

Terrorism Losses and All Perils Insurance[†]

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Summary

This article deals with the role of insurance for damages from catastrophic events. Prior to the attack of September 11, 2001, insurers typically provided coverage for losses from terrorism and those from almost all other causes. These causes were thought by the industry to be of sufficiently low probability and were not a reason for making changes in premiums, underwriting, or reserves. In times past, property-casualty insurance had provided protection only for losses from named causes, but over time contracts had evolved into ones that paid for damages from all causes except for specifically named exclusions. Terrorism was not one of these exclusions, so many insurers (and re-insurers) had to pay claims resulting from the September 11th attacks. After these events, coverage for losses caused by terrorism was explicitly excluded from many commercial insurance policies. This article argues that the “all-cause” or “all perils” contract was useful in providing protection against unusual events, but that it created problems for insurers and policyholders when a catastrophic “unnamed peril” event, such as September 11, occurred. We provide a behavioral explanation for both the offering of all perils insurance for seven decades and the subsequent changes in contracts to exclude terrorism. We then suggest public policy interventions that could improve the functioning of the property-casualty market.

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Introduction

Following the attacks of September 11, 2001 (9/11) there has been a fundamental change in how terrorism is perceived in the United States. Losses to property and income due to terrorism, which were formerly ignored, now fall in the category of low probability-high consequence (LP-HC) events. Insurers and re-insurers, who paid the bulk of the \$40 billion insured losses from 9/11, were reluctant to continue offering protection except at very high prices. As a result, since 9/11 insurers excluded terrorism damages from their “all causes” commercial policies. Those firms demanding insurance protection against such losses were forced to purchase a policy that added terrorism as a specific cause. They often had a difficult time finding an insurer offering such coverage at a premium they were willing to pay, and sometimes could not find a seller willing to provide terrorism insurance at any price. This phenomenon is difficult to understand from the viewpoint of the economic theory of insurance. Why was supply of this insurance so unstable?

The paradox is this: before 9/11 coverage against losses due to terrorism was indeed provided by insurers in the predominant “all perils” policy form, at apparently nominal additional premiums. There was also little or no attention given by regulators to the impact that a terrorist loss would have on insurer reserves or viability. After 9/11 the price of coverage that included terrorism went from almost zero to a very high level. The amount of protection bought in the market dropped dramatically. The economic theory of insurance (Smith 1968) suggests that risk averse buyers would gain from being able to purchase coverage at positive premiums against rare but possible events with high consequences. How do we understand the reasons for such a significant shift by the insurers? Did the absence of regulators’ concern contribute to this significant shift in attitude toward a cause that was known but unappreciated prior to 9/11? What improvements in regulation, subsidization, and insurance markets might help?

This article outlines theories of insurance demand and supply, based on two kinds of conceptual models: standard expected utility models and behavioral models. We then suggest ways of improving the current institutional arrangement for dealing with LP-HC events when there are limited data on a risk from an unknown or poorly understood cause, including (but not limited to) terrorism as a cause. Although we focus on the recent response of insurance markets to the large-scale terrorist attack of September 11, 2001, the concepts are relevant to many situations where buyers desire and would benefit from coverage, but insurers have limited data on which to estimate the risk and have the potential of facing an extremely large loss should a catastrophic event occur.

The Economics of Inclusion and Exclusion

We first want to understand what the insurance demand and supply situation was before the terrorist attack. How would traditional economic models describe what insurers were doing and what regulators were or should be doing?

On the demand side, owners of property (whether consumers or businesses) sought to protect themselves against large losses to the value of that property. Ideally, the type of insurance demanded to satisfy these tastes would be coverage whose benefits depend only on the amount of the loss suffered. Other things being equal, the insurance sought would then be so-called *all-peril* or “risk of direct loss to property” coverage that is common to both homeowners’ and commercial property-casualty insurance (Rejda 1992, 79).

Such coverage is not the only form insurance can or has historically taken. Early casualty insurance for commercial and domestic property (dating from at least the 1800s) was *named perils* coverage that provided indemnification only for losses associated with certain specified or identified causes. It provided no protection against losses that could not be attributed to those causes.

Property-liability coverage transitioned from named-perils to all-perils in the 1930s. The spread of mortgage financing for home ownership meant that lenders were also eager to have all-perils coverage as a condition for making a loan. This is one possible explanation for this change, but there appears to be very little discussion of reasons in the literature as to the rationale. Over time, insurance gave way to *package policies* that combine coverage for a wide range of causes of losses, but still excluded certain specific named risks (e.g., earthquake, flood or acts of war). The typical package policy before 9/11 specifically excluded coverage for damages from acts of war, but included coverage for damages from “riots or civil commotion” and other causes similar to terrorism.¹ In 1995, 93% of homeowners’ policies were all-perils or all-risk policies (Harrington and Neihaus 1999, 573).

Insurance for commercial establishments has followed closely the forms and procedures developed for homeowners’ coverage. When one looks at actual policies from different insurance companies one finds little variation in either homeowners’ or commercial coverage from standard “Causes of Loss Special Form” provided by the Insurers Service Office (ISO). Damages from terrorist attacks were not one of the exclusions. In fact, when insurers provided such coverage, those unnamed and perhaps unknown causes included the ones that were rare or unlikely, and terrorism was one of them. This phenomenon raises the following important questions:

1. The definition is “an assembly of three or more people who commit a lawful or unlawful act in a violent or tumultuous manner” (Rejda, 1992, p. 129).

- How and why was the market willing to supply such coverage?
- How did insurers price coverage for all causes?
- How are supply and demand affected by high consequence events such as the 9/11 attack?

To answer these questions, we begin with the demand side. Insurance scholars have proposed several practical reasons buyers demand such package policies (Webb, Horn, and Flitner 1990, 2-3). There are lower transactions cost for protecting oneself than if coverage was sold as individual policies. There is less chance of a dispute with one or more insurers as to the relevant cause(s) of the loss.

Because buyers are more likely to have private knowledge about risks from one but not all causes, adverse selection due to information asymmetry can be reduced since the insurer would have the same or better data than the buyer on some of the risks. And, perhaps most important of all, especially from a behavioral perspective, the insured knows that he is covered against all risks except the named excluded perils. Individuals and firms value this *certainty effect* by being willing to pay considerably more to reduce their financial exposure to as close to zero as possible than if they were only protected against a set of named perils.

Although there is likely to be demand for this product, why are insurers willing to supply it at prices buyers are willing to pay? Potential suppliers of insurance presumably needed to consider two factors:

- The events that are explicitly excluded by an insurance policy
- The types of risks that are covered by an all-risk policy because they are *not* explicitly excluded.

The reasons for explicitly excluding some named perils are the usual ones associated with uninsurability. There may be adverse selection problems associated with some causes if the insured knows more than the insurer (e.g., excluding specific health-related risks) or there may be moral hazard problems (e.g., exclusion of damage due to normal wear and tear). But the primary reason for uninsurability is associated with highly correlated losses (e.g., earthquakes, floods) that would drain insurers of capital if they occur. These risks may be excluded from a policy even though the cause is known and identified explicitly. Regulators have generally acquiesced to insurer requests to offer coverage that excluded some causes but included all others.

What about the portion of all-perils coverage that provides protection against losses from (literally) all causes not specifically excluded? A characteristic of these risks (and the one we are most interested in here) is the ambiguity or imprecision associated with the probability of events capable of inflicting large losses on the insurer, which makes such insurance challenging to underwrite. By *ambiguity*, we mean a situation in

which data available to the insurer is insufficient to generate a precise estimate of loss probabilities. Insurers often assert that they need valid data from which they can estimate the frequency of occurrence of some event in order to calculate a premium. Actuaries will recommend charging considerably higher premiums if the risk is perceived to be ambiguous, and in some cases may decide not to offer coverage at all (Kunreuther et al. 1993, 1995).

In offering an *all perils policy*, despite these assertions, concern with ambiguity seems to have been ignored by insurers. Coverage was provided at very modest premiums against losses whose causes were often not known or labeled in advance. No reserves were set aside against the rare but possible large loss. No provisions were made for explicit readjustment of future coverage and premiums if an event occurred. As indicated above, terrorism as a cause of loss highlights this point. To understand what happened with that coverage, and why insurer behavior seemed inconsistent with their stated views about ambiguity, we first need to understand why inconsistency existed in the first place.

Calculating Premiums for All-Perils Policies

At first consideration, the inconsistency seems unavoidable. There is no way an insurer could have known all of the possible causes of losses, and hence there is no way to have data on each cause. In addition, it would have been difficult to explicitly exclude a cause that could not easily be specified in advance. That is, since the option of offering only named-perils coverage seemed to have been prevented by the market, the ability to exclude an unsuspected peril in all perils coverage was limited.

In particular, there was before 9/11, as there is now, no reliable data to estimate the probability of a future terrorism loss. It appears as if insurers must have been making a mistake by offering coverage at inadequate premiums and probably with inadequate reserves. It is also unclear why regulators permitted them to do so, particularly in light of the 1993 bombing attempt at the World Trade Center and the 1995 Oklahoma City bombings.

There is, however, a way to think about pricing all-perils coverage that may be reasonable, although there is no evidence that insurers actually use this method. The insurer's risk manager is imagined to ask himself or herself, "What events could possibly occur that would result in a loss...?" (Rejda 1992, 241). The insurer could calculate the premium in two steps. First, probabilities are assigned and expected losses calculated for those events or causes for which there are data with high credibility (in the actuarial sense). Then the insurer examines data on past losses from all causes other than those enumerated, using these data to estimate a probability and expected loss from all "unidentified and unknown" causes.

Slightly more formally, an insurer has to estimate two probabilities: the probability they will have to reimburse losses due to events that are known and enumerated in the policy, p_K , and the probability of paying losses from

an event that was unidentified in the policy (but not excluded from it), p_U . The aggregate probability an insurer has to consider in setting premiums for an all perils policy is thus $P = p_K + p_U$

If p_U is small compared to p_K , and is perceived by the insurer to be associated with potential losses that are relatively small, there may be no incentive for the insurer to undertake additional analyses of unidentified risks offered to its clients. In fact, it would be economically impossible for a single insurer to pay for such analyses on all types of thinkable risks (i.e., all distinct credible scenarios with all possible losses associated with them).² The insurer might also choose to make no explicit addition to reserves if it thought that large losses from unknown causes would be extremely rare. However this would mean that it was still allowing for the possibility of an event that would wipe out the insurance firm. That is, by default the insurer would have agreed to cover losses from an event, which if it could have been identified explicitly, would have been regarded as uninsurable. It is even less clear that regulators were either concerned about reserves for this contingency or would have been able to accept information about it if a company chose to supply it.

Moreover, the decision to provide *all-perils* coverage might be economically justified (at least to the satisfaction of all concerned) if the average claims payments by an insurer in the recent past (e.g., during the last 10 years) for losses from such causes was zero or minimal compared to payments to its policyholders for well-identified risks. In this situation, there is no strong reason for an insurer to modify its estimate of annual losses associated with p_U .

Why Insurers Are Willing to Provide All-Perils Coverage

We now consider two models of insurer supply of all-perils coverage—one based on behavioral concepts and the other based on expected utility [E(U)] theory. We first confront a question that is at the heart of the problem: how do insurance buyers and sellers form expectations about the impact on the firm that will arise from unnamed causes? One possibility is that insurers and buyers of coverage are risk averse and maximize their expected utility [E(U)]. In an E(U) maximization model, the willingness of insurance purchasers to pay for coverage will depend on their estimates of losses from different events and their degree of risk aversion. The premium charged by insurers in a competitive market depends on their subjective estimates of the degree of independence among the losses from unnamed causes; if the losses are not thought to be completely independent, the premium will be equal to the expected loss, plus insurer administrative

2. Some anecdotal examples of non-credible events can also be identified for a specific coverage as soon as there are purchasers. For instance, attacks by the Yeti have been covered in 2001 (Godard et al., 2002).

costs, minus normal return on capital, plus any additional amount to reflect their level of risk aversion. That the insurer might be driven to ruin in rare cases is just one of the potential outcomes that enters owners' or managers' utility function.

A common behavioral model assumes that those who are considering purchasing coverage and insurers who are selling it only consider events whose probability of occurrence is above a threshold level of concern (p^*). Prior to 9/11, firms treated terrorism as a risk that was not worth worrying about, and hence were unconcerned about purchasing coverage against these events. Insurers felt the same way, and hence did not exclude terrorism from their all-perils policies. In a threshold model, for those risks with a probability $p < p^*$, there is no concern with the potential losses that may occur. For events whose probability exceeds the threshold level of concern, but where there is considerable ambiguity, insurers will charge more than the actuarial fair premium because they are ambiguity averse. However, many individuals may want to pay more for coverage than insurers will be willing to charge them, so a market for such insurance exists (Kunreuther et al. 1995).

The E(U) model and the behavioral model yield only moderately different predictions if events from unnamed causes of unknown probability are independent. The expected utility model predicts that such insurance will be bought and sold, and that realized profits will be at the competitive equilibrium level. The behavioral model says that the scope of the market for insurance will depend on whether the desire by buyers for certainty offsets the "ambiguity-aversion" of sellers. If it does, transactions will also occur, but expected profits for insurers will be positive.

In principle, the hypothesis about profits is testable, but we are not aware of any empirical studies examining it. It does not appear that modern property-casualty insurance has been extraordinarily profitable even in those years in which highly correlated losses have not occurred. One reason for this is that there may have been poor estimates of risks of known perils (e.g., fire) as well as large losses from others (e.g., earthquakes, wind-damage from hurricanes). Coupled with competitive market pressure, premiums may have been too low relative to the observed losses.

The two models differ more dramatically if the unknown events are assumed to be correlated. When insurers believe that at a cause could lead to highly correlated losses, they will raise red flags in both models, because a set of simultaneous losses will drain insurers of capital and adversely affect their future prospects in the capital market. However, without knowing the cause of the correlated losses, insurers cannot exclude these perils from their policies. The best they can do, as already suggested in the discussion of the E(U) model, is to form a subjective estimate of the likelihood of large losses and make a choice as to what premium to charge based on this estimate. But in the behavioral model this step is not taken; instead, the already very low probability of highly correlated losses is set at zero, and the potential for a catastrophic event is ignored.

The E(U) model thus predicts that a highly correlated risk would lead to an increase in the loading, and a permanently higher premium, but transactions may still occur if buyers are sufficiently risk averse. The behavioral model contends that ambiguity-averse insurers may not like this situation, but may offer coverage if no highly correlated losses occur over a long period of time; any additional premium to cover this contingency may evaporate over time.

Now we get to the final part of our story. Suppose that one of the previously unidentified causes of loss actually occurs, and that it is highly correlated across the insurer's policyholders. Just by its occurrence, the peril is now known and nameable. Under either the E(U) or behavioral model, insurers will raise the question as to whether they can continue to cover losses from this peril. Both kinds of insurers will want to raise premiums if they provide coverage at all, but probably the hypothesized increase will be larger under the behavioral model than under the E(U) model, which had already taken this possibility into account to some extent. Exactly how insurers respond depends on the type of model they are using and on how they update the risk with new information. The magnitude of the loss from a single event relative to previous annual claims payments by the insurer could be one criterion for modifying premiums or excluding coverage for a specific risk in renewing an existing policy. The stage is now set for new exclusions and new special treatment.

The Evolution of Terrorism Insurance in the US

We now explore whether, based on recent history, terrorism was one of these previously unnamed correlated causes. We consider what recent experience tells us about different models of insurer behavior, and whether, regardless of the model, there are alternative policies, public and private, that can improve upon the current situation.³ There are actually two issues here. One, which we treat first at some length, is how to provide some coverage for a previously unnamed cause that has now been observed and named—terrorism. The other, which we treat more briefly, is how to design coverage and regulation to deal with the possible emergence of other currently unnamed but correlated losses.

Risk Identification

Prior to September 11, 2001 (9/11) terrorism coverage in the United States was included in most standard commercial policy packages without an explicit consideration of the risk associated with these events. Even

3. This section and the next is based on material in Kunreuther and Michel-Kerjan (2005).

though terrorism had occurred in other countries and had been excluded by private insurers as part of their coverage, it was not considered by insurers to be a credible threat in the United States, despite the 1993 bombing of the World Trade Center (WTC) which killed 6 people and caused \$725 million of insured damages (Swiss Re 2002). In South Africa and North Ireland, private insurers decided to stop covering against terrorism after terrorist attacks in 1976 and 1977, respectively. France suffered several terrorist attacks during the 1980's, and terrorism was clearly excluded from all insurance policies until 1986 when a new law required the French insurers to provide terrorism coverage up to the overall limits of a property policy. More recently, large attacks in London led insurers to refuse covering terrorism. This led to the creation of Pool Re in 1993, a reinsurance pool based on a public-private partnership. Kunreuther and Pauly (2002) develop an expected utility model that can explain this behavior if some individuals perceive the probability of a disaster to be so small that they determine that the expected costs from searching for information will be greater than the expected costs expressed in terms of utilities.

So why did insurers still continue to include terrorism as an unidentified peril by 2001? Up to that point in time losses from what might be labeled "terrorism" had been small and, to a large degree, uncorrelated. Attacks of a domestic origin were isolated and carried out by groups or individuals with disparate agendas. Furthermore, there was not a unique and legally recognized definition of an "act of terrorism" in the U.S. before 9/11.

The terrorist attacks of September 11, 2001 killed approximately 3,050 people⁴ and inflicted damage currently estimated at nearly \$80 billion, about half of which was insured⁵ (i.e., the most costly event in the history of insurance) (Swiss Re 2002). Commercial property, workers' compensation, life, health, disability, aircraft hull, and general liability lines each suffered catastrophic losses. More specifically, insured business interruption losses were estimated at \$11 billion, workers' compensation at \$2 billion, and life insurance at \$2.7 billion. The insured property losses at the WTC were estimated at \$3.5 billion, aviation liability also at \$3.5 billion and other liability costs reimbursed by insurers/reinsurers at \$10 billion (Hartwig 2002). In other words, there was a quasi-perfect degree of correlation among individual losses.

This event confronted the insurance industry with a new loss dimension. Re-insurers, who were liable for the lion's share of the claims, were for the most part unwilling to renew coverage to insurers. The few who marketed policies charged extremely high rates for very limited protection. Insurers unable to obtain reinsurance, or to raise sufficient

4. This number represents victims of the attacks in New York, Washington, DC and Pennsylvania, as well as among teams of those providing emergency service.

5. The exact amount is still evolving and can also differ from a study to another depending on what types of loss are considered.

capital either internally or from the capital markets, scrambled by offering policies that explicitly excluded terrorism coverage.

The lack of available terrorist coverage delayed or prevented certain projects from going forward due to concerns by lenders or investors. For example, the U.S. General Accounting Office noted several cases of deals that could not be completed and a construction project that could not be started because the firms could not find terrorism coverage at prices they could afford (U.S. General Accounting Office 2002, 11-14).

Supplying Terrorism Insurance through the Terrorism Risk Insurance Act (TRIA)

In the aftermath of the 9/11 attacks many insurers warned that another event of comparable magnitude could do irreparable damage to the industry. Furthermore, they contended that the uncertainties surrounding terrorism risk were so significant that it was, in fact, an uninsurable risk. By early 2002, 45 States permitted insurance companies to exclude terrorism from their policies (Brown, Kroszner, and Jenn 2002). On the one-year anniversary of the 9/11 attacks, the U.S. remained largely uncovered (Hale 2002).

The President and the U.S. Congress viewed such a situation as unsustainable. If the country suffered future attacks it would inflict severe financial consequences on affected businesses deprived of insurance. TRIA, which provides for up to \$100 billion of terrorism insurance, was passed by Congress in November 2002 and signed into law by President Bush the next month. Insurers are now obligated to offer an insurance policy against terrorism to all their clients who can decide whether or not they want to purchase coverage.

Insured losses from commercial lines of insurance as well as business interruption due to an attack are covered under TRIA only if the event is certified by the U.S. Treasury Secretary as an “act of terrorism”, that is, as having been carried out by foreign persons or interests⁶ and only for losses higher than \$5 million. Under TRIA’s three-year term (ending December 31, 2005), there is a specific risk-sharing arrangement between the federal government and insurers⁷ that operates in the following manner. First, the federal government is responsible for paying 90% of each insurer’s primary property-casualty losses during a given year above an applicable *insurer deductible*, up to a maximum of \$100 billion. The insurer’s deductible is determined as a percentage of the direct commercial property and casualty earned premiums of each insurer the preceding year. The percentage varies over the three-year operation of TRIA: 7% in 2003, 10% in 2004 and 15%

6. An event like the Oklahoma City bombings would not be covered under TRIA.

7. Reinsurers are not part of TRIA but can provide coverage to insurers against their losses from terrorist attacks.

in 2005. The federal government does not receive any premium for providing this coverage.

Second, if the insurance industry suffers terrorist losses that require the government to cover part of the claim payments, then these outlays will be partially recouped *ex post* through a mandatory policy surcharge. That surcharge is applied to all property and casualty insurance policies whether or not the insured has purchased terrorist coverage, with a maximum of 3% of the premium charged under that policy.

TRIA is designed to provide adequate reimbursements and indemnification to victims of major terrorist attacks and to assure social and economic continuity of the country should a terrorist attack occur. Congress passed TRIA in November 2002 partly for these reasons and also because there was a huge demand for coverage by firms during the year following 9/11 with limited coverage available at an affordable price. The expectation was that TRIA would ease insurers' concerns about providing coverage and enable buyers at risk to purchase coverage at reasonable prices.

Demand for Terrorism Insurance Under TRIA

Although insurers are now required to offer terrorism coverage to their commercial clients, they have the freedom to set the premium at whatever level they feel is appropriate. Data compiled quarterly by the insurance broker Marsh from more than 800 businesses and government entities that renewed their property insurance policies indicated that approximately 45% also bought terrorism insurance in each of the first three quarters of 2004. Another survey by Aon found that 57% of 500 commercial accounts that renewed their coverage between October 1, 2003 and September 30, 2004 purchased terrorism insurance. These figures reveal a significant increase in the demand for coverage over the 20-30% range early in 2003.

One explanation for this increase in demand is a decline in the premium for terrorism coverage in 2004 to half of what it was during the first quarter of 2003 just after TRIA was implemented. At that time terrorism rates represented about 10% of the total premium for property insurance (and much higher in downtown Manhattan). In the third quarter of 2004, according to the Aon data, the median rate had fallen to approximately 3.5% of total premium, making coverage more affordable. Coupled with the general decrease in property insurance rates, firms have been able to free up funds to purchase terrorism insurance coverage, according to Aon and Marsh. It is unclear whether buyer expectations of terrorist attacks have also fallen as time has passed; perhaps they have fallen less rapidly than premiums so insurance looks to buyers like it provides greater value.

A factor (consistent with this point) that may have led to increased purchasing of terrorism insurance is the alerts released by the federal government in 2004 on possible attacks in the United States, which have increased firms' concern with this risk. In the current Sarbanes-Oxley

environment, it is likely that executives preferred buying insurance than exposing themselves to the risk of being sued for negligence, should the firm be the target of a terrorism attack. If insurers were less affected by these alerts than buyers were, insurance purchases would increase.

Even though there is now increased purchase of terrorism coverage, a large number of firms are still uninsured. One reason for their lack of interest could be that terrorism is below their threshold level of concern, so these potential buyers have adopted an “it will not happen to me” mentality. Since most businesses have no information on the terrorism risk and no new attack has occurred on U.S. soil since 9/11, firms may perceive the chances of another event to be extremely low. This behavior has been well documented for natural hazards where individuals tend to buy insurance after a disaster occurs and cancel the policy several years later if they have not suffered a loss (Kunreuther 2002). It is hard to convince individuals at risk that the best return on an insurance policy is no return at all. In other words, there is a tendency for most people to view insurance as an investment rather than as a form of protection.

These firms consider insurance, even at relatively low premiums, to be a bad investment. If a business were strapped for cash, then it would be more likely to place insurance against terrorism as very low on its priority list. The expectation that government may financially aid affected businesses whether or not they are covered by insurance after a major attack, as illustrated by the airline industry following 9/11, may also contribute to limiting interest in spending money on coverage.

Dealing with Terrorism Insurance

In his 1963 paper “Uncertainty and the Welfare Economics of Medical Care”, Kenneth Arrow (1963) suggested that:

When the market fails to achieve an optimal state, society will, to some extent at least, recognize the gap, and non-market social institutions will arise to attempt to bridge it. (947)

In the case of terrorism insurance, the government has attempted to bridge the gap by passing TRIA. Our view is there are better ways of developing all-perils coverage than those that currently exist, so insurers will want to keep unnamed perils in their policies should a severe loss occur. We use the case of terrorism to illustrate the nature of proposed public-private combinations but the concepts apply more generally.

Use of Catastrophe Bonds

One of the reasons why insurers have been reluctant to provide terrorist coverage is the lack of capacity by the insurance industry to cover this

event. Cummins, Doherty and Lo (2002) have undertaken a series of analyses that indicate that the U.S. property-liability insurance industry could withstand a loss of \$40 billion with minimal disruption of insurance markets. According to their model, a \$100 billion loss would create major problems for the insurance industry by causing 60 insolvencies and leading to significant premium increases and supply side shortages.

If there was a severe shortage of reinsurance against terrorism, insurers need to find capital from other sources. One possibility would be for an investment bank to issue a terrorism catastrophe bond to cover the damage to a firm from a potential terrorist attack if the industry losses exceed a certain magnitude (e.g., \$25 billion). A catastrophe bond (or “cat bond”) requires the investor to provide money up-front that will be used by the firm if some type of triggering event occurs, such as a terrorist attack. In exchange for a higher return than normal, the investor faces the possibility of losing either a portion of or its entire principal invested in the cat bond.

Catastrophe bonds were initiated in 1996 to cover the risk of large losses from some natural disasters. To date, only two terrorism-related cat bonds have been issued, and neither of them is a pure terrorism cat bond issued for a specific type of attack, but rather multi-event cat bonds associated with the risk of natural disasters or pandemics⁸. A sustainable market to cover losses from terrorist attacks has *not* emerged since 9/11. It is not clear whether the situation will change in the near future.

Most investors and rating agencies consider terrorism models to be too new and untested to be used in conjunction with a catastrophe bond covering risks in the United States. One of the major rating firms noted that the estimates derived from the models could vary by 200% or more. Without acceptance of those models by the major rating agencies, the issuance of terrorist catastrophe bonds would be unlikely, at least in the United States. (U.S. General Accounting Office, 2003).

Government Involvement

If private investors feel that cat bonds are too risky to provide capital, except at very high interest rates, then the government could provide some type of federal catastrophe bond. Such a federal program could be designed so that it does not discourage the private sector from entering the market.

In this regard, Lewis and Murdock (1996) propose that the federal government should write and sell excess of loss (XOL) contracts to insurance companies, pools and reinsurers to cover industry losses from a disaster in the \$25 to \$50 billion range. The XOL contracts are designed so

8. The first terrorism catastrophe bond was issued in Europe in August 2003. The world governing organization of association football (soccer), the FIFA that organizes the 2006 World Cup in Germany, developed a bond to protect its investment. Under very specific conditions, the catastrophe bond covers natural and terrorist extreme events that would result in the cancellation of the final World Cup game. (U.S. General Accounting Office, 2003).

that the private sector can “crowd out” the federal government should it be able to provide protection at this high level of losses.

Solutions in other countries could also be examined to see how well they are working in practice and whether some features would be appropriate for the United States. One option could be the creation of a pool arrangement, between insurers and reinsurers with some type of federal role if the losses were extremely large. This arrangement currently exists in the United Kingdom where a mutual insurance organization, Pool Re, backed by the Treasury has been providing protection against “all risks” including damage caused by terrorism, chemical and biological as well as nuclear contamination since January 1, 2003.

Another type of partnership between the government and private insurance industry exists in France and in Germany. Both countries created special insurers for dealing with terrorism whereby private insurers cover the first portion of any loss, international reinsurers cover a second layer and the government provides additional capacity if the losses exceed a pre-specified amount (Michel-Kerjan and Pedell 2003).

State-Contingent Insurance Contracts

Another possible solution that would not require the creation of special capital market instruments and would not even require government guarantees involves changing the terms of insurance contracts to make payment of claims for a specific loss contingent on some pre-specified values for total insurance claims from terrorism. This approach is based on Borch’s (1962) classic insight that optimal risk spreading requires that every insured (and everyone else) share in the risk of large total losses.

The proposal is similar to catastrophic bonds in that a benchmark level would be set for total claims in the market. If actual claims fall below this level, insurers would promise to pay benefits in full. But if actual claims exceed this level, insurers would pay pro-rated benefits according to a pre-specified schedule. In effect, this arrangement provides protection to insurers from massive capital drains without the cost of bankruptcy. Other things equal, insureds would prefer full protection regardless of the state of the world, but the alternative to a state-contingent contract provided by insurers at moderate premiums is likely to be no insurance at all or very expensive insurance.

If a way could be found to control moral hazard on the part of insurers, the government could cover losses in excess of the benchmark levels financed through general revenue taxation. The moral hazard here refers to the greater incentive to sell insurance at low premiums relative to risk in the expectation this would be another way of achieving the maximum spreading of risk envisioned by Borch.

Coverage for Future Catastrophes from Unknown Causes

Insurers' recent experience with terrorism coverage should raise two kinds of concerns regarding the likelihood of future losses from catastrophes. One obviously is the probability of terrorism and the other is the probability that some currently unknown or unrecognized cause will produce a catastrophic loss. Insurers could be protected against the latter by reverting to a named-perils policy, but doing so would have the adverse effects on buyer demand that we discussed earlier. The most obvious alternative is for insurers in some fashion to "pay attention" to this possibility, but how could that be done?

In the spirit of our earlier discussion, it might be appropriate for regulators and insurers to put in place more flexible ways of responding to such events. Some combination of higher reserving (and associated higher premiums) to handle a larger portion of such losses and a set of contingency plans for public sector actions to pay for damages and to smooth the transition for insurance plans would seem to be desirable. It might also be feasible for there to be some type of federal involvement to subsidize or assist in covering losses above a certain magnitude from an event that may not have been predictable in advance. This reinforces the importance of some type of public-private combination to deal with potentially catastrophic events of unknown cause.

Conclusion

Insurer behavior before and after 9/11 cannot be easily explained by standard economic theory, but it can be understood by a behavioral model of choice where insurers treat events below some threshold level of concern as having a probability of zero until they occur. Insurers willingly offered coverage with no subsidies or guarantees in a situation of great ambiguity before 9/11, and they did so at virtually zero premium. After 9/11, markets disappeared for a time. Insurers were reluctant to offer coverage at all, and claim that they require subsidies or guarantees because of ambiguity.

For the specific cause labeled "terrorism", this article suggests some public-private combinations where insurers are protected against extremely large losses by some combination of new financial instruments (e.g., catastrophe bonds), some type of excess of loss reinsurance contract that the government could auction and/or a pool arrangement with private and public sector involvement. Another possible arrangement would be an *ex ante* contract where insurers pro-rated their claims payments if industry losses exceed a pre-specified amount.

There are open issues that need to be examined in developing meaningful insurance programs for dealing with low probability-high consequence events. If both suppliers and demanders of protection are

concerned with ambiguity, then there are substantial benefits from some type of public-private cooperative arrangement in pooling data and assessing future risks. Regardless of the normative considerations that appeal to economists, if past political history is any guide, there will continue to be debate over who should share the losses.

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