insurance Group	$6.6	$1.7	$0.34	5.15%	6.43%
24. Great American P& C Insurance Group	$2.1	$1.6	$0.32	15.14%	18.93%
25. Hanover Insurance Group P&C	$1.5	$1.6	$0.31	20.63%	25.79%
26. Citizens Property Insurance Corporation	$6.3	$1.5	$0.30	4.79%	5.99%
27. Allstate Insurance Group	$17.1	$1.2	$0.24	1.42%	1.77%
28. Munich-American Holding Corp	$5.9	$1.2	$0.24	4.06%	5.08%
29. Erie Insurance Group	$5.6	$1.1	$0.22	3.84%	4.80%
30. Selective Insurance Group	$1.0	$1.1	$0.21	20.10%	25.12%
Top 30	**393.0**	**$106.1**	**$21**	**5.40%**	**6.75%**
Top 50	449.4	$122.3	$24	5.44%	6.80%
Top 100	493.8	$139.8	$28	5.66%	7.08%
Top 450	567.0	$158.2	$32	5.58%	6.97%
764 insurers	**$592 billion**	**$158 billion**	**$31.7 billion**	**5.35%**	**6.69%**

In evaluating the *D/S* ratios, Table 3.1 shows that 7 of the top 30 insurers have a *D/S* ratio higher than 0.15 (i.e., 15%) – a figure that these insurers are likely to consider higher than their comfort level. The *D/S* ratio varies widely from a low 0.35% for Berkshire Hathaway to highs of 38% and 47.6% for Assurant when the TRIA deductible is 20% and 25% respectively.

Based on our estimates, several insurers will have large dollar retention before the federal government begins to contribute under the current design of TRIA (*D**=20%). For instance, the top 5 insurers (ranked by their current deductible; 2012 AM Best data) taken together retain just over $9 billion: $2.4 billion (Liberty Mutual), $2.2 billion (Travelers), $2.1 billion (AIG), $1.35 billion (Zurich), and $1.2 billion (Hartford).

The top 10 insurers, representing 42% of the market based on direct earned premium (DEP), have a combined dollar retention of $13.2 billion (sum of their TRIA deductibles); the top 30 insurers, representing 67% of the market, have a combined dollar retention under TRIA of $21.2 billion.[20] We also calculated the dollar retention for the groups comprising the top 50 insurers, top 100, top 450 insurers and for all 764 insurers (Table 3.1). The top 450 insurers[21], which represent 99.8% of the market based on direct earned premium, have an aggregate surplus level of $567 billion, TRIA-line eligible premium of $158 billion, and combined deductible of $31.6 billion.[22] **That is, the total deductible paid by all insurance companies in our study is about $32 billion.**

Figure 3.1 depicts the number of insurers among the top 30 (y-axis) whose *D/S* ratio exceeds pre-specified values of *x* percent (x-axis) based on the following TRIA deductible percentages: (a) *D**=15% (2005), (b) *D**= 20% (current level) and (c) *D**= 25% (hypothetical level) using the same 2012 data from AM Best. For the sake of simplicity, we provide a broad overview of the results by plotting the number of insurers whose *D/S* ratio lies between different percentage ranges in increments of 5% (i.e., [0%; 4.99%]; [5%; 9.99%], etc.).

The data show clearly that there is a major shift in the percentage of insurers that would be considered significantly exposed as $D*$ is increased from 15% to 20% to 25%. Three insurers out of these 30 insurers had a D/S ratio of 0.15 (i.e., 15%) or greater when the TRIA deductible was 15%. This number increases to 7 insurers under the current TRIA deductible of 20% and would increase to 11 insurers if the TRIA deductible were raised to 25% (Figure 3.1). When $D*$=25%, three of these large insurers would have a D/S ratio greater than 0.25 (i.e. 25%).
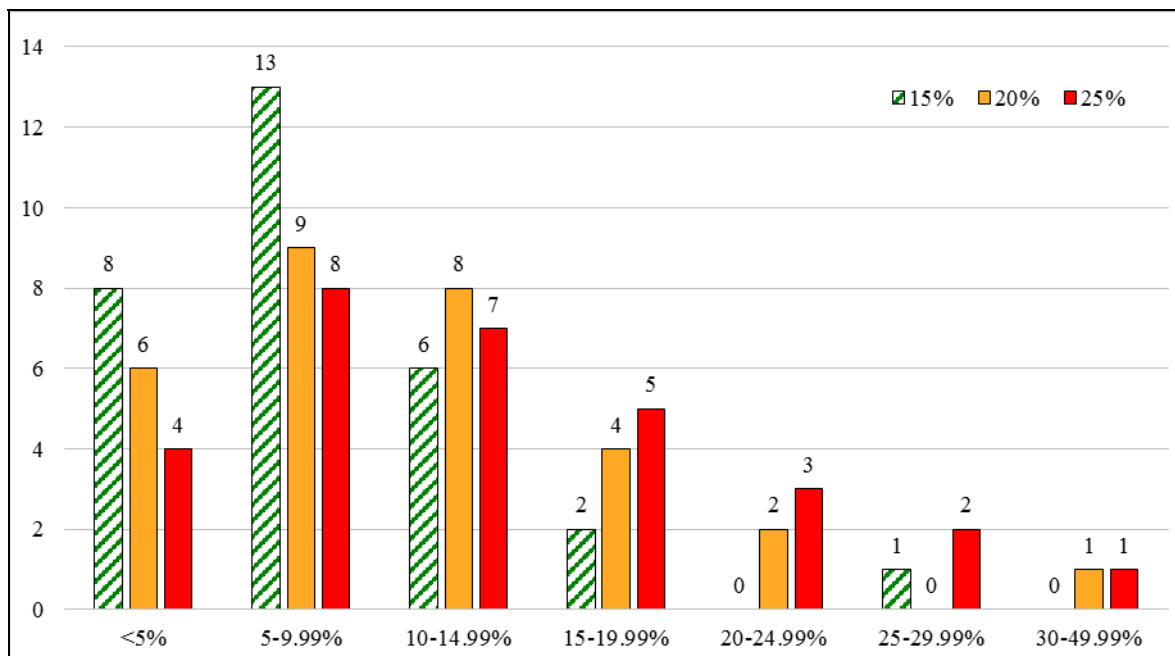

FIGURE 3.1: DEDUCTIBLE OVER SURPLUS (D/S) RATIO FOR THE TOP 30 INSURERS AND THREE LEVELS OF TRIA DEDUCTIBLES (15%; 20%; 25%)
The y-axis shows the number of insurers with a given TRIA deductible/surplus (D/S) ratio on the x-axis.
Sources: Wharton Risk Center using 2012 AM Best data

Figure 3.2 depicts the evolution of the *D/S* ratio for our larger sample of 450 insurers for these same three cases. When *D*=15%*, 95 of these 450 insurers would have a *D/S* ratio greater than 15%. This number increases to 140 when *D*=20%* (current design of TRIA) and to 175 insurers (39% of the top 450 insurers) if *D*=25%*. Our analysis reveals that based on 2012 data 140 insurers already exceed a *D/S* ratio of 0.15 (i.e., 15%) or greater – considered to be a relatively high measure of exposure to terrorism – under the current structure of the program. Should the deductible level be increased again, some companies could face a significant risk of insolvency or financial distress after a severe terrorist attack because they will not have adequate levels of capital. Other insurers might stop selling insurance to some of their commercial clients to avoid having too high a concentration of terrorism exposure in one location (e.g., a large city).
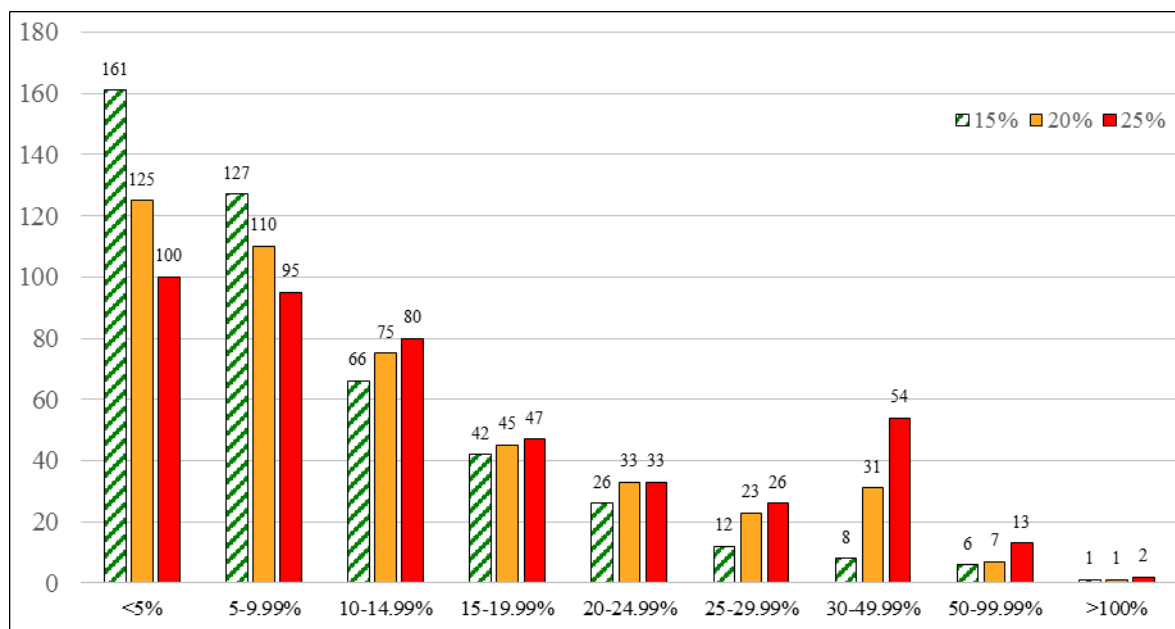

FIGURE 3.2: DEDUCTIBLE OVER SURPLUS (*D/S*) RATIO FOR THE TOP 450 INSURERS AND THREE LEVELS OF TRIA DEDUCTIBLES (15%; 20%; 25%)

Note: The y-axis shows the number of insurers with a given TRIA deductible/surplus (*D/S*) ratio on the x-axis.
Sources: Wharton Risk Center using 2012 AM Best data

3.2. Impact of Increasing the Program Trigger for TRIA to Share Losses

As pointed out earlier, if a certified act of terrorism occurs, compensation is paid under TRIA only if aggregate insurance industry losses exceed a program trigger of $100 million. The program trigger was raised from $50 million to $100 million in 2007 and the House bill proposes an increase to $500 million, prompting the need for a re-examination of how the program trigger impacts insurance companies. Increases in the program trigger have been strongly opposed by small insurers given their concerns that they will have a higher percentage of their surplus exposed to terrorism (See, Marsh & McLennan, 2013).

To assess the impact of changes in the program trigger, we provide some information on the distribution of insurance company retentions relative to the existing program trigger and several alternative trigger level. The number of insurers with TRIA deductibles above specific levels is provided in an endnote.[23] These data are intended to help inform the debate on the vulnerability of insurers to losses from future terrorist attacks under alternative proposals with respect to the future of TRIA.

- Of the 764 insurance companies in the AM Best database, 58 insurers currently have a TRIA deductible that is already in excess of the $100 million program trigger level, effectively invalidating the impact of the program trigger in the determination of compensation for these larger firms. These 58 insurers represented 80% of the TRIA-eligible DEP in 2012 and 78% of 2012 insurance industry surplus.

- If the TRIA program trigger were raised from $100 million to $250 million, the number of insurers whose TRIA deductible exceeds the program trigger would drop to 26, with these companies representing 64% of 2012 TRIA-eligible DEP and 61% of industry surplus.

- Increasing the TRIA program trigger to $500 million drops the number of firms with a TRIA deductible in excess of the program trigger down to 15, with these companies representing 51% of TRIA-eligible DEP in 2012 and 37% of industry surplus.

These statistics confirm that the program trigger is less of an issue for larger insurance companies and more of a potential concern for smaller insurance firms.[24] To understand the potential risk for a small firm, we must analyze the scenario where the program trigger comes into play. Specifically, the risk to an insurer of an increase in the program trigger arises when that company's loss from a given event is greater than the company's TRIA deductible but less than the trigger. Since most of the smaller insurers have an aggregate market share that is well below 1% of total commercial premiums written, increasing the program trigger to $500 million would seem to be innocuous in that their expected share of a $500 million loss would be less than $5 million – well inside most TRIA deductibles and at a level that most insurance companies can cover. For example, if we look at the impact of either a $100 million or $500 million property or workers' compensation loss in any of Chicago, Houston, Los Angeles or New York and assume that the loss would be spread consistent with market share, no individual insurance company would suffer a material loss due to the existence of the program trigger.

The concern, therefore, is that smaller firms may not have been able to achieve an acceptable spread of risk, possibly due to geographic restrictions, lack of reinsurance or limited risk management actions, to ensure a "market-share" level of exposure to a terrorism loss. If so, the program trigger becomes important in providing "shock loss" protection against outsized losses to company surplus. This shock loss protection is related to the likelihood of an above-market share loss for any individual company. If we look at a hypothetical scenario of a $500 million conventional terrorism loss in New York City split evenly between property and workers' compensation payments, individual company losses would have to be *at least 3-5 times their market share* to result in a situation whereby an individual company's loss exceeds its deductible, but industry losses don't exceed the program trigger. In fact, for most companies, loss in relation to the market share would have to be significantly higher than this range. In analyzing similar scenarios in Chicago and Los Angeles, the results were comparable, while a few companies in Houston had market share loss multiples as low as 200%.

A pure analysis of market share, however, can be deceptive. By their nature, terrorist attacks can result in a very concentrated damage footprint that could adversely impact a small number of insurers. That is, conventional terrorism attack profiles, unlike natural catastrophes, are not "market-share" events and an individual smaller insurer could certainly suffer an individual loss of 3-5 times its expected market share in a region. Moreover, smaller insurers are more exposed. For 200 of the 708 insurers with a TRIA deductible of less than $100 million, their deductible was in excess of 10% of their surplus. This observation appears consistent with a recent analysis by AM Best. In a report on their stress test results, AM Best (2013) noted that of the 226 firms in their rated universe with material terrorism exposure, thirty-four (15%) failed the stress test and that there was a strong negative correlation between firm size and stress test failure. Specifically, no firms with surplus greater than $1 billion failed the stress test, while failure rates in the surplus ranges of $500 million to $1 billion, and less than $500 million were 11% and 19%, respectively.

These results suggest that any increase in the program trigger may require that smaller insurers obtain a better spread of risk, possibly in connection with greater access to private reinsurance for terrorism. If smaller insurers are not able to adjust, an increase in the program trigger may force some difficult underwriting decisions at these smaller firms. From a public policy perspective, the debate on the program trigger revolves less around the issue of providing industry protection for terrorism events, and more on the question of supporting smaller insurers. For example, the 200 firms analyzed above represent less than $25 billion or approximately 4% of aggregate industry surplus. As such, the terrorism capacity being provided by these firms would likely be absorbed within the private market absent federal policy to provide further support for a lower program trigger. The public policy question may center on the trade-off of using TRIA to provide additional support for smaller insurance firms at the expense of providing solvency protection for individual underwriting decisions at these firms.

SECTION 4.

ESTIMATING LOSSES FROM TERRORIST ATTACK SCENARIOS

Insurers are concerned about their exposure to terrorism losses given the deductible and coinsurance arrangement under TRIA that determines the cost-sharing arrangement with the federal government. For this reason and given the difficulty in estimating the likelihood of a terrorist attack, insurers often utilize scenarios to determine their maximum exposure to surplus for a range of terrorist actions by location and mode of attack.

Allocation of risk between policyholders, insurers and taxpayers under TRIA requires a detailed analysis of the impact of the specific scenario. Figure 4.1 describes the methodology for allocating losses from a specific scenario.

Step 1. Identify the nature of the terrorist attack (e.g., "certified" or non-certified event) with total insured losses of at least $100 million for TRIA to operate.

Step 2. Determine economic losses potentially covered by insurance. This depends on the insurance lines affected by the attack and the level of terrorism insurance take-up rates among the firms that are victims of the attack.

Step 3. Determine losses covered by property and workers' compensation coverage.

Step 4. Determine the proportion of losses assumed by each of the affected parties after federal reinsurance applies and ex post recoupment occurs.
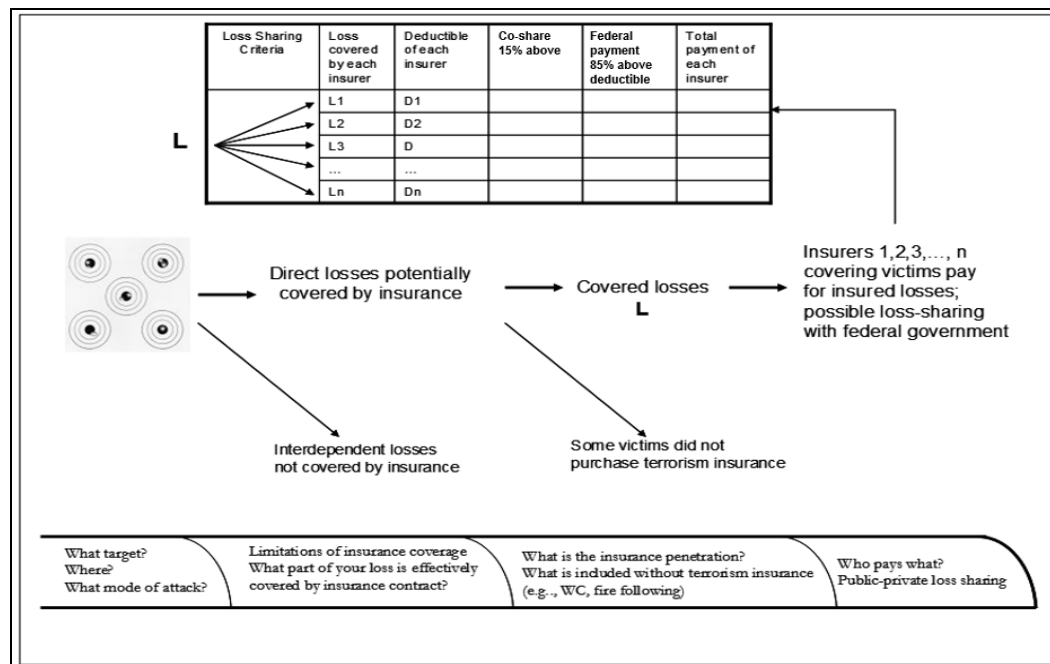

FIGURE 4.1: TERRORISM LOSS ALLOCATION PROCESS

While insurance companies use many different scenarios across multiple locations, for the purposes of this report we selected three possible attack scenarios and four key locations to conduct our analysis. The scenarios utilized in this report are based on the Risk Management Solutions (RMS) terrorism risk model using three modes of attacks: a) 10-ton truck bomb; b) 1-ton Sarin chemical agent release and c) a 1-kiloton nuclear weapon attack. For each of the three attack modes, key high-profile targets were identified in the central business districts of the four major cities of Chicago, Houston, Los Angeles and New York. The models estimated property losses from commercial insurance, and casualty losses arising from workers' compensation coverage. We now discuss each one of these scenarios in detail and our rationale for selecting those modes of attack given the recent evolution of terrorism threats. No discussion of the likelihood of these scenarios is presented here. The RMS white paper on TRIA (RMS, 2013) provides an outline of probabilistic terrorism risk modelling. While progress had been made in modelling terrorism risks, significant uncertainty still remains around estimates of losses from future attacks.

4.1. Scenario a: 10-Ton *(20,000 lb)* Truck Bomb Attack

The selected 10-ton bomb scenario consists of a bomb made from conventional explosives delivered by a truck or other vehicle and detonated as close to the target as possible. Ammonium Nitrate Fuel-Oil (ANFO) is the assumed explosive material, as this is a common commercial explosive. The raw materials for constructing this bomb are more readily available than other explosive materials, although access has been increasingly difficult since 9/11. Other high-explosive materials could be substituted with the same result, assuming equivalent yields.

The pressure wave produced by the bomb around the detonation point is sufficient to cause structural and architectural damage as well as injuries and fatalities. Architectural damage is dominated by shattering glass in windows, and the resulting glass projectiles are the source of most injuries. Large pressure waves can also cause serious injuries, primarily to the ears and lungs. Structural damage to the target building is very sensitive to the distance between the structure and the weapon.

In this scenario the 10-ton bomb is assumed to be detonated at street level in front of the target structure, close enough for the maximum blast pressure generated by the explosion to be exerted on the building structure. Blast effects of an explosion are in the form of a shock wave composed of a high-pressure shock front, which expands outward from the center of the detonation, with the pressure intensity decaying with distance and as a function of time. The magnitude and distribution of the shock wave pressures is a function of the following elements: explosive properties, location of the explosive relative to the structure and amplification of the pressure by its interaction with the ground and immediate surrounding buildings.

Blast damage resulting from an explosion is primarily dependent on the peak overpressure and the impulse force of the wave, which are functions of pressure and the duration of the blast pulse. Thus, both the peak overpressure and the impulse distributions need to be considered and calculated across different buildings in the area when estimating damage. Bomb damage agents include blast pressure waves and debris impact causing damage to property, injuries and fatalities and business interruption loss from clean-up and crime scene investigation. This type of bomb attack requires many personnel to perpetrate, significant expenses, and a year or longer to plan.

Given its size, ambition and complexity, few historical precedents exist for a terrorist bomb of this size. In June 1996, Hezbollah attacked Khobar Towers, a U.S. military accommodation complex in Dharan, Saudi Arabia with a bomb estimated to be of comparable magnitude to 10 tons. This is the largest terrorist vehicle bomb detonated. The force of the explosion was so great it heavily damaged or destroyed six high rise apartment buildings and shattered windows in virtually every other structure in the compound, leaving a crater in the ground 85 feet wide and 35 feet deep. The blast was felt 20 miles away in Bahrain.

Table 4.1 details the average property losses, workers' compensation losses and total losses dollar figures in the central business districts of Chicago, Houston, Los Angeles and New York for a representative 10-ton truck bomb scenario.

TABLE 4.1: ESTIMATED LOSSES FROM A 10-TON TRUCK BOMB ATTACK
IN FOUR OF THE LARGEST AMERICAN CITIES

City	Property Loss ($ billion)	Workers' Compensation Loss ($ billion)	Total Loss ($ billion)
Chicago	$26.4	$10.2	$36.6
Houston	$19.0	$ 9.3	$28.3
Los Angeles	$19.9	$ 6.7	$26.6
New York	$19.4	$12.7	$32.1

4.2. Scenario b: 1-Ton Sarin Chemical Agent Release Attack

There are five basic types of chemical agents categorized in terms of their effects for this type of terrorist attack: choking agents, blood agents, blister agents, G-series nerve agents, and V-series nerve agents.[25] Sarin is the agent chosen by RMS for modeling a chemical attack based on technical and logistical requirements and terrorist interests. Like all nerve agents, Sarin works by interfering with the mechanisms through which one's nerves communicate with one's bodily organs, causing the latter to become highly over-stimulated. Sarin is a liquid at ambient temperature. In vapor form, Sarin is heavier than air and as a result will cling to floors, sink into basements, and gravitate towards low terrain. Sarin is also absorbed by the skin very rapidly.

The impact of such a chemical attack is affected by the time of occurrence, emergency response, and weather conditions, including wind speed and wind direction, and the heating, ventilation and air conditioning (HVAC) filtration systems in operation at affected locations. Victims who inhale large amounts soon lose consciousness, go into convulsions, and stop breathing.

1995 Tokyo subway Sarin attack and decontamination

For a major outdoor release, RMS models the release of 1 ton of Sarin gas into a populated area in the center of a major city. Dispersion modeling input parameters include the quantity of the agent released, the momentum associated with the release, the deposition velocity, buoyancy, wind velocity and direction, and other atmospheric conditions. The time of day and emergency response measures are also considered. Output parameters generated include ground deposition and time integrated dosage over the entire dispersion area. The model uses different vulnerability functions based on building height.

Typical filtration protection in standard air conditioning units would be unable to prevent Sarin gas released in the external environment from penetrating the building interior, although the concentrations inside would be lower than those outside. The amount that enters indoors is a function of building height. The dose gets diluted for taller buildings due to the higher air volume inside tall buildings.

Inhalation of even low concentrations of the gas can be fatal (100 mg per cubic meter per minute will kill 50% of those exposed). Non-fatal injuries include lung damage, eye injury, seizures, and muscle and cell damage. Six injury levels describe the symptoms shown by an affected person in order of increasing Sarin-exposed concentration: Incipient miosis (closure to the eye pupils) and slight headache; increased miosis extends to tightness in chest; complete miosis and bronchospasms in some people; bronchospasms, wheezing, vomiting, nausea; paralysis, convulsions, extreme weakness; respiratory failure, death.

Each of these symptoms is associated with typical Sarin dosage amounts. A probability distribution around these dosage amounts then permits the estimation of casualty rates in each of the six injury levels. The model uses different casualty rates based on building height. For outdoor release, the occupants who are indoors see reduced dosage amounts given the shielding provided by building wall enclosures. The fraction of population outdoors would see the full effects of the outdoor dosage.

Materials can absorb nerve agents, re-releasing toxic gases for a long time afterwards, thus requiring decontamination of buildings and affected areas. If mass casualties occurred from a Sarin gas terrorist attack, civil authority exclusion areas would be applied around the affected area and it would take time to clean up, investigate the scene of the crime and re-establish public confidence to return to the location. For this attack mode it is also assumed that there will be an "area of exclusion" for which there will be no physical damage, but there will be losses due to contingent business interruption (CBI) and business interruption (BI) losses associated with civil authority coverage provided in the underlying property policies. It could take several months for the full clean up to be completed and the area re-opened. As an example, several small businesses in Boston that did not suffer directly from the 2013 marathon bombing suffered BI losses due to the decision of law enforcement agencies to close the area for several days.

Table 4.2 details the average property losses, workers' compensation losses and total losses dollar figures in the central business districts of Chicago, Houston, Los Angeles and New York for a representative large-scale Sarin attack.

TABLE 4.2: ESTIMATED LOSSES FROM A 1-TON SARIN CHEMICAL AGENT ATTACK IN FOUR OF THE LARGEST AMERICAN CITIES

City	Property Loss ($ billion)	Workers' Compensation Loss ($ billion)	Total Loss ($ billion)
Chicago	$ 9.8	$7.3	$17.1
Houston	$ 4.9	$4.3	$ 9.2
Los Angeles	$ 6.2	$5.6	$11.8
New York	$15.6	$9.4	$25.0

4.3. Scenario c: 1-Kiloton Nuclear Weapon Attack

Detonation of a 1-kiloton nuclear weapon would have devastating consequences in an urban area. There are no known cases of a terrorist group getting close to obtaining, let alone using a nuclear device. However in 1998, an unsuccessful attempt by Al Qaeda to purchase uranium from black-market sources suggested an interest in the development of nuclear and radiological weapons.

The nuclear bomb attack scenario considered here is a "*suitcase bomb*"-style nuclear device of 1-kiloton yield detonated in a city center. Although rarer than larger yield nuclear bombs, this size represents one that may be less difficult for terrorists to obtain or develop. Though referred to as a "suitcase bomb," in reality it weighs hundreds of pounds and requires several people just to lift. Logistically, a nuclear attack of this type is extremely difficult to execute, requiring highly specialized technical skills, many operatives, years of planning, and significant financial resources.

Losses that result from any nuclear detonation are so severe that a low-end range of yield was selected as a representative attack. Damage agents include blast wave and intense heat; fires around the perimeter of the destroyed zone; radiation, and radioactive fallout that causes casualties and requires decontamination for many miles. Long-term health effects of radioactive fallout are not included in modeling workers' compensation losses.

The impact of an attack is affected by the time of its occurrence, emergency response measures – especially urban fire suppression and medical treatment capability for very large numbers of injured – and weather conditions. Within the explosion impact region, the effects of radiation are not very significant because the bomb destroys much of the property that might be contaminated. Outside of the area affected by the explosion, there are radiation impacts considered in the model due to fallout.

The nuclear weapon is modeled as a ground level detonation for which the pressure and thermal and radiological radiation levels at different distances from the detonation are computed. Destruction from a nuclear device would come from several sources. The bomb will produce a pressure wave similar to that of a conventional bomb, although much larger in magnitude. A large amount of heat will also be generated, causing burns and fires. Finally, a plume of radioactive material will be generated, and dispersed by the wind. This radioactive plume would be much more intense than that created by a dirty bomb, but the radiation would decay at a faster rate than dirty bombs. The isotopes released in a nuclear blast are relatively short-lived, and may disappear within hours.

The loss model uses different vulnerability functions based on construction class and building height. Business interruption loss is anticipated to be significant given the time needed to repair extensive physical damage, extra expense required for relocation, and reticence of employees to return to work. Human casualty estimates are based on the following hazards:

- Blast effects: Direct pressure wave effects, severe heat and indirect effects from building damage, flying debris

- Nuclear radiation: Effects of nuclear radiation would result in immediate deaths and near-term increased cancer-related deaths

- Thermal radiation: Effects of thermal radiation would result in first, second, and third degree burns

- The combined effects of the above three (e.g., radiation effects on blast-survivors)

The loss estimates developed were validated against Hiroshima and Nagasaki nuclear bomb casualty studies, as well as benchmarked against published scenario studies by government agencies. Table 4.3 details the average property losses, workers' compensation losses and total losses dollar figures for a representative 1-kiloton nuclear attack in the central business districts of Chicago, Houston, Los Angeles and New York.

TABLE 4.3: ESTIMATED LOSSES FROM A 1-KILOTON NUCLEAR WEAPON ATTACK IN FOUR OF THE LARGEST AMERICAN CITIES

City	Property Loss ($ billion)	Workers' Compensation Loss ($ billion)	Total Loss ($ billion)
Chicago	$241.4	$100.9	$342.3
Houston	$ 99.7	$ 74.2	$173.9
Los Angeles	$163.3	$ 69.9	$233.2
New York	$392.7	$159.6	$552.3

SECTION 5.

ANALYSIS OF LOSS SHARING UNDER TRIA AND ALTERNATIVE DESIGNS

How would losses from a terrorist attack on U.S. soil be distributed across insurers, commercial policyholders and the federal government? This section examines this question in some detail under the three different terrorist attack scenarios described above with respect to location and magnitude of damage. (See Steps 2-4 in Section 4 and Figure 4.1.)

5.1. Assumptions on Terrorism Insurance Market Share and Take-up Rates

We have utilized *market shares* of insurers in the individual states in which the four cities are located to allocate losses from a terrorist attack among the insurance companies that are operating in each state. These firms comprised virtually 100% of the terrorism insurance market placed with U.S. licensed primary insurance carriers with respect to TRIA-line direct earned premiums (DEP) at the end of 2012. Property insurance lines have been separated from workers' compensation (WC) lines.[26] Actual losses from a terrorist attack are unlikely to be distributed among insurance companies exactly according to their market share in the affected state.

As discussed earlier, terrorism cannot be excluded from workers' compensation insurance and is required to be purchased by commercial enterprises, so we assume a 100% take-up rate for terrorism-related workers' compensation losses. There is no available data on terrorism coverage for all commercial firms operating in the U.S., so we rely on sample estimates. Insurance brokers Marsh (2013) and Aon (2013) have both published terrorism insurance take-up rates for their clients. This level has remained stable over the past 5 years ranging from a low of 40% in the chemical industry to a high of 80% in the media industry (Marsh, 2013). We assume a 50% take-up rate for terrorism insurance for the property lines, recognizing that the actual percentage may vary from one city to another as well by the type of firm. These assumptions apply to all the analyses undertaken below.

5.2. Alternative TRIA Designs: S. 2244; H.R. 4871

Senate bill S. 2244, passed by the Banking Committee in June 2014 and by the full Senate in July 2014, would renew TRIA for another seven years with several modifications from the current program. The House bill, H.R. 4871, passed by the Financial Services Committee at the end of June 2014, would renew TRIA for five years with some modifications that differ from the Senate bill in the following ways:

(1) The House bill increases the program trigger from $100 million (the current TRIA level) to $500 million for conventional terrorism (an additional $100 million per year starting in 2016). The Senate bill maintains the $100 million trigger.

(2) The House bill specifies the insurance industry retention amount as the sum of the deductible amounts of all insurers (including captives) participating in TRIA for the year in which a terrorist attack occurs, rather than a fixed amount as in the Senate bill (where the retention level is increased from the current TRIA level of $27.5 billion to $37.5 billion over a five-year period). By proposing a variable market retention the House bill reflects the dynamic nature of the insurance market.

(3) The House bill increases the percentage the federal government recoups against all commercial policyholders from 133% to 150% for losses subject to mandatory recoupment. The Senate bill maintains the current 133%.

(4) The House bill bifurcates CBRN and non-CBRN events so the risk-sharing arrangement differs depending on the nature of the attack, reducing the federal government exposure for non-CBRN attack even further than it is today. (The distinction between CBRN and non-CBRN attack may not be easily determined after a terrorist attack. For example, would the blast from the explosion of a nuclear device be considered "conventional" (fire following) or CBRN?)

We first undertake a comparative analysis of the loss distribution between the affected parties under the current TRIA arrangements and then turn to the proposed Senate and House legislations focusing on the following three core changes in the risk-sharing design.

> **Key features we study here as alternative designs to TRIA's current arrangement:**
>
> - **Insurer's coinsurance** on "certified" terrorism losses would increase incrementally over five years **from the current 15% to 20%.** The federal government would thus pay only 80% of the insurers' losses above the 20% deductible of TRIA-line direct earned premiums.
>
> - The **insurance industry marketplace aggregate retention amount** would increase **from the current $27.5 billion** by $2 billion annually to **$37.5 billion in our analysis of the Senate bill.** With respect to the **House bill,** we analyze two levels of insurance industry marketplace retention: **$32 billion** (based on 2012 data that was the basis for our analysis of the *D/S* ratio in Section 3), **and $44 billion** (the aggregate retention amount used by the Congressional Budget Office in its July 15, 2014 cost estimate of the proposed House bill).
>
> - The **mandatory recoupment rate against all commercial policyholders** would remain the same at 133% under the Senate bill but would increase to 150% in the House bill.

In the analyses that follow we assume that the federal government recoups only the mandatory portion of the insured losses it pays upfront, and not the discretionary amount. This assumption is similar to the one made by the Congressional Budget Office in its estimate of the impacts on different stakeholders in its analysis for the renewal of TRIA in 2007.[27]

5.3. Analysis of Loss Distribution across Key Stakeholders under Alternative TRIA Designs, Varying the Location of the Attack and Size of the Loss

We utilize projected damage to each of the four cities (Chicago, Houston, Los Angeles and New York) from a 10-ton truck bomb based on data from the RMS model (Table 4.1) to determine the distribution of losses among the non-insured, insured, all policyholders and the federal government. One could also undertake similar analyses using the other scenarios discussed in Section 4 of the report.

Table 5.1 (a-to-f) examines the impact of changes in the co-insurance share assumed by insurers for losses above their deductible from 15% to 20% (proposed in the Senate and House bills, to 25% (a hypothetical case), the impact of an increase in the requirements for mandatory recoupment up to uncompensated insurer losses and a change in the deductible from 20% to 25%. Table 5.1a depicts the current TRIA design. Table 5.1e depicts the proposed Senate bill. Table 5.1f depicts the House bill. The other tables examine changes in either the coinsurance share and/or deductibles to other levels with the mandatory recoupment retained at its current level of $27.5 billion.

To illustrate how mandatory recoupment operates, let's assume a $27.5 billion retention (current legislation). Assume a $35 billion insured loss and that the insurers' deductible under TRIA accounted for $l5 billion of these losses. If there is a 20% coinsurance share by insurers, they will pay an additional $4 billion of the remaining $20 billion loss. The federal government will cover the remaining $16 billion. Since the total amount paid by insurers is $19 billion ($15 billion + $4 billion) and is below the market retention, then the mandatory recoupment will apply to the difference between $27.5 billion and $19 billion (i.e., $8.5 billion) that will be recouped against all commercial policyholders at a rate of 133% with the remaining $7.5 billion being discretionary. Had insurers' payments exceeded the $27.5 billion retention, then the federal government would not have recouped any money from the mandatory recoupment and the entire difference between the federal government's payment and what the insurers paid would be subject to discretionary recoupment. Workers' compensation losses are assumed to be fully insured; the take-up rate for property lines is assumed to be 50%.

TABLES 5.1: LOSSES DUE TO ONE 10-TON TRUCK BOMB.
INSURERS' CO-INSURANCE VARIES FROM 15% TO 25%, DEDUCTIBLE IS 20% OR 25% AND
RETENTION IS $27.5BN, $32.0BN, $37.5BN OR $44.0BN

5.1a. 10-Ton Truck Bomb: 15% Co-Share, 20% Deductible, $27.5bn Retention (Current TRIA)

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$36.59	$26.39	$10.21	$13.19	$23.40	$21.12	$3.04	$0.00
Houston	$28.29	$19.02	$9.27	$9.51	$18.78	$15.00	$5.03	$0.00
Los Angeles	$26.51	$19.86	$6.65	$9.93	$16.58	$14.66	$2.55	$0.00
New York	$32.07	$19.38	$12.69	$9.69	$22.38	$16.39	$7.97	$0.00

5.1b. 10-Ton Truck Bomb: 15% Co-Share, 25% Deductible, $27.5bn Retention

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$36.59	$26.39	$10.21	$13.19	$23.40	$21.81	$2.11	$0.00
Houston	$28.29	$19.02	$9.27	$9.51	$18.78	$15.16	$4.82	$0.00
Los Angeles	$26.51	$19.86	$6.65	$9.93	$16.58	$15.16	$1.89	$0.00
New York	$32.07	$19.38	$12.69	$9.69	$22.38	$17.07	$7.06	$0.00

5.1c. 10-Ton Truck Bomb: 20% Co-Share, 20% Deductible, $27.5bn Retention

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$36.59	$26.39	$10.21	$13.19	$23.40	$21.25	$2.86	$0.00
Houston	$28.29	$19.02	$9.27	$9.51	$18.78	$15.22	$4.74	$0.00
Los Angeles	$26.51	$19.86	$6.65	$9.93	$16.58	$14.77	$2.40	$0.00
New York	$32.07	$19.38	$12.69	$9.69	$22.38	$16.74	$7.50	$0.00

5.1d. 10-Ton Truck Bomb: 25% Co-Share, 20% Deductible, $27.5bn Retention

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$36.59	$26.39	$10.21	$13.19	$23.40	$21.39	$2.68	$0.00
Houston	$28.29	$19.02	$9.27	$9.51	$18.78	$15.44	$4.44	$0.00
Los Angeles	$26.51	$19.86	$6.65	$9.93	$16.58	$14.89	$2.25	$0.00
New York	$32.07	$19.38	$12.69	$9.69	$22.38	$17.09	$7.03	$0.00

5.1e. 10-Ton Truck Bomb: 20% Co-Share, 20% Deductible, $37.5bn Retention (S. 2244)

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$36.59	$26.39	$10.21	$13.19	$23.40	$21.25	$2.86	$0.00
Houston	$28.29	$19.02	$9.27	$9.51	$18.78	$15.22	$4.74	$0.00
Los Angeles	$26.51	$19.86	$6.65	$9.93	$16.58	$14.77	$2.40	$0.00
New York	$32.07	$19.38	$12.69	$9.69	$22.38	$16.74	$7.50	$0.00

5.1f. 10-Ton Truck Bomb: 20% Co-Share, 20% Deductible, $32bn or $44bn Retention (H.R. 4871)

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$36.59	$26.39	$10.21	$13.19	$23.40	$21.25	$3.22	$0.00
Houston	$28.29	$19.02	$9.27	$9.51	$18.78	$15.22	$5.34	$0.00
Los Angeles	$26.51	$19.86	$6.65	$9.93	$16.58	$14.77	$2.71	$0.00
New York	$32.07	$19.38	$12.69	$9.69	$22.38	$16.74	$8.46	$0.00

Note: All numbers in $ billion; Property take-up rate is assumed to be 50%; Workers' compensation (WC) is 100%.

The data reveal that there is a slight increase in the insurers' payments and decrease in policyholders' payments as the co-insurance or deductible increases. Increasing the deductible from 20% to 25% has a more significant impact on how much insurers are paying than increasing the co-insurance share, since insurers assume 100% of the loss below their deductible. More specifically, increasing the insurers' co-insurance share from the current 15% (Table 5.1a) to 25% (Table 5.1d) has less impact on the insurers than increasing the deductible from the current 20% (Table 5.1a) to 25% (Table 5.1b), all else being equal.

For the 10-ton truck bomb scenario, the difference between the Senate bill (Table 5.1e) and the current version of TRIA (Table 5.1a) comes from the increase in co-insurance since the insured losses are below $27.5 billion. Under the House bill (Table 5.1f), all commercial policyholders pay a larger amount than the current version of TRIA because the federal government recoups 150% for losses subject to mandatory recoupment. Note that since the insured losses from the 10-ton truck bomb in each of the four cities are all less than $32 billion, the difference in the value of the insurance industry retentions of $32 billion and $44 billion does not affect the distribution of payments by the different stakeholders. Across all the designs discussed in Table 5.1, the federal government shares some of the insured losses with insurers, but it can recoup all of these payments from commercial policyholders, so federal taxpayers do not have any residual liability. (Since the federal government recoups either 133% or 150% of the difference between the mandatory recoupment and the insurers' payments, it is actually receiving payments that are more than the total insured loss.)

Analysis of Loss Distribution across Key Stakeholders, Varying the Location of the Attack

We are also interested in the impact that the same level of losses would have if the terrorist attack occurred in different locations in the United States since the insurers providing coverage and the industry market share differs across states. Tables 5.2 compare the current TRIA arrangement and the proposed Senate and House bills under the assumption that the total loss was fixed at $25 billion, with $15 billion in property damage and $10 billion in workers' compensation (WC) for each of the four cities where the 10-ton truck bomb attack occurred. As in the previous analysis, half of the property damage to commercial enterprises in the buildings was assumed to be covered by either terrorism insurance or fire following a terrorist attack, and all the WC losses were insured. This results in a $17.5 billion insured loss out of the $25 billion total loss.

TABLES 5.2: $25 BILLION LOSSES DUE TO ONE 10-TON TRUCK BOMB IN DIFFERENT CITIES

5.2a. TRIA 2014: 15% Co-Share, 20% Deductible, $27.5bn Retention

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$25.00	$15.00	$10.00	$7.50	$17.50	$16.20	$1.73	$0.00
Houston	$25.00	$15.00	$10.00	$7.50	$17.50	$13.70	$5.05	$0.00
Los Angeles	$25.00	$15.00	$10.00	$7.50	$17.50	$14.68	$3.74	$0.00
New York	$25.00	$15.00	$10.00	$7.50	$17.50	$13.36	$5.51	$0.00

5.2b. Proposed Senate Bill: 20% Co-Share, 20% Deductible, $37.5bn Retention

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$25.00	$15.00	$10.00	$7.50	$17.50	$16.28	$1.63	$0.00
Houston	$25.00	$15.00	$10.00	$7.50	$17.50	$13.92	$4.76	$0.00
Los Angeles	$25.00	$15.00	$10.00	$7.50	$17.50	$14.85	$3.52	$0.00
New York	$25.00	$15.00	$10.00	$7.50	$17.50	$13.60	$5.19	$0.00

5.2c. Proposed House Bill: 20% Co-Share, 20% Deductible, $32bn and $44bn Retention

Location	Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
Chicago	$25.00	$15.00	$10.00	$7.50	$17.50	$16.28	$1.83	$0.00
Houston	$25.00	$15.00	$10.00	$7.50	$17.50	$13.92	$5.36	$0.00
Los Angeles	$25.00	$15.00	$10.00	$7.50	$17.50	$14.85	$3.97	$0.00
New York	$25.00	$15.00	$10.00	$7.50	$17.50	$13.60	$5.85	$0.00

Note: All numbers in $ billion; we assume a 50% take-up rate on property lines, 100% on workers' compensation lines (WC) and a federal recoupment that applies only to the mandatory recoupment portion, not the discretionary portion for reasons explained above in the text.

For this $25 billion loss scenario, the insurers and policyholders will absorb the entire insured loss in each of the four cities under the current arrangement as well as the proposed legislation. Under the House bill, the commercial policyholders would pay a larger share than under the Senate bill because the federal government would recoup 150% for losses subject to mandatory recoupment instead of 133%. Since the insured loss is only $17.5 billion, the difference in the value of the insurance industry retentions of $32 billion and $44 billion does not affect the distribution of payments by the different stakeholders in our analysis of the House bill.

Analysis of Loss Distribution across Key Stakeholders, Varying the Size of Loss

Building on the range of possible terrorist attack scenarios specified in Section 4, Table 5.3 details how changing the size of the loss from $5 billion to $100 billion affects the distribution of payments in one specific metropolitan area (New York, NY) under current TRIA loss sharing arrangements and the proposed Senate and House bills using the same assumptions as above regarding terrorism insurance coverage with respect to property damage and workers' compensation (WC) losses. The $32 billion loss scenario is taken from Table 4.1 (10-ton truck bomb attack). The other damage scenarios are extrapolated from the loss ranges using the RMS models.[28]

TABLES 5.3: IMPACT OF VARYING TERRORISM ATTACK LOSSES –
ILLUSTRATION WITH NEW YORK CITY

5.3a. TRIA 2014: 15% Co-Share, 20% Deductible, $27.5bn Retention

Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
$5.00	$3.00	$2.00	$1.50	$3.50	$3.12	$0.51	$0.00
$15.00	$9.00	$6.00	$4.50	$10.50	$8.40	$2.79	$0.00
$25.00	$15.00	$10.00	$7.50	$17.50	$13.36	$5.51	$0.00
$32.00	$19.20	$12.80	$9.60	$22.40	$16.37	$8.01	$0.00
$50.00	$30.00	$20.00	$15.00	$35.00	$22.29	$6.93	$5.78
$100.00	$60.00	$40.00	$30.00	$70.00	$30.86	$0.00	$39.14

5.3b. Proposed Senate Bill: 20% Co-Share, 20% Deductible, $37.5bn Retention

Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
$5.00	$3.00	$2.00	$1.50	$3.50	$3.14	$0.48	$0.00
$15.00	$9.00	$6.00	$4.50	$10.50	$8.53	$2.62	$0.00
$25.00	$15.00	$10.00	$7.50	$17.50	$13.60	$5.19	$0.00
$32.00	$19.20	$12.80	$9.60	$22.40	$16.73	$7.54	$0.00
$50.00	$30.00	$20.00	$15.00	$35.00	$23.04	$15.91	$0.00
$100.00	$60.00	$40.00	$30.00	$70.00	$33.16	$5.77	$31.07

5.3c. Proposed House Bill: 20% Co-Share, 20% Deductible, $32.0bn Retention

Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
$5.00	$3.00	$2.00	$1.50	$3.50	$3.14	$0.54	$0.00
$15.00	$9.00	$6.00	$4.50	$10.50	$8.53	$2.96	$0.00
$25.00	$15.00	$10.00	$7.50	$17.50	$13.60	$5.85	$0.00
$32.00	$19.20	$12.80	$9.60	$22.40	$16.73	$8.51	$0.00
$50.00	$30.00	$20.00	$15.00	$35.00	$23.04	$13.45	$0.00
$100.00	$60.00	$40.00	$30.00	$70.00	$33.16	$0.00	$36.84

5.3d. Proposed House Bill: 20% Co-Share, 20% Deductible, $44.0bn Retention

Loss	Property	WC	Non-Insured	Total Insured	Insurers	Commercial Policyholders	Federal Taxpayers
$5.00	$3.00	$2.00	$1.50	$3.50	$3.14	$0.54	$0.00
$15.00	$9.00	$6.00	$4.50	$10.50	$8.53	$2.96	$0.00
$25.00	$15.00	$10.00	$7.50	$17.50	$13.60	$5.85	$0.00
$32.00	$19.20	$12.80	$9.60	$22.40	$16.73	$8.51	$0.00
$50.00	$30.00	$20.00	$15.00	$35.00	$23.04	$17.95	$0.00
$100.00	$60.00	$40.00	$30.00	$70.00	$33.16	$16.26	$20.58

Note: we assume a 50% take-up rate on property lines, 100% on workers' compensation lines (WC) and a federal recoupment that applies only to the mandatory recoupment portion, not the discretionary portion for reasons explained in the text.

This analysis demonstrates that it would take a very high loss even under the current design of TRIA for taxpayers to pay anything as a result of a terrorist attack. Under the current program, the insurance companies and policyholders will bear all of the losses for the three scenarios where the losses are $32 billion or lower. Even when the losses are as high as $50 billion, the federal government will pay only 10.5% percent (or $5.78 billion) of the $50 billion insured loss, with the option to recover the federal outlays through discretionary recoupment provisions (Table 5.3a). Based on the proposed Senate and House bills, the federal government will not pay any of the losses even for a $50 billion attack.

Tables 5.1, 5.2 and 5.3 show only discrete levels of losses. It is also interesting to determine loss sharing through the entire continuum from the current minimal program trigger of $100 million up to $100 billion. The amounts paid by the relevant stakeholders as a function of losses to New York City from terrorist attacks are depicted in Figure 5.1 under current TRIA loss-sharing arrangements legislation and in Figures 5.2 and 5.3a and 5.3b should the proposed Senate or House bills (with two different retention levels) be enacted. The two vertical lines in these figures represent the scenarios discussed earlier of $32 billion (10-ton truck bomb attack) and $25 billion loss (Sarin attack).

Several findings are worth noting under the current TRIA design:

- Under the current loss-sharing arrangement, the federal government will not be responsible for *any* payments after mandatory recoupment until the losses from a terrorist attack exceed $40 billion. Any federal outlays above this level can be recovered through the discretionary recoupment process.

- Insurers will always pay more than the federal government until the total losses from the attack reach $80 billion, again with the federal government retaining the right to recover its outlays through discretionary recoupment.

- Should the losses be as high as $100 billion, the federal government will be responsible for almost $40 billion of payments ($39.14 billion as detailed in Table 5.3a), insurers $30 billion, the commercial policyholders $0. The remaining $30 billion would be un-insured, that is, to be paid by the uninsured firms that suffer the loss.

- Commercial policyholders remain exposed to terrorism; under the current design they will always have to pay something until total loss reaches $80 billion. They could end up paying up to more than $10 billion depending on the size of the attack.

Based on the proposed Senate and House bills, we find the following:

- The federal government will not be responsible for any payments not recovered by the mandatory recoupment provision until the total insured losses from a terrorist attack exceed $59 billion for the Senate bill and either $52 billion (with a $32 billion aggregate retention) or $74 billion (with a $44 billion aggregate retention) for the House bill.

- Under the Senate bill, when total insured and non-insured losses reach $100 billion, insurers will ultimately be responsible for approximately $33 billion in payments, insurers almost $31 billion, the commercial policyholders over $5.7 billion (through mandatory recoupment) and the remaining $30 billion would be uninsured (Table 5.3b).

- For the House bill with a $32 billion aggregate retention, the insurers will pay the same amount as in the Senate bill (approximately $33 billion) but commercial policyholders will not pay anything because the aggregate retention amount of $32 billion is below the value of insurer's payments ($33 billion). Hence, the government recoups nothing from the policyholders and is left paying the entire $36.84 billion (Table 5.3c). For the House bill with a $44 billion aggregate retention, at $100 billion loss our analysis reveals that while insurers will be responsible for the same $33 billion as they would under the Senate bill, the commercial policyholders will now pay $16.26 billion ($44 billion minus $33.16 billion multiplied by 150%) and taxpayers would be responsible for $20.58 billion of the insured loss (Table 5.3.d). These two cases illustrate the sensitivity of the loss sharing arrangement between stakeholders under the House bill to the aggregate retention level.

- Under the Senate bill, commercial policyholders would always pay more than $10 billion when total losses from terrorist attacks in New York City are in the $38 billion to $82 billion range. The maximum they would pay – $17.9 billion – is reached when losses are $54 billion.

- Under the House bill with a $32 billion aggregate retention, commercial policyholders would always pay more than $10 billion when total losses from terrorist attacks are in the range of $36 to $59 billion. The maximum they would pay – $15.3 billion (lower than in the Senate bill) – is reached when losses are $46 billion.

- Under the House bill with a $44 billion aggregate retention, commercial policyholders would always pay more than $10 billion when losses from terrorist attacks are above $36 billion. The maximum they would pay – $26.8 billion – is reached when total losses are $63 billion.

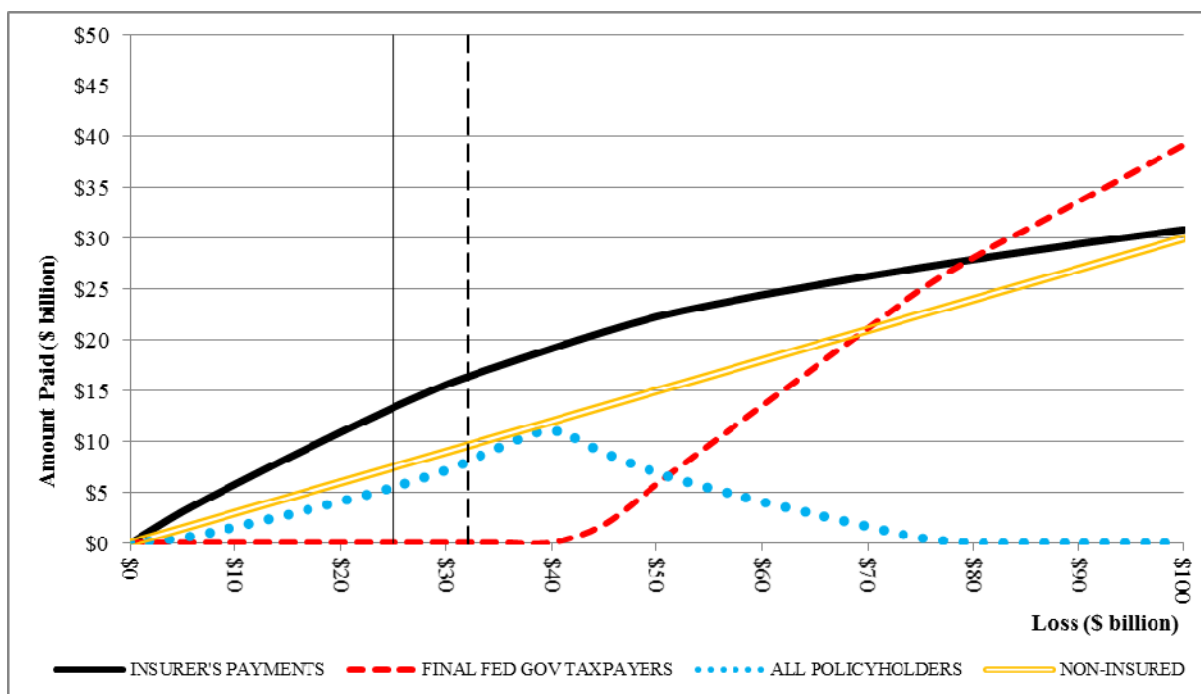The Appendix provides analyses for Chicago, Houston and Los Angeles.

FIGURE 5.1: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO NEW YORK CITY UNDER CURRENT TRIA LOSS-SHARING ARRANGEMENTS
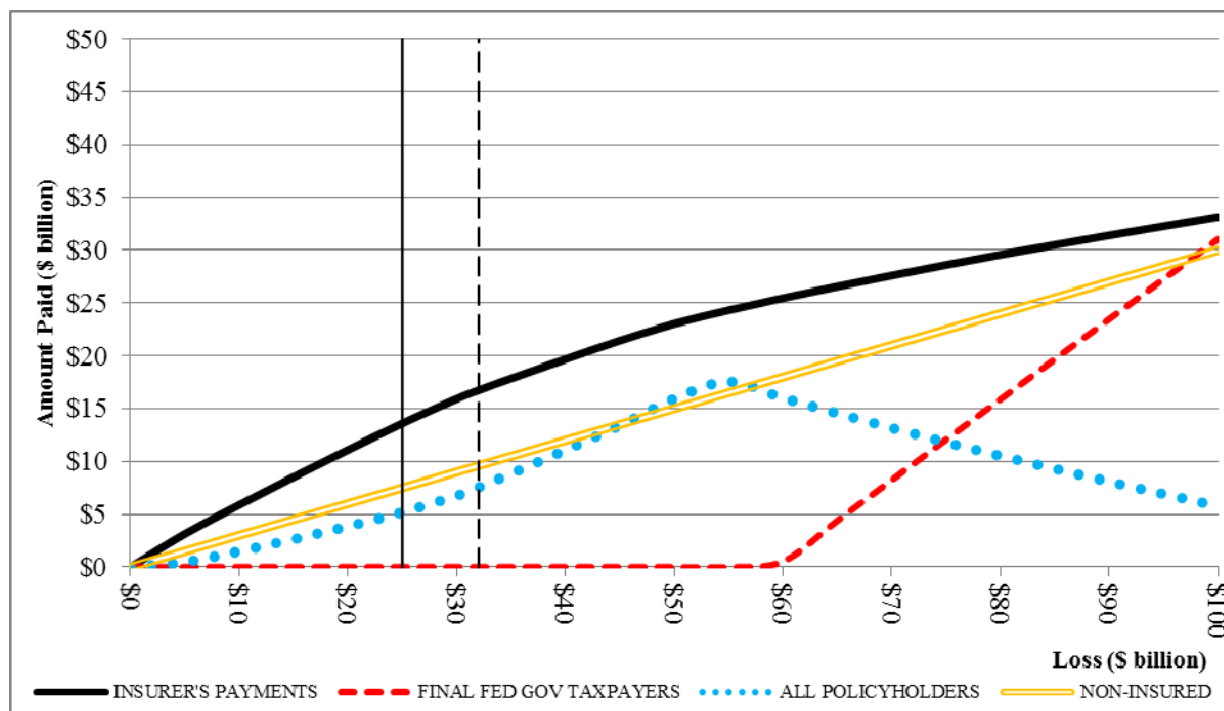

FIGURE 5.2: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO NEW YORK CITY UNDER PROPOSED SENATE BILL S. 2244
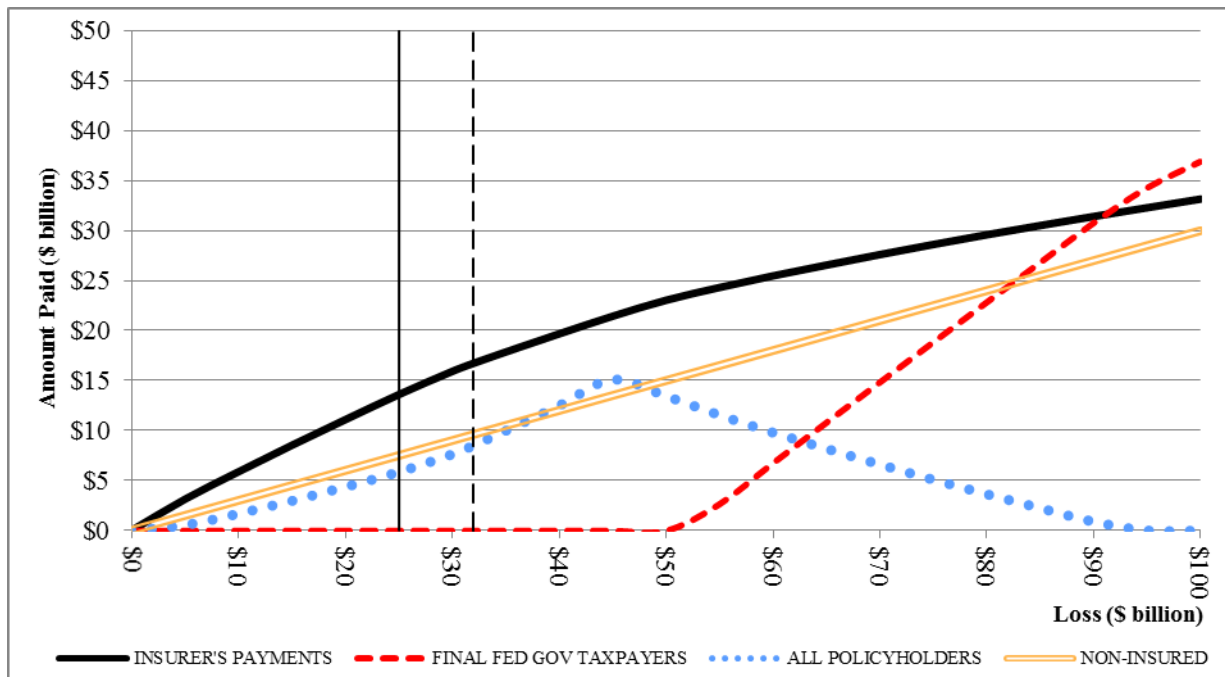
FIGURE 5.3A: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO NEW YORK CITY UNDER PROPOSED HOUSE BILL H.R. 4871 ($32 BILLION RETENTION)
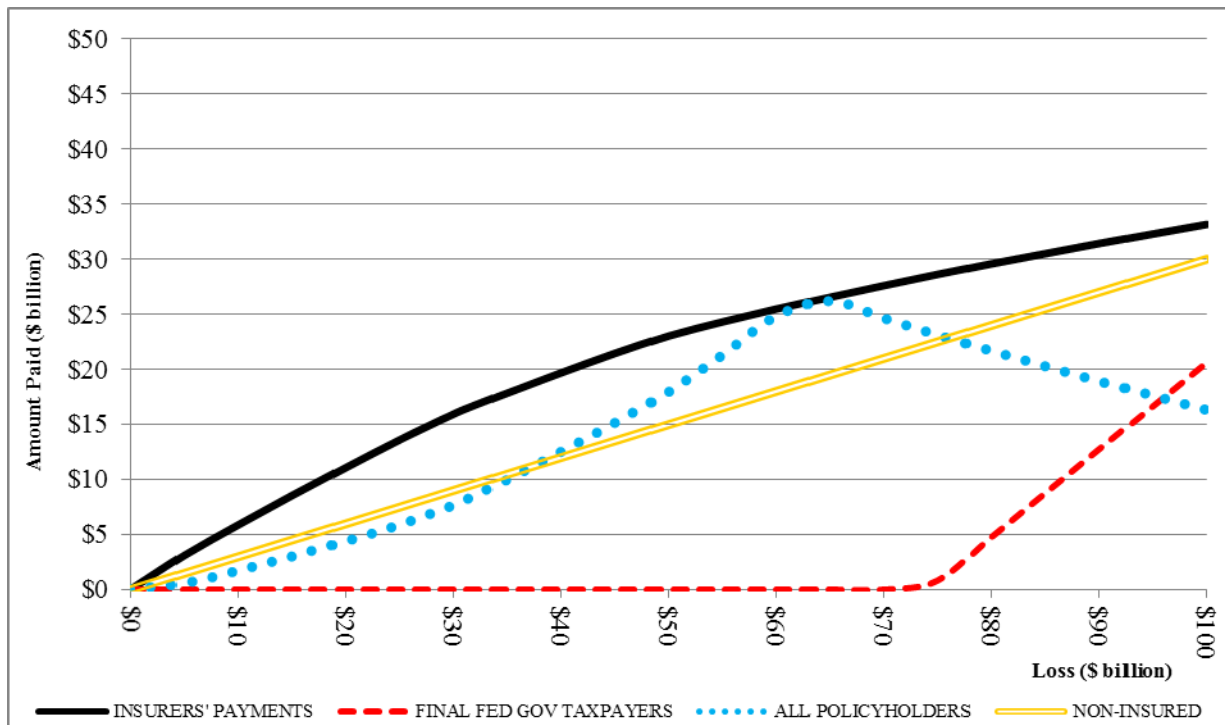

FIGURE 5.3B: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO NEW YORK CITY UNDER PROPOSED HOUSE BILL H.R. 4871 ($44 BILLION RETENTION)

SECTION 6.

CONCLUSIONS AND OPEN ISSUES

The Terrorism Risk Insurance Act of 2002 was passed in the aftermath of the terrorist attacks of September 11, 2001. In 2005, the Wharton Risk Center released a report *TRIA and Beyond*, undertaken in collaboration with a large number of stakeholders that evaluated possible renewal options for TRIA. TRIA was renewed later that year for two years and again in 2007 for seven years.

To assist Congress and the Administration in their evaluation of renewal options before the program expires at the end of 2014, the present report provides quantitative analyses of the loss-sharing features of the current TRIA program and alternative legislative options for modifying its design. To do this we examined the impacts on the different stakeholders of three different terrorist attack scenarios in four large cities located in different parts of the United States without making any policy prescriptions.

We have not considered the impact a large-scale terrorist attack would have on the national mindset nor the terrorism or commercial insurance markets should a loss occur. If experience with other large-scale insured events serves as a guide, the way the federal government and the insurers (and their reinsurers) will react to a terrorist attack on U.S. soil will depend on its size. Should an attack inflict minor economic losses, as was the case in the 2013 Boston Marathon bombing, the insurance market is not likely to be affected. However, another large-scale attack such as 9/11, or more frequent small-scale attacks, may cause a further retrenchment by insurers with restrictions in capacity and coverage especially in the absence of a TRIA program. One of the reasons terrorism insurance prices have decreased in recent years can be explained by the absence of any significant attack, competitive pressure on general insurance rates, and concerted efforts by insurers over the past decade to bring their exposures into line with existing TRIA parameters (GAO, 2014).

There is at present very little data on premiums collected by insurers from their marketing of terrorism insurance. TRIA requires the Treasury to annually compile information on the terrorism insurance premium rates of insurers and permits the Treasury to require insurers to submit that information to National Association of Insurance Commissions (NAIC) but to date, the Treasury has not taken either action (GAO, 2014).

Another open question relates to our assumption that uninsured firms that suffer losses from a future attack will not receive compensation from the federal government. Based on the experience of 9/11 as well as the lessons learned from large-scale natural disasters, it is likely that the federal government will provide considerable assistance to uninsured victims (Kunreuther and Michel-Kerjan, 2011). As a reference point, post-disaster relief and special Congressional appropriations represented 80% of the cost of Hurricane Sandy in 2012 (Michel-Kerjan, 2013). But absent legislation on such an intervention, this aid will be ad hoc and hard to quantify (LaTourrette and Clancy, 2014). This so-called "Samaritan's dilemma"[29] also needs to be considered when designing any terrorism insurance program.

Finally, in analyzing each of these scenarios, we have focused solely on the insurable losses under the scenario and not the broader economic losses that would have to be addressed. To the extent that a terrorist attack causes contingent business interruption and other indirect impacts, one needs to consider the role that insurance and other protective measures undertaken by firms can play in cushioning these longer term economic effects.

APPENDIX

**LOSS DISTRIBUTION IN CHICAGO, HOUSTON AND LOS ANGELES
UNDER THREE TRIA DESIGNS
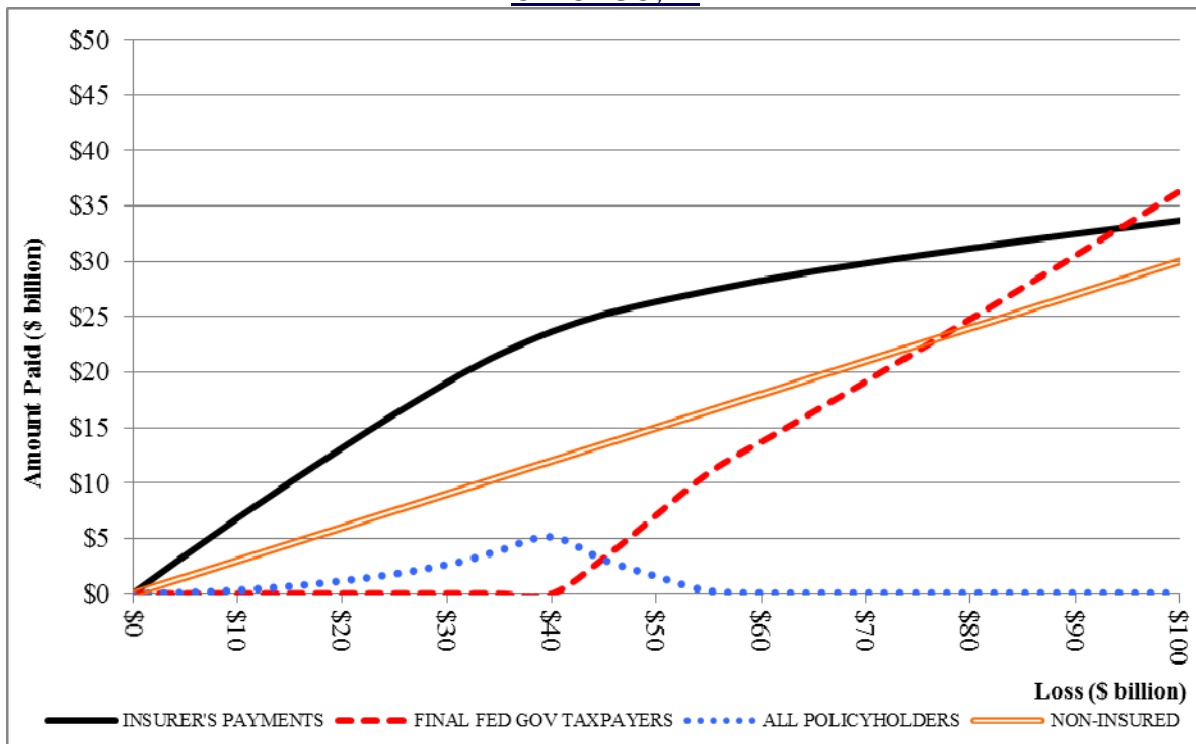(CURRENT DESIGN; SENATE BILL S. 2244; HOUSE BILL H.R. 4871)**

FIGURE A.1A: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO CHICAGO, IL UNDER CURRENT TRIA LOSS-SHARING ARRANGEMENTS
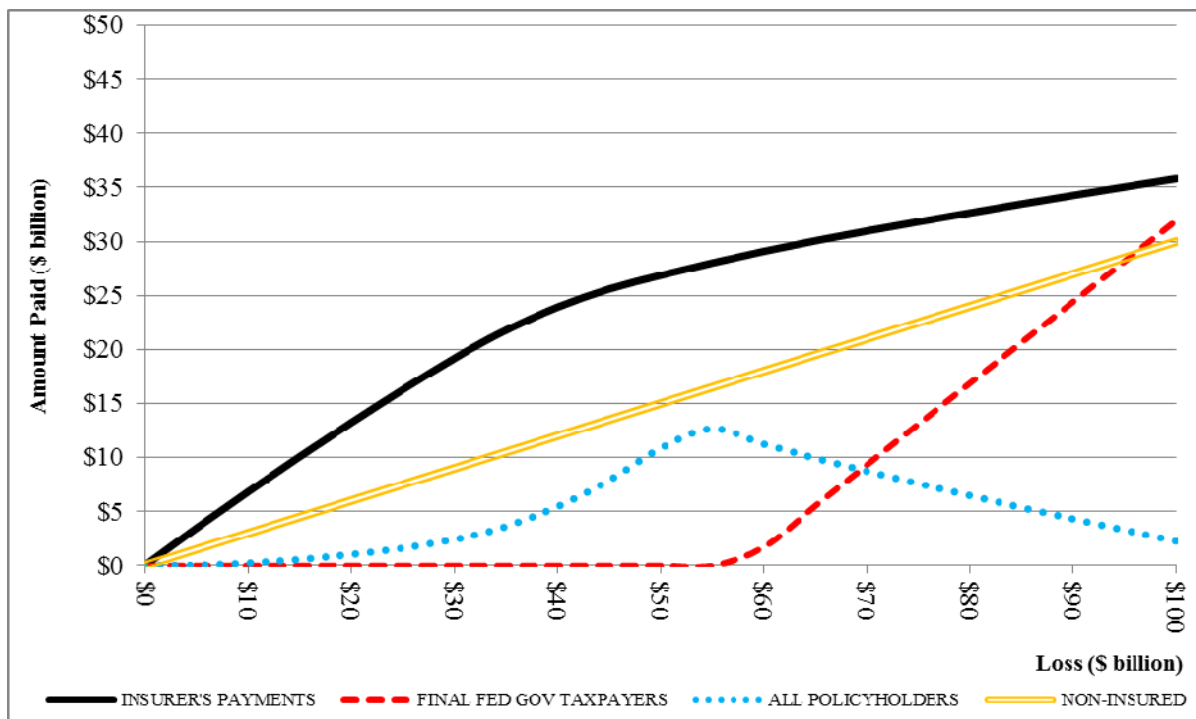

FIGURE A.1B: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO CHICAGO, IL, UNDER PROPOSED SENATE BILL S. 2244
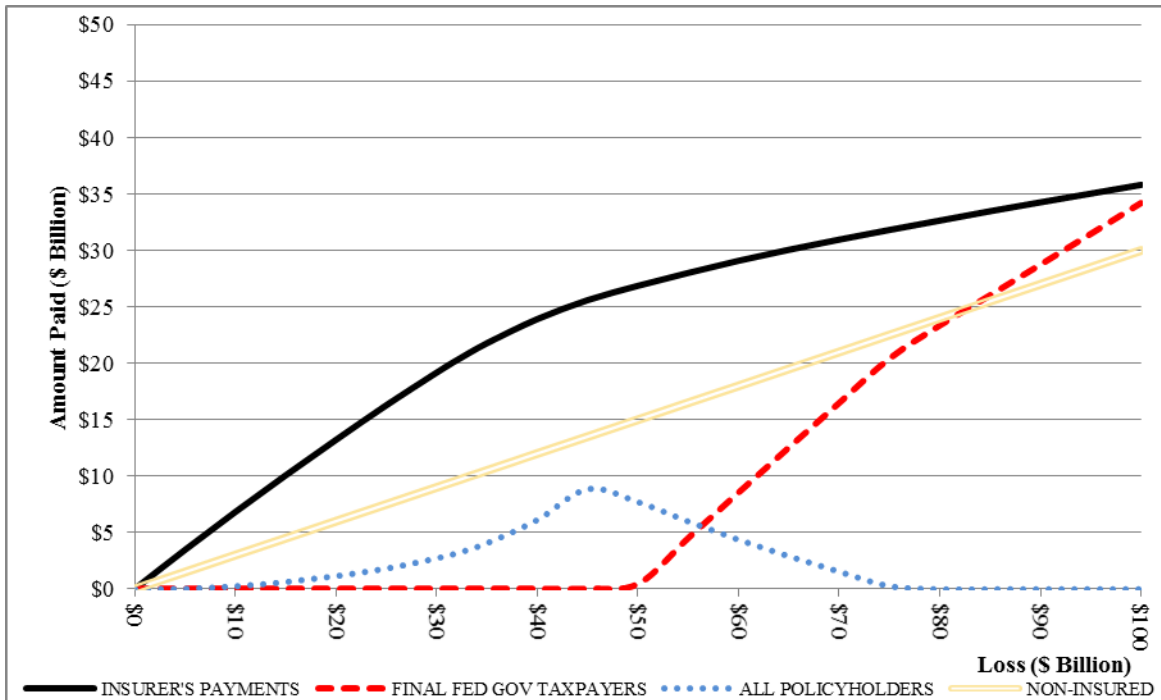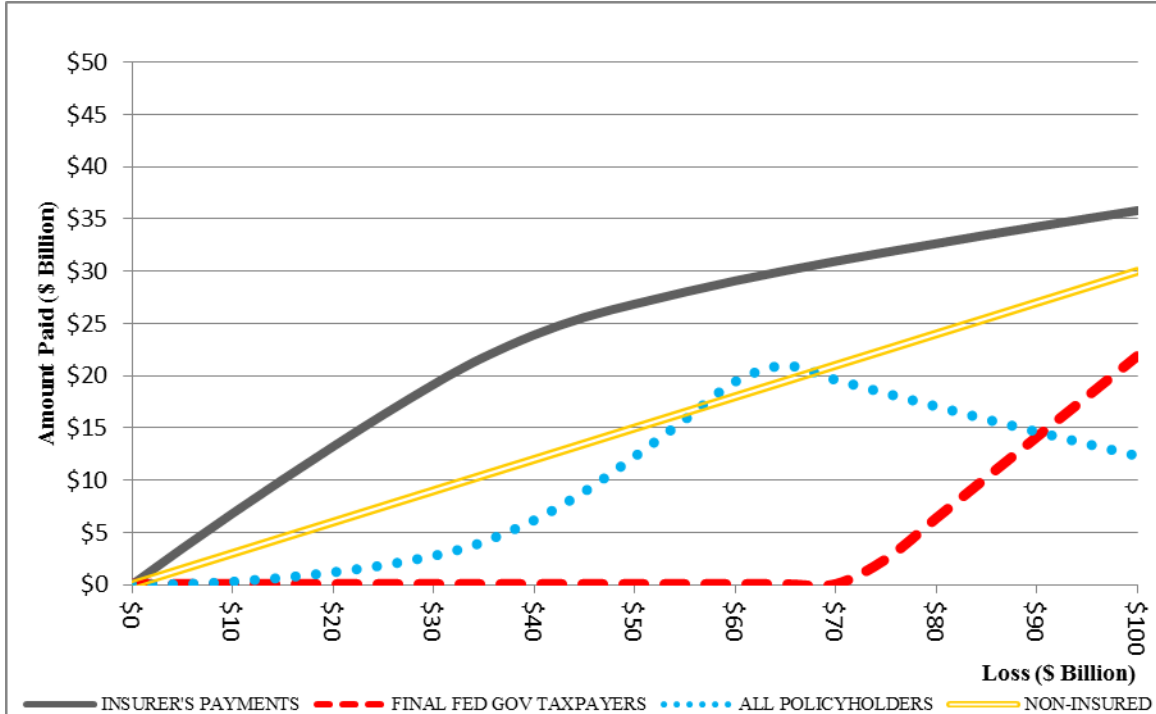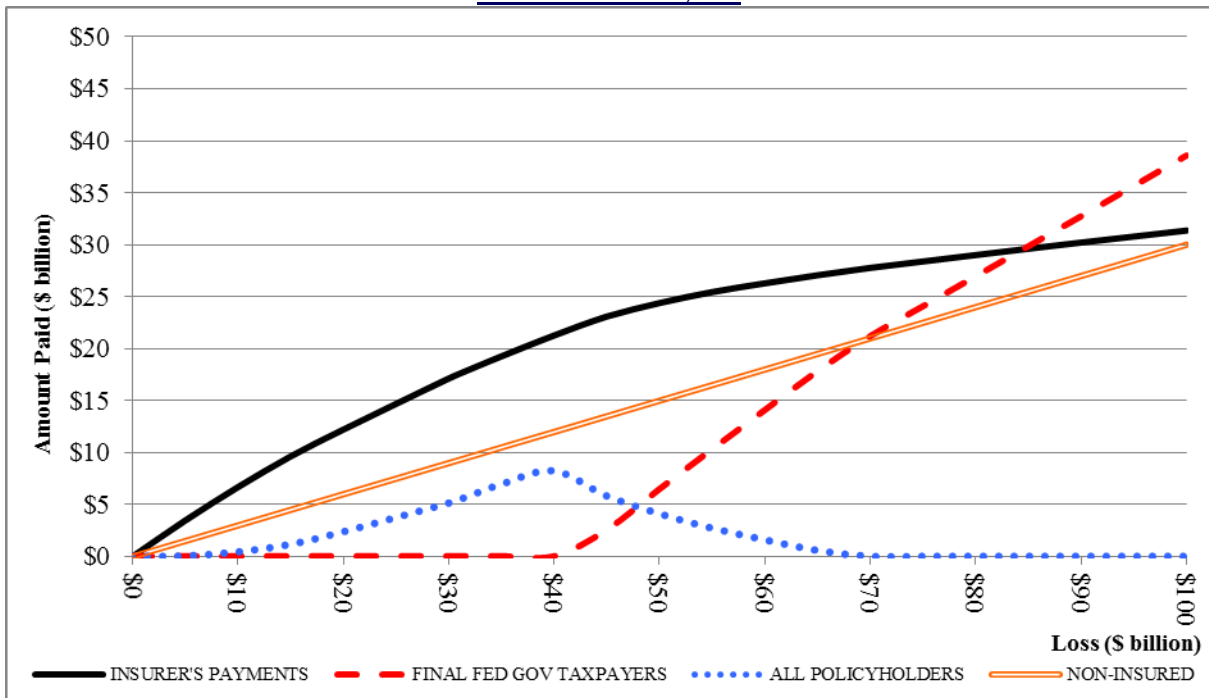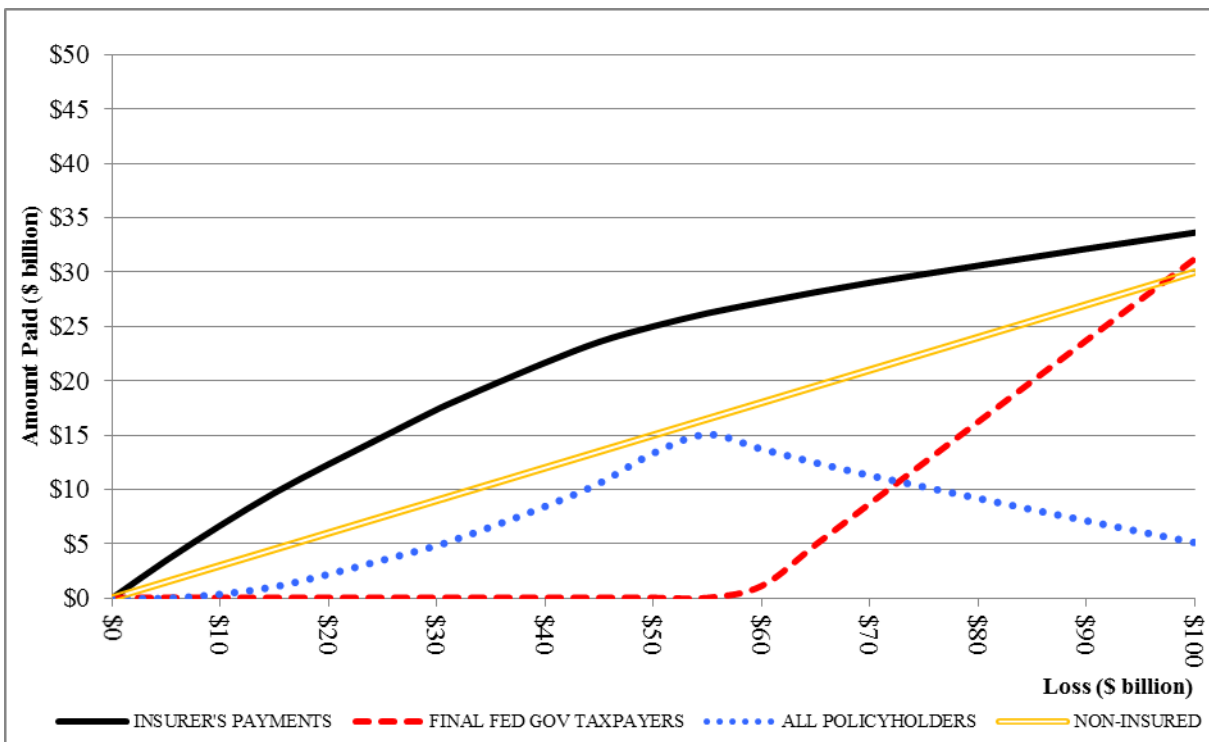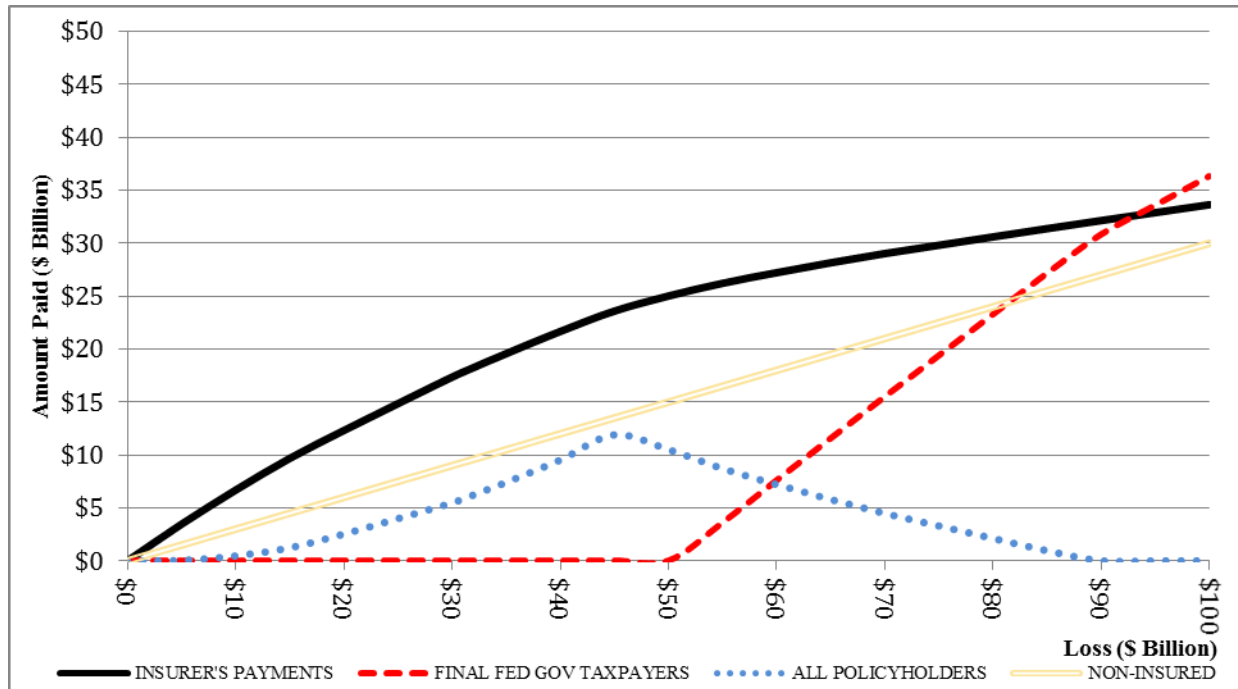
FIGURE A.1C: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO CHICAGO, IL, UNDER PROPOSED HOUSE BILL HR. 4871 (WITH $32BN RETENTION)
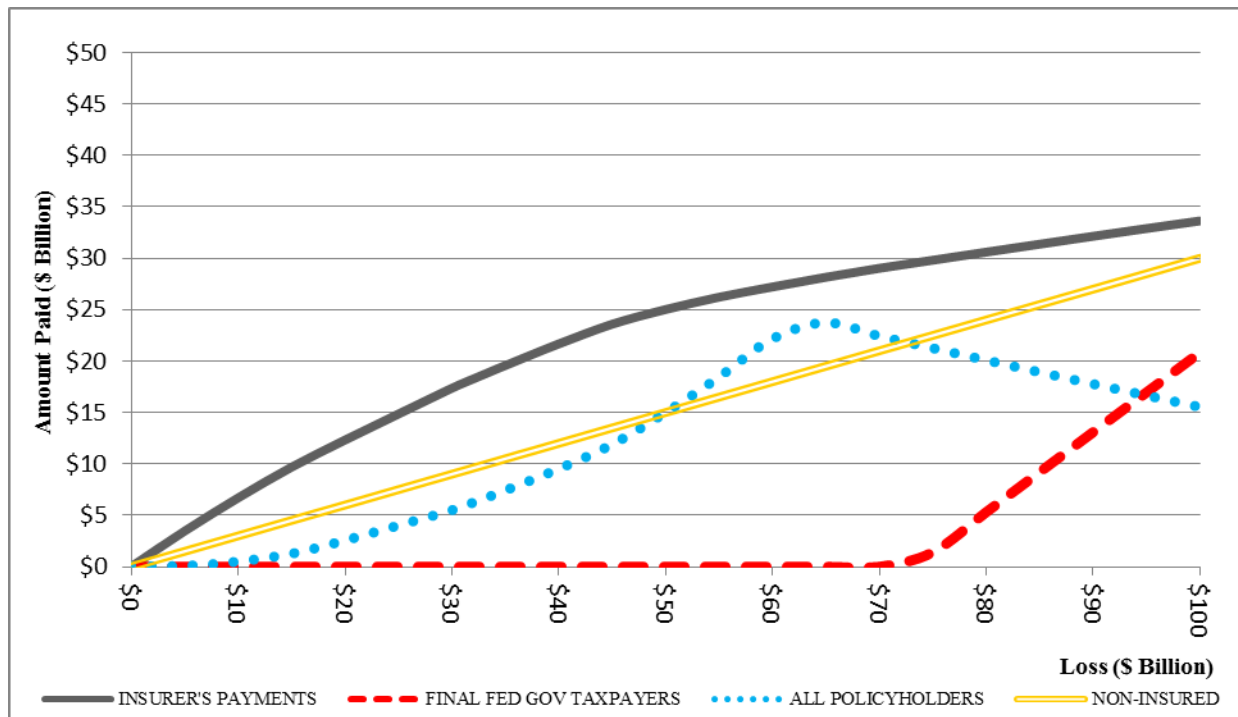

FIGURE A.1D: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO CHICAGO, IL, UNDER PROPOSED HOUSE BILL HR. 4871 (WITH $44BN RETENTION)
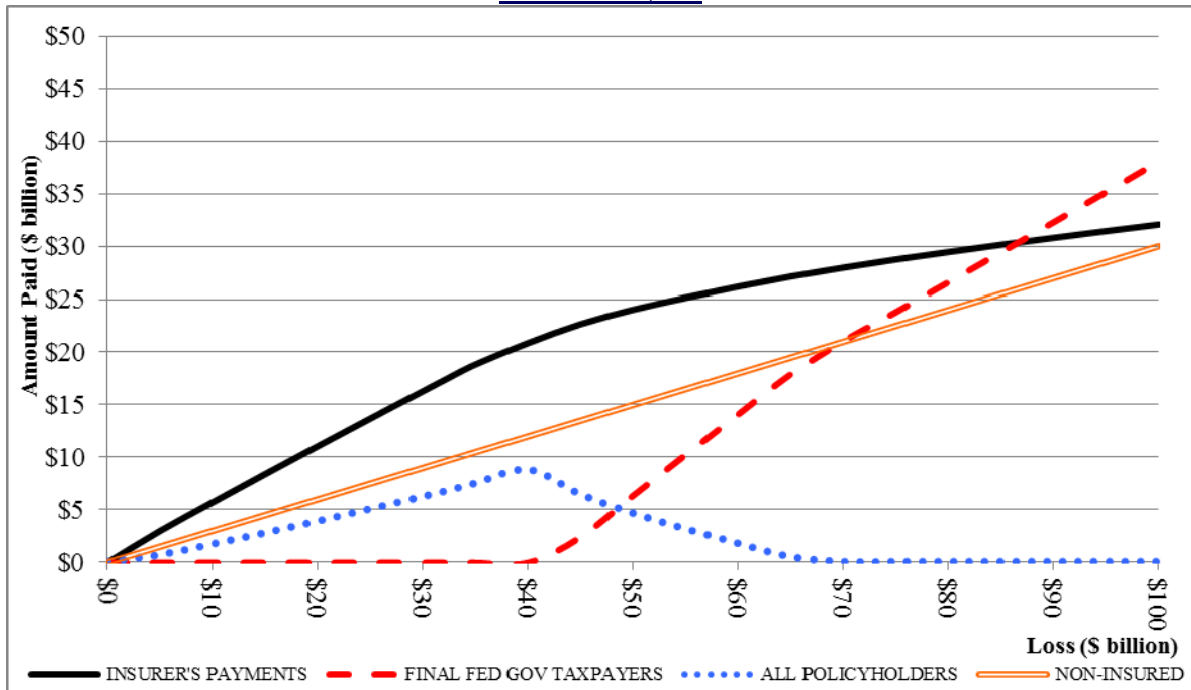
LOS ANGELES, CA

FIGURE A.2A: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO LOS ANGELES, CA UNDER CURRENT TRIA LOSS-SHARING ARRANGEMENTS
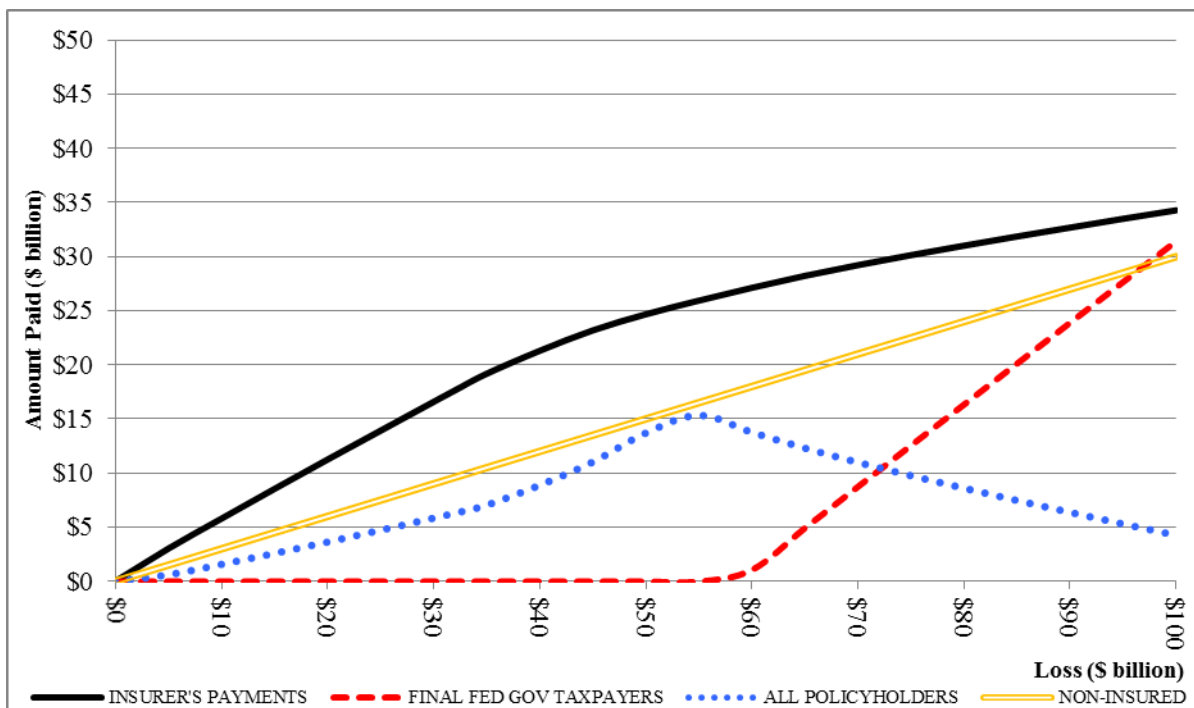

FIGURE A.2B: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO LOS ANGELES, CA UNDER PROPOSED SENATE BILL S. 2244

FIGURE A.2C: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO LOS ANGELES, CA UNDER PROPOSED HOUSE BILL H.R. 4871 (WITH $32BN RETENTION)

FIGURE A.2D: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO LOS ANGELES, CA UNDER PROPOSED HOUSE BILL H.R. 4871 (WITH $44BN RETENTION)

HOUSTON, TX

FIGURE A.3A: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO HOUSTON, TX UNDER CURRENT TRIA LOSS-SHARING ARRANGEMENTS

FIGURE A.3B: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO HOUSTON, TX, UNDER PROPOSED SENATE BILL S. 2244
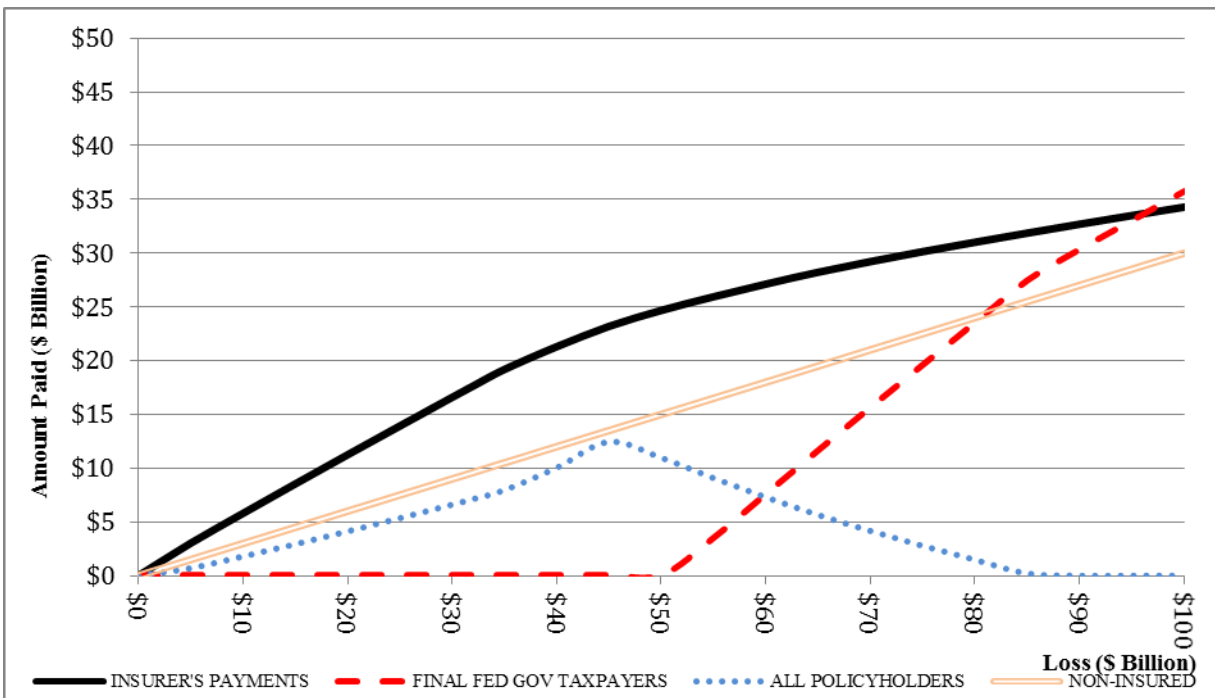
FIGURE A.3C: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO HOUSTON, TX, UNDER PROPOSED HOUSE BILL H.R. 4871 (WITH $32BN RETENTION)
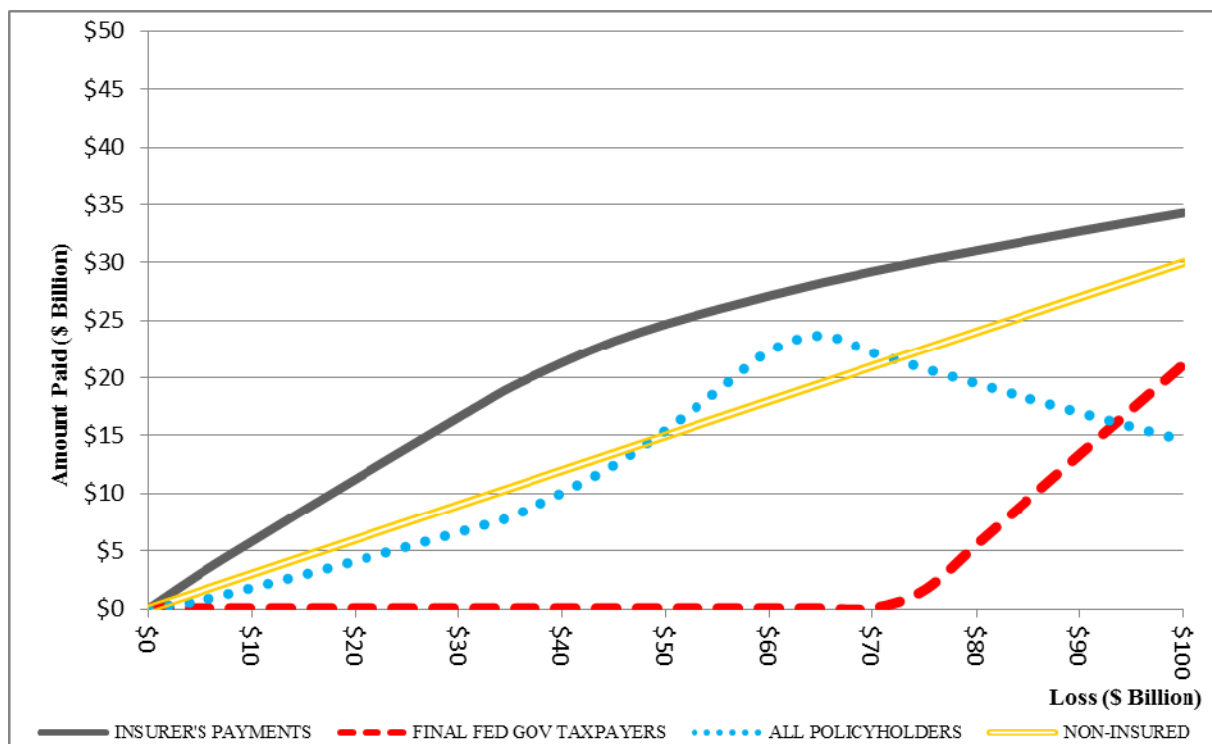

FIGURE A.3D: AMOUNT PAID BY STAKEHOLDERS FOR DIFFERENT LOSSES FROM TERRORIST ATTACKS TO HOUSTON, TX, UNDER PROPOSED HOUSE BILL H.R. 4871 (WITH $44BN RETENTION)

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NOTES:

[1] The Bishopsgate bombing of April 24, 1993 in the financial district of London, UK, killed 54 people and cost over $1.2 billion worth of damage (OECD, 2005). Two years later, two other severe attacks occurred in the UK: one on February 9, 1996 when the Irish Republican Army (IRA) detonated a truck bomb in Canary Wharf, one of London's two main financial districts which killed two people and cost nearly $350 million of insured losses, and one on June 15, 1996 – an explosion of a car bomb near a shopping mall – which killed 228 and caused nearly $900 million of insured losses.

[2] Testimony of Jacques Dubois, Chairman and CEO Swiss Re America on behalf of Swiss Re before the United States Senate on Banking, Housing, and Urban Affairs, May 18, 2004.

[3] See, e.g., Cal. Ins. Code §2701; Ga. Admin. Code 120-2-19-.01; Haw. Rev. Stat. §431:10-210; 50 Ill. Admin. Code §2301.30; Iowa Code §515.109; Me. Rev. Stat. tit. 24-A, §3001; Mo. Code Regs. Tit. 20, §500-1.100; N.Y. Ins. Law§3404; N.C. Gen. Stat. 58-44-16; Or. Rev. Stat. §742.216; Wash. Admin. Code §284-20-010; W. Va. Code §33-17-2; and Wis. Admin. Code Ins. 6.76. Some states have adopted specific exclusions for terrorism "fire following" loss, but many of those exclusions are tied to the continuation of TRIA (See, e.g., Ariz. Rev. Stat. §20-1503; Conn. Gen.Stat. §38a-307a; Idaho Code §41-2401; La. Rev. Stat. §22:1311; Mass. Gen. Laws ch. 175, §99; Mich. Comp. Laws§500.2834; Minn. Stat. §65A.01; N.H. Rev. Stat. Ann. §407:22; N.D. Cent. Code §26.1-39-06; 40 Pa. Cons. Stat. §636; and Va. Code §38.2-2102).

[4] Terrorism coverage is not offered in most other countries unless the national government shares the risk with the insurers such as in the UK with PoolRe, France with Gareat and Spain with Consortio.

[5] Statement of Richard J. Hillman, U.S. General Accounting Office, "Terrorism Insurance: Rising Uninsured Exposure to Attacks Heightens Potential Economic Vulnerabilities," before the Subcommittee on Oversight and Investigations of the House Financial Services Committee, at 9-10 (February 27, 2002), available at http://www.gao.gov/new.items/d02472t.pdf. See *e.g.*, President George W. Bush, "Remarks on signing the Terrorism Risk Insurance Act of 2002, Weekly Compilation of Presidential Documents, Proquest Information and Learning (December 2, 2002).

[6] In most instances, this "make available" requirement means that insurers are required to offer a policy without a terrorism exclusion or limitation. Once an insurer has satisfied this offer requirement, the insurer is permitted to offer other terrorism coverage options, such as a policy with a sub-limit.

[7] In jurisdictions utilizing the standard New York Statutory Fire Policy that have not allowed terrorism exclusions for fire following a loss, insurers cannot exclude the risk of terrorism. In these states, it will be very difficult to tell the difference between "blast/fire" and nuclear damages from a large-scale attack. There is some ambiguity as to whether the standard pollution exclusions would be upheld in court in the event of a certified terrorist act involving CBRN weapons as they may be subject to challenges because the exclusions were not specifically developed to address terrorist attacks. For more details see GAO (2009).

[8] See Brown, Cummins, Lewis, and Wei (2004) for a discussion on the events leading to the passage of TRIA and the market's assessment of the perceived cost-benefit for various industries.

[9] The House bill has yet to be voted on by the full House as this report goes to press.

[10] See: Michel-Kerjan, Raschky and Kunreuther (in press); LaTourrette and Clancy (2014); Willis and Al-Shahery (2014); Dworsky and Dixon (2014); Hartwig and Wilkinson (2013); Rhee (2013).

[11] The President's Working Group on Financial Markets is composed of the Secretary of the Treasury, the Chairman of the Board of Governors of the Federal Reserve System, the Chairman of the Securities and Exchange Commission, and the Chairman of the Commodity Futures Trading Commission. The Secretary of the Treasury, or his designee, is the Chairman of the President's Working Group.

[12] The Terrorism Risk Insurance Program Reauthorization Act of 2007 (TRIPRA) includes standard disclosure requirements for all policyholders to ensure that they are aware of the existence of the industry cap on liability at $100 billion and the process for any reimbursements should industry losses exceed $100 billion. For simplicity we use the word "TRIA" across this report.

[13] The TRIA legislation states that: "If the aggregate insured losses exceed $100,000,000,000, (i) the Secretary shall not make any payment under this title for any portion of the amount of such loss that exceeds $100,000,000,000; and (ii) no insurer that has met its insurer deductible shall be liable for the payment of any portion of that amount that exceeds $100,000,000,000. Congress shall determine the procedures for and the source of any payments for such excess insured losses." §103(e)(2)(A).

[14] The 133% was driven by the budget scoring of the 2007 extension of TRIA to make the legislation budget neutral within the 10-year windows used to score the legislation.

[15] TRIA-eligible lines include liability lines of insurance in addition to property and workers' compensation insurance. However, given the challenges in attempting to model the terrorism losses associated with liability exposures, we focus our examples on the property and workers' compensation lines of business.

[16] Insurer *capital* represents the net worth of the company (assets minus liabilities). Capital enables the insurer to pay any claims above their expected losses. It serves as a safety net to support the risk that an insurer takes on by writing insurance and helps ensure that the insurer will be able to honor its contracts. The cost of that capital is an insurer's expense that must be considered in pricing insurance, along with expected losses, sales and administrative expenses for policies written.

[17] According to the Federal Insurance Office (2013), the capital supporting TRIA-eligible lines is estimated to be only about one-third of total insurance industry capital.

[18] According to Aon Benfield (2013), approximately 30% of P&C capital is needed to support investment and credit risk, 23% is needed to support non-catastrophe underwriting risk, and 47% is being used to support reserving risks.

[19] Testimony of J. Eric Smith, President and Chief Executive Officer, Swiss Re Americas, "The Terrorism Risk Insurance Act of 2002," United States House of Representatives, Committee on Financial Services, September 19, 2013.

[20] Note also that this analysis is done with 2012 data and thus does not reflect changes that might have occurred in the market in 2013 and early 2014.

[21] The 50th insurer has $583 million DEP ($117 million TRIA deductible); 100th insurer has $209 million DEP ($42 million TRIA deductible); the 200th insurer has $63 million DEP ($12.6 million TRIA deductible); the 300th insurer has $22.3 million DEP ($4.5 TRIA deductible); the 450th insurer has $4.3 million of direct earned premiums and a $873,000 deductible under TRIA today; all based on 2012 data.

[22] Insurers that were ranked lower than the top 450 had very small deductibles and/or no TRIA line business so we did not include these insurers in our analysis.

[23] Of the 764 insurers we looked at, 445 insurers have a TRIA deductible higher than $1 million , 146 insurers have a deductible higher than $1 million but lower than $5 million and represented only 0.235% of the TRIA-eligible DEP in 2012 but 2.25% of the industry surplus; 220 insurers have a TRIA deductible higher than $10 million; 166 insurers have a TRIA deductible higher than $20 million and 90 insurers have a TRIA deductible higher than $50 million.

[24] Note that section 105 of the House bill H.R. 4871 has an op-out option for small insurers.

[25] Phosgene and chlorine are choking agents but require very large amounts to inflict mass casualties. Hydrogen cyanide and cyanogen chloride contaminate the blood. Mustard gas can cause injuries on a large scale but is unlikely to cause death en masse. Technical challenges associated with weaponizing V-series nerve agents are formidable. Tabun, Sarin, and Soman are examples of G-series nerve agents. Sarin is highly toxic, and relatively easy to manufacture.

[26] Note that we do not consider capacity provided through captives since this data is not widely available for the entire market. For more about the role of captives see Wharton Risk Center (2005).

[27] "Terrorism Risk Insurance Program Reauthorization Act of 2007: Cost Estimate." Congressional Budget Office, October 29, 2007.

[28] In our analyses we focus on conventional terrorist attack scenarios and thus do not consider the bifurcation between CBRN and non-CBRN attack introduced in the House bill. In fact, it might be difficult to quantify precisely what part of the loss would be CBRN and what part would be covered under conventional.

[29] The Samaritan's dilemma was introduced by Nobel laureate James Buchanan; see Buchanan, J. (1975). The idea is that the government (the Good Samaritan) wants to help victims after a major loss. While such an attitude is likely to generate public approval after a disaster it has potentially negative effects on potential victims' behavior prior to the event. Indeed, it creates moral hazard problems by encouraging risk-taking behavior (including not purchasing insurance) by those who feel they will be financially protected by disaster assistance after an event.

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About the Wharton Risk Center

Established in 1984, the Wharton Risk Management and Decision Processes Center develops and promotes effective corporate and public policies for dealing with catastrophic events including terrorism, natural disasters, technological hazards, terrorism, pandemics and other crises. The Risk Center research team – over 70 faculty, fellows and doctoral students – investigate how individuals and organizations make choices under conditions of risk and uncertainty under various regulatory and market conditions, and the effectiveness of strategies such as alternative risk financing, incentive systems, insurance, regulation, and public-private collaborations at a national and international scale. The Center actively engages multiple viewpoints, including top representatives from industry, government, international organizations, interest groups and academia. For more information, see http://www.wharton.upenn.edu/riskcenter.

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