The Role of Insurance in Managing Extreme Events: Implications for Terrorism Coverage*

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A key question raised since September 11th is the appropriate role of the private and public sectors in reducing losses and offering insurance protection against extreme risks such as natural disasters, technological accidents and terrorist activities.

This note briefly discuss the following three questions:

1. What factors determine whether these risks are insurable?
2. What is the potential role of catastrophe bonds in providing protection against extreme events such as terrorism?
3. What role can and should the private and public sectors play in providing protection against terrorism?

Insurability of Risks[1]

What does it mean to say that a particular risk is insurable? This question must be addressed from the vantage point of the potential supplier of insurance who offers coverage against a specific risk at a stated premium. The policyholder is protected against a pre-specified set of losses defined in the contract.

[1] A more detailed discussion of insurability conditions can be found in Freeman and Kunreuther (1997). Gollier (2000) also examines the various factors that may make certain risks uninsurable.

Two conditions must be met before insurance providers are willing to offer coverage against an uncertain event. **Condition 1** is the ability to identify and quantify, or estimate, the chances of the event occurring and the extent of losses likely to be incurred. To satisfy this condition, estimates must be made of the frequency of specific events and the extent of losses likely to be incurred. Such estimates can use historical data and/or scientific analyses.

Condition 2 is the ability to set premiums for each potential customer or class of customers. This requires some knowledge of the customer's risk in relation to other potential policyholders. Once the risk has been identified, the insurer needs to determine how much coverage to offer and what premium to charge so as to make a reasonable profit while not subjecting itself to an unacceptably high chance of a catastrophic loss. There are a number of factors that influence these decisions. For purposes of this roundtable I will only focus on the ambiguity of the risk and its correlation. [2]

Ambiguity of Risk Actuaries and underwriters charge a much higher premium for an ambiguous risk than for one where the probability is well specified and the outcomes are known. Empirical data support this point. Kunreuther, et al, (1995) conducted a survey of 896 underwriters in 190 randomly chosen insurance companies to determine what premiums would be required to insure a factory against property damage from a severe earthquake, underground storage tanks or when the scenario was context-free. Their study examined changes in pricing strategy as a function of the degree of uncertainty in either the probability and/or loss and found that the premiums charged were considerable higher when there was uncertainty in either the loss and/or probability of the event occurring. For example, for an uncertain earthquake scenario the premiums were between 1.43 to 1.77 times what they were for a well-specified risk.

Correlated Risk Correlated risk refers to the simultaneous occurrence of many losses from a single event. Natural disasters such as earthquakes, floods, and hurricanes produce highly correlated losses. Many homes in the affected area are damaged and destroyed by a single event**.** A risk-averse insurer who faces highly correlated losses from one event may want to charge a premium that not only covers its expected losses but also protects the firm against the possibility of having to pay out an unusually large claim. An insurer will face this problem if it has many eggs in one basket, such as providing earthquake coverage mainly to homes in Los Angeles County rather than diversifying across the entire state of California.

If Conditions 1 and 2 are both satisfied, a risk is considered to be insurable. But it still may not be profitable. In other words, it may be impossible to specify a premium for which there is sufficient demand, so that incoming revenue covers the development, marketing, operating and claims processing costs of the insurance and yields a net positive profit. In such cases the insurer will opt **not** to offer coverage against this risk.

[2] The other factors include adverse selection, moral hazard and amount of available capital.

Potential Role of Catastrophe Bonds in Providing Capital to Insurers

A key issue that has been discussed since September 11th is the amount of capital required by an insurer or reinsurer to provide protection against an extreme 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.

The GAO estimates that the losses paid by insurers as a result of the attacks on the World Trade Center are about $50 billion with reinsurers expected to pay about two-thirds of this amount (General Accounting Office 2002, p. 8). In the aftermath of September 11th there has been a severe shortage of reinsurance against terrorism. For insurers to provide their clients with the same amount coverage they offered prior to September 11th, they must find capital from other sources. If the cost of this capital is high, the insurance premium that would have to be charged would be prohibitively expensive, and demand for coverage will dry up. In Kunreuther (2002) I show that the annual premium charged by an insurer to cover a building against $500 million damage from catastrophic events will be $73 million if the cost of capital is 20%.

Nature of Terrorist Cat Bonds Although there was in excess of $10 billion of capital added to the insurance and reinsurance industries during the fourth quarter of 2001, these funds were not used to support terrorism coverage. One possibility would be for an insurers to protect itself against a large loss from a terrorist attack is to utilize a catastrophe bond (henceforth called a cat bond).[3] A cat bond requires the investor to provide money up front that will be used by the insurer to cover a portion of its losses 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.

The amount paid out to the insurer depends on how the cat bond is constructed. This amount is specified in advance of the triggering event. If investors are concerned with the ambiguity associated with the terrorist risk, they will require a much larger than average return on their investment in order to compensate them for the possibility of losing their principal. Given the unusually high premiums on cat bonds for natural hazards risks where there is considerably less ambiguity and uncertainty than for a terrorist attack, this should not be surprising.

It is interesting to speculate as to why a market for cat bonds to cover losses from terrorist attacks has not emerged since September 11th. Consider the case where an investment banker was considering issuing a one-year cat bond for covering the losses from terrorism. Let *p* represent a conservative estimate of the probability of a terrorist

[3] Up until now there have been no efforts to market catastrophe bonds for terrorist coverage but there is no reason why such this may not occur in the future. See the papers in Froot (1999) for a more detailed discussion of new developments in providing capital for dealing with catastrophic risks.

attack during the year 2002 that would destroy a building that an insurers is covering. In this case a risk neutral investor who committed $Y to a cat bond would require the following Return on Investment (ROI) when there was no terrorist attack, if the normal annual rate of return was assumed to be 8%(i.e. .08):

$$(1-p)\ (\text{ROI})\ \$Y \ - p\$Y = .08\ \$Y \qquad (1)$$

Let p_i be the annual probability of a terrorist attack where an investor is indifferent between receiving an annual ROI= i on a cat bond knowing it would lose its entire investment should the attack occur. Substituting i for ROI and p_i for p in equation (1) and rearranging terms one obtains:

$$p_i = \ (i-.08)/(1+i) \qquad (2)$$

Thus if $i = .10$ one can determine from (2) that $p_{.10} = .02/1.10 = .018$. If a risk neutral investor believed the annual probability of a terrorist attack were $p < .018$, then an ROI of 10% would be an attractive investment. If $i=.20$ then $p_{.20} = .12/1.20 = .10$ implying that if $p<.10$, an individual would want to invest in a cat bond if it returned 20% when there was no terrorist attack. These indifference probabilities would be slightly lower if the investor were risk averse. Yet it is still hard to comprehend why the investors have not viewed cat bonds as a viable option for dealing with terrorism, particularly if a terrorist cat bond comprised only a small portion of their portfolio.

Reasons for Lack of Interest in Cat Bonds Bantwal and Kunreuther (2000) examined a set of factors that might account for the relatively thin market in cat bonds in the context of natural hazard risks. They point out that spreads in this market are too high to be explained by standard financial theory, giving rise to another asset pricing puzzle that cannot be fully explained by investor risk aversion. The paper suggests that the high spreads are not just a consequence of investor unfamiliarity with a new asset, but instead signal some deeper issues that need to be resolved before the cat bond market can fully develop. In particular, the authors show that ambiguity aversion, myopic loss aversion, and fixed costs of education can account for the reluctance of institutional investors to enter this market.

Two additional factors may help explain the lack of interest in new financial instruments for covering the terrorist risk. Investment managers may fear the repercussions on their reputation of losing money by investing in an unusual asset. Unlike investments in traditional high yield debt, money invested in a terrorist cat bond can disappear almost instantly and with little warning. Those marketing these new financial instruments may be concerned that if they suffer a large loss on the cat bond, they will receive a lower annual bonus from their firm and have a harder time generating business in the future. In other words, the short-term incentives facing investment managers differ from the long-term incentives facing their employers. If this is a major problem in marketing cat bonds, then there is a need to develop strategies for bringing the principal (employer and its shareholders) and its agents (investment managers) into alignment.

A second reason why there has been no market for terrorist cat bonds in the past few months is the reluctance of reinsurers to provide protection against this risk following the World Trade Center attacks of September 11th. Investors see reinsurers as experts in this market. When learning that the reinsurance industry believes that the terrorist risk is uninsurable, they were not willing to provide funds to cover losses from these highly uncertain events unless they received a sufficiently high interest rate to overcome their loss aversion and ambiguity aversion.[4]

A Public-Private Partnership for Financial Protection Against Terrorism

Although there was considerable pressure by insurers and reinsurers for government to provide some type of federal protection against large losses from terrorism, Congress did not pass any legislation at the end of its session in December 2001. As a result there has been limited terrorism insurance provided on the market. When coverage has been offered the amount of protection is much more limited and priced considerably higher than prior to September 11th.

Given the limited availability of terrorism coverage from the private sector and the role that the public sector plays in providing protection in other countries there appears to bean opportunity to develop some type of public-private partnership in the United States. The challenge is to develop an efficient program that can satisfy the different interested parties, each of whom has their own set of values and concerns.

One also needs to consider the importance of providing protection prior to an event so as to reduce the need for the public sector to provide financial aid following a disaster due to political pressure. Federal funding provided to the airlines after September 11th points to the need for preventive actions now rather than waiting until after the next catastrophe.

Below I outline the features of a program that may help satisfy the demand for protection against terrorism without having to rely primarily on the federal government to supply insurance coverage:

- Utilize existing institutional arrangements, such as banks and financial institutions, to require terrorism coverage as conditions for loans and mortgages. By having these institutions protect their own investments, then those who are at risk will be eligible to receive insurance claims after a catastrophic event to aid their recovery process. Furthermore the potential costs of terrorism will be borne by those at risk. For example, rents to tenants in commercial buildings may increase to reflect the extra cost of terrorist insurance coverage since September 11th.

- Limit exposure that insurers face with respect to losses from terrorism so that private insurers can price coverage at reasonable rates. Insurers may want to require risk reduction measures as a condition for coverage where these costs would be borne by the insured. If insurers know that their losses from a terrorist

[4] Jim Ament provided me with this interesting insight.

attack will be capped at a certain amount, much of the uncertainty regarding the event will be reduced. Insurers will then focus primarily on the probability of certain events occurring rather than on the entire distribution of potential losses.

- Involving the government by their providing some form of federal cat bonds and/or federal reinsurance. Given the reluctance of private investors to provide capital to insurers and/or reinsurers and the high return they require on private catastrophe bonds, one may have to involve the public sector in this type of activity. Federal involvement should be undertaken in such a way that it does not discourage the private sector from entering the market and should be viewed as a temporary measure. For example, investment managers may have an interest in marketing terrorist cat bonds by emulating the program developed by the federal government

- Address the question as to who should pay for the costs of a federal program while this system is in operation. If terrorism is viewed as a national problem with the costs borne by all taxpayers rather than just those who suffer losses, then some type of tax on all citizens might be appropriate. Alternatively all property owners who purchased insurance might pay a special *terrorism surcharge* to cover future anticipated losses. To the extent that there is some agreement on the nature of the risks faced by different property owner then differential surcharges could be charged.

  If on the other hand, Congress feels that the costs of terrorism should be borne by those who are at risk, then insurers who provide terrorism coverage would cover the cost of the program. Suppose that the US Government set up a Terrorism Reinsurance Fund (TRF) to cover losses above a certain amount. Looking at the scenario in the introduction, the AR Insurance Company would pay TRF for $400 million of reinsurance just as it was paying RE for this coverage before September 11th.

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