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REPORT ON THE ROLE OF GOVERNMENT IN THE COVERAGE OF TERRORISM RISKS

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TABLE OF CONTENTS

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1. Introduction and Agenda; Executive Summary

Insurance--the transfer and sharing of risk--is by its nature an intrinsically social economic activity. Most other economic activities can be carried out individually (if not efficiently), but insurance requires partners (self-insurance being considered no insurance). Thus, when insurance markets fail to operate effectively, citizens reasonably look to their government for a remedy. And the greater the risks, the greater will be the demand for a government solution.

Terrorism risks, which themselves are intrinsically social, create an immediate and urgent demand for government intervention when private terrorism insurance markets malfunction.[2] As Tom Russell has pointed out (Russell [2002, page 12]):

> "Paradoxical as it may be, when the basic notion of the free market itself is threatened, state intervention may be a necessary response."

In a similar vein, Howard Kunreuther and Erwann Michel-Kerjan have written (Kunreuther and Michel-Kerjan [2004], p. 3):

> "…we argue that large-scale international terrorism today presents a set of very specific characteristics that make it even more important for the public sector to play a role than they do for other extreme events,"

This is also consistent with what in France is called the "national solidarity principle" which motivates government intervention in the markets for natural disaster and terrorism insurance (Michel-Kerjan and Pedell [2004, p.18]).

The primary goal of this paper is to describe and evaluate alternative forms of government intervention in the market for terrorism insurance. The question whether or not the government should intervene is discussed in Section 1.C, where we review the arguments of Priest [1996] and Smetters [2003] that government intervention in terrorism insurance markets may not be warranted.

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[1] This report was written by Dwight M. Jaffee, Willis Booth Professor of Banking and Finance, Haas School of Business, University of California. The author would like to thank Thomas Russell for extremely useful comments on an earlier draft of this paper. Errors, of course, are the responsibility of the author.

[2] Terrorism insurance may provide coverage for a variety of risks, including property damage, liability, business interruption, workers compensation, and life insurance risks. Countries vary as to whether chemical, biological, nuclear, and radiological (CBNR) attacks are included under terrorism coverage; in some cases these forms of terrorism risks are not covered at all.

The evaluation of alternative forms of government intervention for terrorism insurance requires an analysis of the specific market malfunctions that motivate the intervention. Economic theory provides the framework for evaluating the factors that motivate the government intervention (including a possible private market failure), for considering whether government intervention can redress the failure, and finally for judging the alternatives forms of government intervention. This analysis, however, requires combining the tools of economic theory with an accurate understanding of the institutional structure within which both the insurance industry and the government operate. It is sometimes suggested, however, that economic theory and institutional structure are not the happiest of companions: economic theory often makes assumptions that appear to conflict with institutional reality; and real-world institutions sometimes appear to arise independently of economic needs. In combining them in this Report, we are encouraged by a recent paper by Robert Merton and Zvi Bodie [2004], "The Design of Financial Systems: Towards A synthesis of Function and Structure." In this paper, the authors point out that the institutional structures we observe have often evolved precisely to eliminate the effects of the very transactions costs and frictions that are commonly assumed away in economic models. In other words, the institutional structures have evolved in exactly such a way as to make economic models highly applicable, even when a simple comparison of model assumptions and actual institutions might suggest otherwise. Furthermore, this approach indicates that although countries may vary significantly in their institutional structure (reflecting different underlying costs and traditions), a single analysis can still be applicable in determining how best to fulfil fundamental economic needs.

Gathering institutional information is, of course an empirical exercise. Empirical knowledge concerning private terrorism insurance markets is very limited because government interventions now dominate these markets in most countries.[3] The question, "how well do private markets for terrorism insurance operate?" is now basically a counterfactual query. It is thus essential to enlarge our "database" of empirical information. One strategy in this Report is to use the markets for natural disasters (i.e. floods, earthquakes, and wind damage) as an additional source of information where applicable. Figure 1 shows the number of "natural" and "man-made" catastrophes and Figure 2 shows the corresponding value of insured losses, in both cases from 1970 to 2003 as tabulated by Swiss Re [2004]. The high consequence character of natural disasters is especially apparent in Figure 2 since 1992, a period that includes the US Hurricane Andrew (1992), the US Northridge Earthquake (1994), and the European storms Lothar and Martin (1999). Similarly, the terrorist attack of September 11, 2001 clearly stands out in Figure 2. It is this shared low probability, but high consequence, character that makes the experience with natural disaster insurance potentially useful in understanding current developments and policies in the markets for terrorism insurance.

It is also clear from the two Figures that a significant number of both natural disasters and man-made catastrophes occur in most years, and that the vast majority of these events individually have relatively minor insurance consequences.[4] Thus, the distinctive feature of both natural disaster and terrorism risks remains that single events can and do occur with very large insured losses. This feature is the focus of our analysis.

[3] To be clear, most countries have mixed private/public systems for the delivery of terrorism insurance, but a critical part of the risk is generally held by the government. Existing systems are compared in Section 3.B.

[4] The small amount of insured losses created by most events arises in part because most losses are not insured. Nevertheless, these events do contribute, in the aggregate, to a "background" level of about $5 billion annually in insured losses for each category.

Figure 1: Number of Catastrophic Events [5]
Source: Swiss Re [2004]

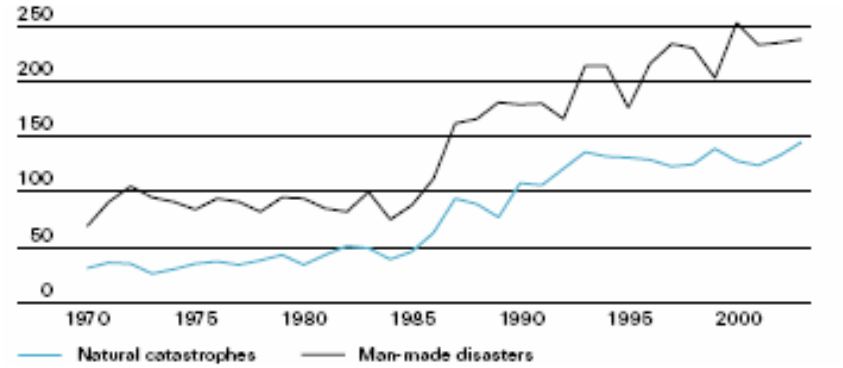
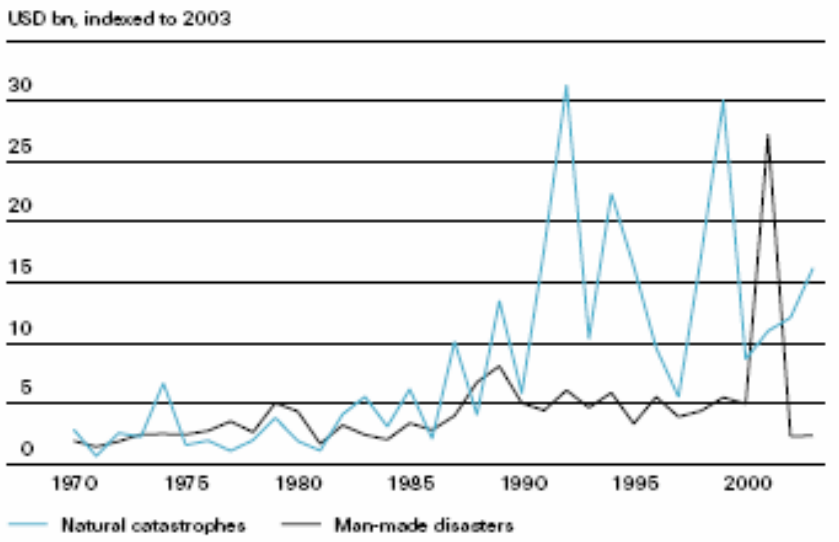


Figure 2: Insured Losses from Catastrophic Events [5]
Source: Swiss Re [2004]



While natural disaster and terrorism risks share the low probability, high consequence, feature, the differences between them must also be carefully considered. These differences, which include the fact that terrorism attacks are intentionally created by human action and that actuarial methods for evaluating terrorism risks are not as well developed, will also be considered in the later discussion. We will also consider the special issues raised by the interdependent nature of terrorism risks, for example that inadequate airport security may allow a building to be attacked by hijacked aircraft, whatever the security precautions taken at that particular building. We will use the term catastrophe insurance when referring to the insurance markets for terrorism and natural disaster risks on a combined basis.

[5] Natural catastrophes include cold waves and frost, droughts and forest fires, earthquakes, floods, storms, and other (such as hail and avalanches). Man-made disasters covers events associated with human activity, such as aviation, mining road, railroad, shipping, space, and terrorism disasters; see Swiss Re [2004], p. 40, for further details.

1.A Key Features of Catastrophe Insurance Markets

Terrorism and natural disaster insurance share the key property that the underlying risks are often created by low probability, but high consequence, events.

This has two important implications for private insurance firms operating in catastrophe lines:

1) Firms holding catastrophic risks cannot rely on *cross-policy diversification* to limit the likely range of their total losses in any given year, or to limit the variation in total losses across different years. (In contrast, for standard casualty insurance lines, such as auto insurance, the expected claims in any given year are highly predictable on a continuing basis.)

2) The claims paid by the firm when the catastrophic event does occur will far exceed the *annual* insurance premiums paid to the firm (based on the actuarial likelihood of the catastrophic event during that year). In insurance industry jargon, this means that the annual loss ratios—defined as the claims paid in a given year divided by the premiums collected for that year—will be highly volatile year to year, and can be extremely high in any given year. In contrast, the loss ratios for standard casualty insurance lines such as auto insurance will be quite stable year to year.

The implication for insurance firms bearing catastrophic risks is that they must hold extraordinarily large amounts of capital and reserves if they are dependably to cover the infrequent, but very large, claims that will occur. It is also immediately clear that governments, relying on their power of taxation, have a key advantage in providing credible commitments to pay catastrophic claims.

Looking first at natural disaster insurance, governments dominate most markets for this insurance around the world. Prior to the 1990s, the United States (US) provided an exception in that earthquake and wind damage coverages were provided mainly through private markets (flood damage insurance has been a Federal government program in the US since 1968). However, in the aftermath of the Andrew Hurricane in Florida in 1992 and the Northridge Earthquake in California in 1994, even wind damage and earthquake insurance markets required government intervention to maintain sufficient insurance availability. It is the empirical fact that government intervention in some form is present today in most countries and for most natural disaster insurance lines where natural disaster insurance is available at all.

Turning to terrorism risks, terrorism insurance was available from private market insurance firms in a number of countries prior to the attack of September 11, 2001. In France, Germany, and the US, for example, terrorism coverage was commonly included in standard commercial property insurance policies prior to 2001. As an example, Table 1 provides estimates of the insured losses that arose from the September 11 attack, based, of course, on coverage that was in place before the attack. These private markets became disrupted immediately after the September 11 attack, with private firms rapidly leaving the market, in much the same pattern observed earlier in the US markets for natural disaster insurance. That is, once the insurance industry recognized the catastrophic nature of the possible losses from terrorist attacks, most firms immediately became unwilling to provide such insurance in the absence of government support. The governments generally obliged, with the new plans introduced in France, Germany, and the US illustrating the range of possible modalities for government intervention. Today, in most countries where terrorism insurance for commercial properties is available at all, the coverage is based at least in part on government participation.

Table 1: September 11, 2001 Attack, Insured Losses by Line
Source: Hartwig [2002]

Insurance Line	Insured Losses ($ Billion)
Business Interruption and event cancellation	12.0
Other Liability	10.0
Property, Other	6.0
Property, World Trade Center	3.5
Aviation Liability and other	4.0
Life	2.7
Workers' Compensation	2.0
Total	40.2

1.B Why Private Catastrophe Insurance Markets Fail to Operate Effectively

The core of this report begins with an analysis of why private markets systematically fail to provide insurance against catastrophes, thus creating a need for government intervention. It is essential to understand the precise bases for these market failures, since only then can intelligent decisions be made concerning the most effective form of government intervention. We shall see that the low probability, high consequence, nature of catastrophic risks requires that firms offering such coverage have access to large amounts of capital (to cover the payments to policyholders when the catastrophic event occurs). There is strong evidence, however, that access to risk capital is highly limited, for both primary insurers and reinsurers. If catastrophe insurance is offered without access to the necessary amount of capital, then the insurance firm faces a ***bankruptcy risk*** (called ***risk of ruin*** in the insurance literature), to the detriment of all its stakeholders. Private insurance firms can, of course, avoid this risk simply by withdrawing from the sale of catastrophe insurance, and the general experience is that insurance firms do exactly this in the absence of government intervention. This discussion is provided in Section 2.A below.

While terrorism risks share with natural disaster risks their low probability, high consequence, character, terrorism risks also have the unique feature that they are ***man-made***. It is thus critical to understand the impact that the man-made feature of terrorism risks has on the provision of terrorism insurance, whether provided by private markets or the government. For example, the government will likely have better information than the private markets concerning the probability and location of a future terrorist attack, which provides one reason why private firms may be unwilling to provide coverage against such risks. It is also possible that terrorism events have greater spillover effects on the overall economy, creating another basis for the failure of private insurance markets. On the other hand, it is also possible that terrorists may choose not to attack insured targets, which would increase the willingness of private firms to offer terrorism insurance. The discussion of this and related topics (including the complexity of underwriting terrorism risks) is provided in Section 2.B below.

1.C The Initial Decision to Intervene

The initial decision to intervene will generally arise following a major terrorism attack, with private insurers and reinsurers withdrawing from the market, and with rising concerns for major macroeconomic losses if the government does not intervene.[6] In this setting, the government will have no choice but to intervene, for the following three reasons:

1) The government will possess the best information concerning the likelihood of future attacks. It must demonstrate to its own citizens, the insurance industry, and perhaps also to the terrorists, that it can control the problem. Its willingness to commit government resources to provide indemnification against future losses provides a very credible tool for this purpose.

2) Major macroeconomic losses could follow from the failure of the private markets for terrorism insurance. Government intervention will offset, if not eliminate, these losses. Indeed, government action is likely to go forward in all but the most extreme case, even if calculations suggest that the plan costs actually exceed the likely macroeconomic benefits (Russell [2002]).

3) Whatever the immediate macroeconomic effects, *were a further attack to occur soon thereafter*, there would be serious regret not to have intervened initially.

This is the setting in which the government must determine the most advisable form for its intervention. Before developing our main conclusions in this regard, however, it is useful to review two recent papers that argue firmly against government intervention. The papers are Priest [1996], "Government Insurance Versus Market Insurance," which argues against government intervention in any insurance market, and Smetters [2003], "Insuring Against Terrorism: The Policy Challenge," which argues against the US government's intervention in terrorism insurance following the September 11 attack.

The starting point for the Priest [1996] paper is the position of Kenneth Arrow, who had made the case for government intervention in insurance markets in a series of famous papers. Priest quotes the core of Arrow's position as (Arrow [1963], p. 961):

> "The welfare case for insurance policies of all sorts is overwhelming. It follows that the government should undertake insurance in all those cases where this market, for whatever reason, has failed to emerge".

Priest does not directly take exception to the affirmative aspects of Arrow's position. Instead, the focus of his critique is a series of issues that Arrow did not consider, or at least did not emphasize:

1) Priest points out that insurance purchased from private markets is always ***voluntary***, ensuring that such purchases always make the individuals or firms better off. In contrast, Priest argues that government insurance is frequently ***compulsory***, raising the possibility that individuals could be made worse off. In particular, he suggests that government insurance systems typically use some degree of risk pooling—in which high-risk and low-risk individuals are charged the same insurance premium. In this case, the low-risk individuals are overcharged, and thus might prefer not to participate in the government plan at all, if that were an option.

[6] In principle, the issues of intervention should be addressed before an attack, and the planning should take a long-term outlook, including within it the possibility that attacks will occur. The text describes the more realistic scenario in which government interventions in such situations are usually event driven.

2) Priest argues that government insurance facilities are intrinsically *less efficient* than their private market counterparts. He focuses on the presumed failures of government insurers to diversify risks by selecting the clientele, to control adverse selection through the use of risk rating, and to control moral hazard through deductibles and coinsurance. The inefficiencies that arise with government insurance not only raise the costs of the insurance, but they may also distort the allocation of resources, for example by providing homeowners incentive to build on river banks.

3) Priest argues that government insurance plans often derive from a desire to *redistribute resources*, in particular toward high-risk individuals. Priest's argument here is not with redistributional policies in general, but with regard to redistributional policies that masquerade as government insurance plans, and as a result may not be properly evaluated.

Our purpose is to evaluate Priest's argument only in the very narrow focus of our topic, namely government intervention in terrorism insurance markets. In this regard, a key factor is that the observed government interventions in terrorism insurance markets arose because private sector firms were no longer willing to provide such coverage. Therefore, points (1) and (2) above appear largely irrelevant, since there is no private market with which to make the comparison. It is also noteworthy that the plans reviewed here are basically voluntary, with the partial exception that terrorism insurance is required on a class of policies providing property damage insurance in France. Point (3) is more complex, since it is true that the government interventions in terrorism insurance may well be redistributing resources toward high-risk individuals and firms. However this redistribution appears not to be hidden, since it is the explicit goal of the policy to help those facing terrorism risks. Thus, we conclude that Priest's arguments, whatever their more general applicability, do not provide strong grounds for avoiding government intervention in terrorism insurance markets. Nevertheless, the concerns raised in his paper are exactly the reason that (i) government plans should be designed to minimize the crowding out of private market activity and (ii) the plans should be organized to provide an orderly sunset as soon as possible

The analysis of Smetters [2003] provides a critique of the US government's intervention in the terrorism insurance market following the September 11 attack. His analysis covers three key areas:

1) Smetters provides evidence suggesting that the private markets for terrorism insurance in the US actually failed much less badly following the September 11 than is the conventional wisdom. For one thing, he points out that by the Fall of 2002, the time at which the US intervention was actively considered in Washington D.C. (and more than one year after the attack), the private markets for terrorism insurance in the US were already showing substantial improvement relative to the initial shock. For another, he points out that the low take-up rates for terrorism insurance during 2002 could as well reflect low demand as low supply (based on arguments similar to those we made above in Section 3.B.2).

2) Smetters questions the validity of factors often used to motivate government intervention in terrorism insurance markets. First, he questions whether the difficulty of evaluating terrorism risks can explain the private market failure (based on arguments similar to those made above in Section 2.3.B). Second, he argues that private market firms could have limited their exposure by using devices such as retroactive premiums or the equivalent.

3) Smetters notes that many of the likely explanations for the failure of private markets for terrorism insurance reflect government action, including tax and accounting policies; see also our discussion below in Section 2.A).

In conclusion he writes (Smetters [2003], p. 30):

"Private commercial property and casualty insurance markets are likely able to insure against terrorism and even war losses if government tax, accounting, and regulatory policies were changed in order to reduce the insurer cost of holding capital as well as to support the securitization of large risks. Modifying these fiscal policies would have likely been much more efficient than the approach taken in TRIA, which has created several potential problems: Crowding out the development of private insurance; excess demand for subsidized insurance by diversified shareholders; ex-ante and ex-post moral hazard, and, unfunded liabilities on future generations."

Smetters' analysis is by and large consistent with the positions taken in this Report. In particular, we share the conclusion that the "first best" solution for terrorism insurance is to create conditions that allow the revival of the private insurance market, and that changes in the government's tax, accounting, and regulatory rules are a critical first step in this direction. On the other hand, we disagree with Smetters' position that it would have represented better public policy to allow the private markets for terrorism insurance to stand on their own in the Fall of 2002. This difference of opinion arises primarily from our alternative evaluations of the evidence concerning how badly the terrorism insurance markets had failed and of the likely costs this would have imposed on the economy. Looking forward to the forthcoming termination dates of the existing country plans, we certainly join with Smetters in the hope that we will have reached the point at which private firms are again prepared to insure against terrorism without direct government support

1.D Modalities for Intervention in Catastrophe Insurance Markets

We next turn to the possible modalities of government intervention. A particularly simple, and thereby appealing, form of government intervention has the government provide specific and direct incentives to revive the private markets to functionality. In other words, the government would help *to recreate the private markets*, rather than *to create a public substitute for the private markets*.

The provision of tax incentives or other subsidies to lower the cost of capital for private firms that bear catastrophic risks is one example. The idea is that if insurance firms hold sufficient capital, then the risk of ruin from a catastrophic event can be reduced to a manageable level, thus allowing the reemergence of a private market for catastrophe insurance. Government action to expedite the development of financial instruments that allow insurance firms to transfer risk to capital market investors is another example. Catastrophe bonds, which insurance firms have used on a small scale to transfer catastrophe risks, represent a specific case. These and other examples of government incentives to recreate private markets for catastrophe insurance are described in Section 3.A below. Unfortunately, as we shall see, initiatives to recreate private markets for catastrophe insurance have had limited success to date, although there are now proposals pending for further regulatory and tax-law changes in the US that might significantly expedite the recovery of the private insurance markets for catastrophe risks in the US.

This leads to a review of the alternative modalities for explicit government intervention. The many existing government interventions in the terrorism insurance markets illustrate the wide range of possible formats. To organize an analytic understanding of these various formats, it is useful first to distinguish the *market micro structures*, through which the sale of policies and the settlement of claims occurs, from the *insurance functions* through which risk bearing occurs. Most existing government interventions are mixed private/public enterprises with the private markets handling most, if not all, of the market micro structure functions, while the government is responsible for varying amounts of the insurance functions. Although we will comment on the features of alternative market micro structures in our discussion of individual country plans, our primary focus is on the alternative modalities used for risk bearing and how it is shared between the private and public sectors.

The following list provides examples of the key distinguishing features that are observed in the various existing government formats for insurance activity:

- How is risk shared among the government, capital market investors, and insurance firms?
- Is participation in the government plan mandatory?
- Does the government subsidize the costs for the reinsurance coverage it offers?
- What are the limitations in the type of terrorism risks that are covered?
- Are there maximum limits with regard to the exposure of insurance firms and/or the government?
- Do private firms retain a role in setting underwriting standards and risk-based prices?
- What sunset provisions are adopted to end the government participation by a future date?

These and other components of the existing government interventions in catastrophe insurance markets are discussion in Section 3.B.

1.E Limits and Drawback to Government Intervention in Terrorism Insurance Markets

Having reviewed how governments intervene in terrorism insurance markets, it is critical to consider the possible limits and drawbacks to government intervention. A particularly important question, from both economic and political perspectives, is whether the government intervention *crowds out* or otherwise displaces private markets. The government intervention will, of course, be viewed much more favourably if it does not displace functional private markets.

Unfortunately, it is very difficult empirically to determine if crowding out of private terrorism insurance is occurring, since it requires counterfactual knowledge as to the behavior of private terrorism insurance markets in the absence of government intervention. The US markets for wind damage and earthquake insurance, however, do provide an interesting perspective since the private markets have become partly reestablished as time has passed since the date of the major disaster that triggered the primary market failure. The discussion in Section 4.A below takes up the general question of crowding out by government insurance plans and evaluates specific cases.

The possibility that government interventions may displace private actions to mitigate the damage that may be created by terrorist actions is another possible drawback to government activity in terrorist or natural disaster insurance markets. This reduction in mitigation can be understood as an application of the principle of *moral hazard*, in which the provision of insurance provides individuals and firms incentive to take on *greater risk*. On the other hand, insurance providers normally use *risk-based pricing* to create price incentives for the insured parties to take their own actions to mitigate the risks. The interplay of these two forces are considered when we discuss the impact that government intervention has on terrorism risk mitigation in Section 4.B below. Also, given the public nature of terrorism risks, some mitigation efforts will be influenced by factors other than the narrowly definite economic incentives, and some of the effects of terrorism will exceed the reach of mitigation by private sector firms and individuals. These topics, as well as how mitigation activity is influenced by the interdependent nature of terrorism risks, are discussed in Section 4.B.

Individuals will generally anticipate that governments will provide emergency aid and relief following a catastrophic event (either natural disaster or terrorist attack), independent of any formal government

insurance program. In the US, for example, this aid is provided on a continuing basis by the Federal Emergency Management Agency (FEMA). The primary activity of this agency is emergency disaster relief—providing victims with immediate medical care and shelter on a short term basis—with little or no intention to provide compensation for lost assets. Individuals, however, may think the relief agency also provides financial compensation for losses incurred, in which case issues of moral hazard may arise. The Victim Compensation Fund, created to provide compensation for the victims of the 9/11 attack, provides another example, where the government has decided to provide *ex post* compensation, even though there was no *ex ante* commitment. These issues are discussion in Section 4.C below.

1.F Optimal Formats for Government Intervention in Terrorism Insurance Markets

When intervention does occur for terrorism insurance, it is important to ascertain the optimal format for that intervention. Key questions will include:

- What should be the overall extent of the government's participation?
- What should be the duration of the intervention—transitional to rebuild private capacity, or long-term reflecting a fundamental market failure?
- What should be the financial modality of the government intervention? For example, the government could act as the *primary insurer*, as *reinsurer of last resort*, or as *ex-post lender of last resort*. What determines the most appropriate modality?

These and other policy proposals are covered in Section 5. Section 6 provides literature references.

2. The Failure of Private Insurance Markets for Catastrophic Risks

Private insurance markets for catastrophic risks—covering natural disasters and terrorism—generally fail to operate effectively on a world-wide basis. Instead, active markets almost always involve a strong element of government intervention. In this section, we explore the features of catastrophe insurance that make it so susceptible to a private market failure. We first consider the markets for natural disaster insurance, then we turn to the additional issues raised by terrorism insurance.

2A. The Failure of Private Markets for Natural Disaster Insurance

Natural disasters—such as floods, earthquakes, and wind damage—have always occurred and inflicted large losses on individuals and firms. We would therefore expect well functioning private markets to exist to provide insurance against these risks. In reality, natural disaster insurance is government-based in most countries of the world. The virtual absence of private catastrophe insurance markets makes it very difficult to ascertain what factors led to the market failure, or to determine whether or not the government interventions are crowding out what would otherwise be well-functioning private markets.[7]

Fortunately, the United States (US) provides a partial exception to the general absence of private natural disaster insurance markets. First, prior to the 1990s, earthquake and wind damage insurance were provided primarily by private firms in the US. Then, following the Andrew Hurricane of 1992 and the Northridge Earthquake of 1994, most private firms began to withdraw from these markets, forcing the state

[7] See Jaffee and Russell [1997], US Government Accounting Office [2001], and Nutter [2002] for discussions of how natural disaster insurance is provided around the world.

governments in Florida and California to create quasi governmental entities to ensure coverage.[8] Most recently, private insurance firms have started to re-enter these markets.

Since the private market collapses of the 1990s clearly preceded the government interventions, there is no possibility that the government intervention initially crowded out what would have been well-functioning private markets. This leaves open, however, the question whether the private markets might have reopened more rapidly in the absence of the government intervention.[9] More generally, the observation of insurance firms withdrawing from catastrophe markets, and to some degree returning later, provides a useful laboratory for understanding why the private markets fail, which is exactly the focus in Jaffee and Russell [1997] and [2003]. The following discussion in this section is a summary of the key points of those papers.

The unique problem presented by catastrophe insurance, in comparison to standard lines of property and casualty insurance such as auto insurance, is that the benefits of ***cross-policy diversification*** are not generally available to catastrophe insurance firms. The problem is best illustrated by the following simple example.[10] First, consider an auto insurer with a total insured coverage of $100 million. If the expected annual loss rate were 1%, the firm would anticipate $1 million of claims annually. If it charged an actuarially fair premium—that is, a premium commensurate with those losses--the income would also be $1 million annually, providing exactly the funds needed to cover the expected losses.[11] Of course, the actual losses for the year might vary from the expected amount, but, assuming a well diversified insurance portfolio with a large number of relatively small individual risks, these deviations should be relatively small and thus covered by a relatively small amount of additional capital.

Now consider a catastrophe insurer, also with a total insured coverage of $100 million, facing an expected annual loss rate of 1%, and charging an annual premium of $1 million. But now assume—consistent with the character of catastrophe risks—that the firm faces claims of either $0 (99% of the time) or $100 million (1% of the time); this is the proverbial once in a hundred years event. This firm will need $100 million in resources to guarantee to pay its claims when the catastrophic event occurs. Since annual premiums are $1 million, this leaves $99 million to be raised as capital or from other sources. Thus, in contrast to standard casualty lines such as auto insurance, catastrophe lines require a large amount of capital, or its equivalent, if the insurance firm is to pay the catastrophic losses when they occur. Otherwise,

[8] To be precise, the insurance entities were created by Acts of the respective state legislatures, and government officials sit *ex officio* on their governing boards. The entities, however, are not formally part of the state governments.

[9] Government interventions for natural disaster insurance in the US occur mainly at the state level, not the federal level. Our discussion in the text focuses on the interventions in the state of Florida following the Andrew Hurricane and the state of California following the Northridge Earthquake, but other US states have also intervened in natural disaster insurance markets. As examples, the state of Hawaii became a direct provider of hurricane insurance following the Iniki Hurricane in 1992, and the state of Texas established the Texas Windstorm Insurance Association in 1971 following Hurricane Celia in 1970.

Brown, Cummins, Lewis, and Wei [2003] suggest a less important role for government intervention following the Andrew Hurricane and the Northridge Earthquake. Their comments are directed primarily, however, to the limited role of ***federal intervention*** in these markets, not the major state interventions that did occur.

[10] A similar example is given in Harrington and Niehaus [2001].

[11] In practice, of course, premiums exceed actuarial levels, allowing firms to cover operating costs and to earn profits.

the firm will face a major bankruptcy risk, which would likely be unacceptable to potential policyholders and its own shareholders alike.[12]

Adequate capital is thus the nub of the issue for any firm providing catastrophe coverage.[13] And, unfortunately, the following list indicates insurance companies face fundamental impediments when attempting to raise large amounts of capital to underwrite catastrophe risks:[14]

- Accounting Requirements. Generally accepted accounting principles (GAAP) preclude an insurance firm from *earmarking* capital or retained earnings for use only to pay for future (not yet incurred) catastrophe losses.

- Tax Provisions. Casualty insurance firms in the US are not allowed to take tax deductions against premium income even if they use retained cash flows to create reserve allocations against future expected losses; thus retained earnings are a highly taxed means for accumulating capital.[15] Furthermore, even if insurance firms do set aside capital or retained earnings to cover expected future catastrophe losses, the earnings on these funds will be fully taxable, further increasing the cost of capital. Harrington and Niehaus [2002] estimate that the disadvantageous tax treatment of catastrophe insurance firms creates an implicit expense that may equal in size the expected loss itself, thus effectively doubling the premium that must be charged insurance customers.

  The US insurance industry has evolved methods to moderate the disadvantageous tax treatment it faces. For one thing, while a primary insurance firm must be chartered in the US state in which it sells policies, it can purchase reinsurance from firms that operate in off-shore tax-haven areas such as Bermuda. The goal is that the reinsurer's offshore tax benefits be reflected in lower reinsurance costs for the primary insurer. The use of offshore reinsurance entities, however, raises questions of performance risk. For another solution, the firms can issue subordinated debt (including catastrophe bonds), instead of retaining earnings or issuing equity shares. The benefit here is that bond financing creates it own tax-shield., but catastrophe bonds represent a newly developed market that has found only limited use so far. Reinsurance and catastrophe bonds are discussed further just below.

- Takeover Risk. The two factors above not withstanding, if a firm still accumulated a large base of capital and reserves, it would then face a significant takeover risk. The acquiring entity would

[12] Insurance markets in which insurance companies face recognizable bankruptcy risks have been analyzed in recent papers, for example Phillips, Cummins and Allen [1998] and Cummins and Mahul [2003]. Shareholders will particularly wish to avoid bankruptcy risks if the insurance firm has significant "going-concern value" based on its franchise in other, non-catastrophic, insurance lines.

[13] See Froot [2001] for an empirical description of the limited capital available to the catastrophe insurance industry, and an additional analysis of why this is the case.

[14] The list pertains only to US insurance firms, based on US accounting, insurance, and tax regulations. The regulations that apply, for example, to European Union insurance firms are different.

[15] US casualty insurance firms can take tax deductions for claims paid, and even for anticipated payments when the loss event has already occurred. However, when very large catastrophic events actually do occur, the firm may well end up with negative net income for tax purposes, and thus the tax deduction will be fully usable only as a tax loss carry forward against future positive income. This feature reduces the present value of the tax deduction.

just have to wait one year until the existing policies all expired, following which it would have complete access to the capital trove for any purpose it wished.[16]

Reinsurance provides primary insurance firms with an alternative to capital accumulation as a means to lay off catastrophe risks. Reinsurers and primary insurers, however, face the same capital issues, so reinsurance really only pushes the capital problem back one stage. Indeed, in the US following the Andrew Hurricane of 1992, the Northridge Earthquake of 1994, and the terrorist attack of September 11, 2001, primary insurers and reinsurers withdraw their coverage for catastrophe line simultaneously, in parallel attempts to protect their capital positions against possible large future losses.[17]

Exchange-traded catastrophe futures and options provided insurance firms with a mechanism to transfer catastrophe risks to capital market investors, thus bypassing the reinsurers. Such instruments were introduced in the US financial markets in 1992, but they failed to become actively traded and they no longer exist. Part of the problem was the unwillingness of investors to place capital at risk, given that there was (i) no standard methodology for pricing the instruments, (ii) no mechanism for hedging the risks, and perhaps most importantly (iii) a fear of asymmetric information. There was also a lack of demand by the insurance companies, due in part to counterparty risk—the fear that counterparties would not have sufficient resources to make the required payments if and when a major catastrophe actually did occur.

Catastrophe bonds provide insurance firms with another mechanism to transfer catastrophe risks to capital market investors, while avoiding the counterparty risk of exchanged-traded options.[18] An insurance company issues a catastrophe bond in the same way as a corporate bond. The purchase price paid by investors, however, is deposited in a special collateral account and used to purchase government bonds. Investors receive interest payments funded by the government bonds plus a premium from the insurance company to compensate for the annual expected loss from the catastrophe. If no catastrophe occurs, the investors receive their principal back at maturity through the liquidation of the government bond account. On the other hand, if the catastrophe occurs, then the *insurance firm* receives a payment based on the liquidating value of the government bonds, and the investors receive no principal repayment and no further interest payments.[19]

Following the Andrew Hurricane and Northridge Earthquake disasters of the early 1990s, the first catastrophe bonds were issued by insurance firms. The premiums required by investors in these bonds, however, far exceeded any reasonable valuation of the expected loss. For example, for a catastrophe bond on which the expected annual loss was 1% (and thus the expected bond coupon could have represented little more than a 1 percentage point spread over the risk-free government bond rate), the actual spread was often 7 percentage points or more, representing a huge risk premium.[20] This high spread appears to be the

[16] It is a fair question to ask why a firm with a cash trove takes on such exceptional value, that is, a value beyond its net cash position. The likely answer is that capital market imperfections make it easier to obtain such cash when it is within an established firm, as opposed to the task of borrowing the same amount directly from a bank. Whatever the reason, it seems an established fact that a firm with a large amount of unprotected cash may face a high takeover risk.

[17] See Froot [2001] for further discussion of the limited role played by reinsurers in supporting the US markets for disaster insurance following the Andrew Hurricane and Northridge Earthquake.

[18] See McGhee [2002] for a good description of the historical development of the catastrophe bond market, as well as an accessible, but detailed, discussion of how the bonds work and the current shortcomings that must be resolved.

[19] In recent versions of catastrophe bonds, the repayment of principal to investors is deferred for a long period, but is not literally cancelled. The credit ratings provided on catastrophe bonds have improved as a result of this change.

[20] Froot [2001] discusses of the development of the catastrophe bond market and the observed pricing patterns.

result of a variety of factors.[21] Perhaps the main one is the difficulty of evaluating catastrophe risks, with the effect that only investors with specialized knowledge have been attracted as investors in these bonds. Other more traditional factors may also be at work including asymmetric information (the possibility that the bond issuer has special information) and agency problems (employees within an investment firm may avoid securities with potentially large losses). Finally, there are a number of more technical tax and accounting issues that are obstacles to the widespread use of catastrophe bonds; these issues are discussed in detail in Section 3.A.2.

Insurance firms have continued to experiment to find formats for catastrophe bonds that are more appealing to investors, and the risk premiums on recent issues are lower. One change has been to replace indemnity bonds (in which catastrophe losses are measured by the issuing firm's book of business) with "parametric" bonds (in which the loss is determined by a specified event—such as an earthquake size 7.0 or higher in a given region), which reduces the problem of asymmetric information. Another change has been to include a variety of catastrophic losses within the same bond, which means that investor returns have a more traditional pattern, instead of the "all or nothing" character created by traditional catastrophe bond structures. Nevertheless, catastrophe bonds do not yet provide insurance firms with a sufficiently dependable vehicle to motivate these firms to provide catastrophe insurance on a wider scale.[22]

Opportunistic insurance firms might be expected to enter catastrophe insurance markets *following* major events, given that premium levels will be high as other firms exit the market. In practice, it appears that new entry is not sufficient to forestall government intervention. One explanation is that the capital market conditions immediately following a major event make it difficult for a firm to raise new capital because investors in new equity issues are wary that (i) the funds will be used to pay off past losses, not to support new activities; and (ii) the issuing firm may have asymmetric information regarding the underlying risks. An additional explanation is that principal-agent issues make it unlikely that employees within an insurance firm will recommend entry into a market where the existing firms have just suffered major and unexpected losses. To be sure, opportunistic entry does occur, but it seems to be highly isolated.[23]

Behavioral impediments in the evaluation of catastrophe risks represent a further factor that may help explain why both insurance firms and capital market investors avoid catastrophe insurance markets following major events, even when their participation would be well compensated. *Ambiguity aversion* is a particularly good example. Ambiguity aversion is said to occur when the premium required to bear risk is based on the most pessimistic model of the event (given that alternative models do exist). For example, ambiguity aversion might be responsible if, following a catastrophic event, insurers or investors raise their

[21] Bantal and Kunreuther [2000], Kunreuther, Michel-Kerjan, and Porter [2003], and Kunreuther and Michel-Kerjan [2004] discuss a variety of factors that have so far precluded the emergence of a fully effective market in catastrophe bonds.

[22] The US Government Accounting Office [2003] indicates that at year-end 2002, catastrophe bonds outstanding equaled less than 3% of the total reinsurance in force on a worldwide basis. The report also draws a pessimistic conclusion regarding the likelihood of using catastrophe bonds to support terrorism insurance in the near future. The only terrorism catastrophe bond issued to date provides very specialized coverage for the World Cup football games to be held in Germany in 2006.

[23] Opportunistic entries by insurance firms controlled by Warren Buffett and his holding company Berkshire Hathaway are particularly telling, since his firms have access to ample capital and his leadership precludes normal agency issues; see Buffett [1996] and [2001]. His National Indemnity firm significantly under-priced the competition to provide reinsurance to the California Earthquake Authority, the quasi government entity created in the aftermath of the 1994 Northridge Earthquake. Buffett's firm was also one of the few to offer terrorism insurance, for selected risks and under specified conditions, following the terrorist attack of September 11, 2001, even though its General Reinsurance subsidiary suffered significant losses due to that attack.

estimated probability of another event to a level above what would be suggested by normal Bayesian updating.[24] This would occur, for example, if the insurers or investors became unsure of their knowledge concerning the process that determines the catastrophic events, and thus require an additional premium for *model uncertainty*, over and above their best estimates of the expected loss.

The Andrew Hurricane and Northridge Earthquake events occurred more than ten years ago, and no further natural disasters of equivalent impact have occurred in the US. And we now see the re-entry of private firms to these natural disaster insurance markets. Private market coverage is currently available, however, only for specific risks, typically low-risk locations and structure types, where the government plan is charging comparatively high prices. But the activity is expanding, which is consistent with an ambiguity aversion effect that dies away as new events do not occur, and insurers become more confident in the estimates of risks provided by the existing models. On the other, it is expected that were another major event to occur, insurers would once again leave the market for natural disaster insurance. We return to the topic of natural disaster insurance in Section 3, where we discuss some features of government interventions in these markets

2B. The Failure of Markets for Terrorism Insurance

Prior to the terrorist attack of September 11, 2001, terrorism coverage was routinely included in standard commercial property insurance policies in many countries, including, for example, France, Germany, and the United States. But these markets were disrupted following that attack, in a pattern similar to the withdrawal of insurance firms from the markets for natural disaster insurance in the US during the early 1990s, as just discussed.[25] Today, terrorism insurance, like natural disaster insurance, involves at least some government participation in most countries. It appears that the same issues of capital adequacy and bankruptcy risk that motivate private firms not to provide natural disaster insurance also motivate these firms not to provide terrorism insurance. There is no need to repeat the discussion written just above, but Congressional testimony given a few months after the 9/11 attack by a Director of the US Government Accounting Office on the existing conditions in the private market for terrorism insurance provides a useful summary (Government Accounting Office [2001], p.15):

> "It seems clear, given insurers increased recognition of their exposures in the aftermath of the unprecedented events on September 11, 2001, that coverage for terrorist acts is not now amenable to normal insurance underwriting, risk management, and actuarial techniques. As a result, insurers and reinsurers are concerned about their ability to set an appropriate price for insurance coverage for terrorist acts. Given this uncertainty if this kind of insurance were to be offered at all, it is likely that either the prices insurers set would be prohibitively high or so low as to invite insolvency. However, even if we conclude that insurers cannot price and, therefore, cannot sell this kind of insurance, defining the nature of the problem facing both the economy and the insurance industry is a critical first step."

[24] See Bantal and Kunreuther [2000], Hogarth [2002], and Kunreuther and Michel-Kerjan [2004] for discussions of ambiguity aversion in the context of catastrophic events. Jaffee and Russell [2003] describe a range of behavioral factors that may impact the willingness of insurance companies to provide catastrophe coverage.

[25] Cummins and Lewis [2003] provide a discussion of the similarities in market reactions to the Andrew Hurricane, the Northridge Earthquake, and the 9/11 attack. There is general agreement that the market for terrorism insurance became disrupted—including both rising prices and limited availability--following 9/11, but there is disagreement whether this should be characterized as a market failure. The US Government Accounting Office and various real estate and trade groups tended to consider it a market failure (see US Government Accounting Office [2002]), while other observers offer a contrary view (see for example Smetters [2003]).

We now complete our discussion of the market failure for terrorism insurance by discussing several features that distinguish terrorism insurance from natural disaster insurance; see also Kunreuther, Michel-Kerjan, and Porter [2003] and Kunreuther and Michel-Kerjan [2004]. These features include (i) the man-made nature of terrorism risks, (ii) the possibility of very large spillovers on the macroeconomy, and (iii) the greater complexity in modelling terrorist risks. We discuss these in turn.

2.B.1 The Man-Made Nature of Terrorism Risks

Terrorism risks are *man-made*, in contrast to the relatively benign (i.e. non-strategic) behavior of "mother nature" as the source of natural disaster risks. In many respects, the human involvement in terrorism makes these risks even more difficult for private markets to insure, although there are some offsetting aspects. The following summarizes the main effects of the man-made nature of terrorism risks:

- The government will likely have better information than the private markets concerning the probability and location of a future terrorist attack. This should allow the government to assess risks more accurately than can private insurance firms, and could allow the government to set more accurate prices for terrorism insurance. It is unlikely, however, that the government would allow its detailed information to be used for setting insurance premiums. For one thing, terrorists could then deduce what the government knew, or thought it knew, by analyzing the pattern of posted insurance premiums. For another, owners and residents in locations that received high risk ratings would want to know the basis for these valuations, creating pressure for the government to release confidential information.[26]

- The upshot is that if insurance premiums reflect detailed risk ratings at all, then they are likely to be based only on information directly available to the private insurance firms. These firms will recognize, of course, that more accurate evaluations could be made using the government's information, and this would likely lead to higher premiums, in compensation for the ambiguity created by the firm's limited access to information.

- The willingness of the government to serve as the insurer of last resort, thus committing the resources to make payments if and when a terrorist attack occurs, will lend credibility to its programs that have the goal to stop terrorism attacks from occurring in the first place.

- Terrorists will choose their targets strategically, and the strategy may include picking targets based on their insurance status. For example, if the terrorists choose to target insured structures, then private market insurance would be especially costly, if available at all.[27] More generally, any element of *moral hazard*—in which the likelihood of a loss rises when insurance is provided—will create higher insurance premiums; also see Kunreuther and Michel-Kerjan [2004].

- The actions that individuals and firms take to mitigate the likely damage from a terrorist attack will depend on the strategy the terrorists are expected to employ in choosing targets. For example, if terrorists are expected to focus on unprotected targets, then private mitigation activity is more likely to occur. In this case, however the social benefit of mitigation will be limited, to the extent that it only serves to change the location at which an attack will occur.

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[26] In the case of hurricane and earthquake risks in the US, government agencies are also very knowledgeable (the US National Weather Service for hurricanes, and the US Geological Survey for earthquakes), and both agencies must and do release their information in publicly available reports.

[27] For discussion of the strategies that might be employed by terrorists, and the implications for the nature of the risks and the impact on terrorism insurance, see Woo [2002], as well his other papers and other reports on the web site of Risk Management Solutions, at http://rms.com/ .

2.B.2 Spillovers on the Macroeconomy

The spillover effects on the overall economy are likely to be greater for terrorism than for natural disaster events, since (i) the direct losses could well be greater (as witnessed by the 9/11 attack), (ii) the failure to stop the attack will be seen as a failure of the government, and (iii) terrorists may well aim their attacks to maximize the overall impact on the economy.

Insurers (including private investors holding securitized insurance risks) will be less willing to bear terrorism risks when they fear that the realized losses will coincide with negative macroeconomic periods. The mechanism for this relationship starts with the notion that suffering a loss, whether due to a terrorist attack or just a macroeconomic slump, causes investors to place a higher value on an additional unit of wealth or income. Thus, if a terrorist attack creates both direct property losses and a more general macroeconomic slump, then the "cost" of the property damage may be greatly magnified. Investors and insurance firms cannot easily avoid the macroeconomic slump, but they can avoid the magnified effect of the direct property loss simply by avoiding the terrorism insurance risks.

In financial market terms, terrorism risks that also create bad macroeconomic conditions and falling stock market prices have a positive Beta statistic, meaning that the terrorism insurance losses have a high (i.e. positive) correlation with depressed share prices in the stock market. To induce investors to take on high-Beta risks, or to purchase high-Beta securities, the market must offer a higher expected return on the capital tied to those investments—this is the compensation for holding the high-Beta risks. The implication is that the insurance premiums that compensate those holding terrorism risks will be higher to the extent that the direct losses from a terrorist attack are expected to spillover to the general economy and the stock market.

2.B.3 Modelling Terrorism Risks

It is often suggested that terrorism risks are more difficult to evaluate in an actuarial sense than are natural disaster risks, and that terrorism risks are certainly more difficult to evaluate than most other lines of casualty insurance. This is attributed in part to the more limited record of historical terrorism experience, and in part to the man-made and strategic aspects of terrorism risks. Based on this premise, it is possible to argue that (i) private insurance firms may be reluctant to participate at all in terrorism insurance markets, or that (ii) they will charge higher than expected premiums to compensate for the ambiguity. It is also possible that the difficulty in modelling terrorism risks complicates the efforts of individuals and firms to act to mitigate their possible future losses from a terrorist attack.

To evaluate these propositions, it is important to note that there are many examples where insurance firms have offered, and continue to offer, coverage even when there is highly limited information concerning the risk to be insured. Marine insurance was available starting in the earliest Roman times, using a combined loan and insurance contract called ***bottomry***, which is also an early form of a catastrophe bond.[28] Surely this insurance was offered on the basis of very limited information—including the possibility that boats might sail off the flat edge of the world! In a later era, in 1688, Lloyds of London created its reputation by providing marine insurance even in the highest risk situations. A more recent example is that private firms insured the first commercial earth satellites, even in the absence of a significant historical record. And most currently, the Towers Perrin [2004] report discusses how loss

[28] With a bottomry contract, the lender (and insurer) provided the shipowner with funds to purchase the ship and the inventory of tradable goods. If the ship returned safely, the lender received the loan principal back with interest. But if the ship were lost at sea, then the lender received no repayment at all from the shipowner—this is the insurance component. This pattern of payoffs to the lender is identical to that of a modern catastrophe bond.

estimates provided by a modelling firm were used to set premiums for a proposed, industry-wide, terrorism reinsurance facility; also see the discussion below in Section 3.A.3.

The implication is that high uncertainty and a limited historical record are not sufficient to deter insurance firms from offering coverage. The more likely impact of modelling uncertainty is that the insurance firms will charge relatively high premiums, as compensation for accepting the inherent uncertainty and ambiguity concerning the correct probabilities and expected losses. In fact, a willingness to supply, but at a suitably high price, does appear to characterize the current status of insurance coverage across a wide range of high-risk casualty lines.

These facts change when we consider the catastrophe lines—both natural disasters and terrorism. Here we find a very limited willingness of the private market to supply coverage (in the absence of government support). To be sure, the catastrophe coverages do have greater modelling uncertainty, and the terrorism risks have the greatest uncertainty, but the distinction with risky casualty lines such as marine, satellites, and product defect appears more a matter of degree than of kind. The key feature of the catastrophe lines is that when losses do occur, they are likely to be large, indeed catastrophic, quite possibly enough to threaten firm insolvency. It is our opinion, therefore, that it is the *joint occurrence of catastrophe-sized losses and modelling uncertainty* that creates the possibility of supply disruptions in the natural disaster and terrorism insurance lines.[29]

3. Modalities for Government Intervention In Terrorism Insurance Markets

The discussion in the preceding section has made the case that, around the world, insurance is generally available for protection against catastrophe risks—both natural disasters and terrorism—only when we observe significant government intervention in the market. In this section, we review the primary modalities for the observed government interventions in the markets for terrorism insurance. The discussion here focuses on the economic aspects of the plans. More detailed descriptions of the country plans are provided in separate Reports of this Project.

3A. Government Interventions to Recreate Private Markets for Terrorism Risks

The most desirable form of government intervention is to create the conditions that will allow private markets for terrorism insurance to operate again. This form of intervention responds directly to the factors that created the private market failure in the first place, in essence a "first-best" solution. Several specific policy actions can be considered in this category.

3.A.1 Direct Remedies to Improve Access of Insurance Firms to Capital Sources

The direct approach is to create conditions under which insurance firms can readily raise capital dedicated to support terrorism insurance lines of business. As described earlier, the primary impediments, at least in the US, are accounting rules and tax regulations, which in turn raise the cost of capital and create firm takeover risks. It does not seem a Herculean task to change the accounting rules to allow capital to be earmarked for use only to pay terrorism claims, or to change the tax rules to allow expected losses from future terrorism events to be deducted against current unearned premiums. Nevertheless, it is now three years since the September 11, 2001 event, and no significant action has occurred in either dimension. There is also the empirical question whether such actions would be sufficient to reactivate private terrorism

[29] The willingness of private insurance firms to re-enter the US markets for hurricane and earthquake insurance following extended periods in which no new unexpected losses have occurred is consistent with a moderation of the modelling uncertainty that arose immediately following the initial events.

insurance markets. In this regard, there are two pieces of evidence, one from the United States (positive), the other from Europe (negative).

The positive US evidence is provided by two features of the quasi-public agencies created to provide insurance coverage for wind damage (Florida) and earthquakes (California). First, the capital raised by each agency is available only for paying claims on its natural disaster coverage, since the quasi-public agencies are fully protected against any take over attempts by private market firms.[30] Thus, the plan structures effectively circumvent the accounting rules that otherwise preclude the earmarking of capital to specific expected future losses. Second, both agencies acquired special tax exemptions from the Internal Revenue Service (IRS, the US tax authority). Indeed, there was a stage at which the IRS had denied the tax exemption for the California Earthquake Authority, and the state's response was that this would be a "deal breaker". Ultimately, the IRS agreed, no doubt motivated by the quasi-public nature of the Authority and the political support it was able to muster. Thus, the state-based agencies did achieve structures that solved both the accounting and taxation issues, and this was essential to their success in reviving activity in their respective natural disaster markets. It is intriguing, of course, that the quasi-public agencies were able to circumvent the accounting and tax impediments, while the US accounting and tax authorities appear unwilling to provide similar opportunities to private sector entities.

Evidence from the Economic Union (EU) suggests, however, that while solving the accounting and taxation issues may be a necessary condition to raise capital for catastrophe insurance, this is not a sufficient condition. Insurance firms in the EU face accounting and taxation rules that are more flexible with regard to capital to support catastrophe insurance, but these EU insurance firms still do not offer catastrophe insurance. While it is beyond the scope of this Report to analyze the possible reasons that private EU insurance firms do not offer catastrophe coverage, the main point is that flexible accounting and tax regulations provide necessary but not sufficient, conditions to recreate active catastrophe insurance markets.

3.A.2 Improved Access for Catastrophe Bonds

The market for catastrophe bonds has been steadily, but slowly, evolving since the first such bond was introduced in 1997. A total of 51 catastrophe bonds have been issue as of mid-year 2004, accounting for a risk transfer of about $8 billion. In 2003, 8 new transactions were completed, for a total issuance amount of $1.73 billion (see Bowers [2004)]. The market thus continues to grow, but it has not yet become a comprehensive solution for the funding of catastrophe insurance capital needs.

There are currently three regulatory issues relating to the use of catastrophe bonds by US insurance firms (see US Government Accounting Office [2002], [2003]). The first issue concerns accounting standards that do *not* allow insurance firms to reflect the risk transfer achieved by *non-indemnity* catastrophe bonds on their financial reports filed with state insurance regulators. Non-indemnity catastrophe bonds, which release capital to the issuing insurer based on a triggering event, such as an earthquake of level 7.0 or higher in a specified geographic region, have become increasingly popular with investors because the payout is not based on the issuing firm's book of policies (as it would be with an indemnity-based catastrophe bond). The National Association of Insurance Commissions (NAIC, the association of all US state insurance regulators) is currently considering a proposal to make this change.

[30] It is possible, however, that another government entity might "takeover" the capital resources of a disaster insurance agency. In fact, this has happened at least twice, in both cases where the government took the capital assets in the context of a budgetary crisis. One case occurred in New Zealand in 1990, when the earthquake fund was taken, the other in the US state of Hawaii in 2003, when the state wind damage agency was closed (under Hawaii House Bill 1466).

The second issue refers to a new Financial Accounting Standards Board (FASB, which establishes GAAP accounting rules) proposal that clarifies accounting rules for *special purpose vehicles* (SPVs), including those that hold the government bond collateral for catastrophe bonds. The proposal enlarges the conditions under which the assets and liabilities within the SPV must be consolidated on the books of the issuing firm; it was initiated in response to the incomplete consolidation of SPVs by Enron. The change will be detrimental to the use of catastrophe bonds by insurance companies if it is determined to apply in these cases. The interpretation and implementation of FASB Interpretation No. 46 is currently in process.

The third issue is an attempt to obtain more favourable tax treatment for the SPV in a catastrophe bond, creating benefits that are currently available only to multiple class loan securitizations such as mortgages. Without this favourable tax treatment, the SPVs for catastrophe insurance structured instruments are typically located in offshore tax-havens, similar to those used for reinsurance firms. Unfortunately, these offshore entities also introduce new transaction costs that significantly offset the tax benefits they provide. A legislated tax-free conduit status was critical to the development of the US mortgage-backed and asset-backed security markets, and it could be equally significant in the development of the catastrophe bond market.

While action on any of the three issues would improve the usefulness of catastrophe bonds for raising capital to back catastrophe insurance, it is unlikely that this will be sufficient to activate private markets in natural disaster or terrorism insurance. The primary issue is that the evaluation of catastrophe bonds continues to require specialized knowledge and skill, and investors without these attributes have been inclined to invest elsewhere.[31] Indeed, other insurance firms are among the largest investors in catastrophe bonds, with little or no participation from "generic" capital market investors. In principle, this problem could be solved by creating catastrophe bond *investment or mutual funds* with the bonds chosen by professionally skilled managers. The failure to create such funds, however, likely reflects the judgment within the fund industry that it would be difficult to market a fund with the unique, that is *catastrophic*, attribute of catastrophe bonds.

3.A.3 The Creation of Mutual Risk Retention Pools

Mutual risk retention pools, organized within the private markets, represent another possible device to help recreate private markets for the provision of terrorism insurance. Such pools can be organized either within a group of insurance users, or by a group of insurance firms. Historically, farmers who were without access to established insurance markets, or who considered the premiums of insurance firms to be too high, joined to together to provide mutual coverage. More recently, and following the September 11 attack, a group of US airlines organized a mutual pool called *Equitime*, but it never become operational, perhaps due to the continued subsidization of the industry by the US government (Kunreuther and Michel-Kerjan [2004]).

Another recent and instructive example is the attempt of 14 US insurance firms to create a mutual reinsurance pool to cover their workers' compensation risks that arise from terrorism events. The issue of terrorism risks for workers' compensation insurance in the US is particularly severe because almost all states require that terrorism risks be covered in every workers' compensation policy. The firms engaged the Tillinghast and Reinsurance businesses of Towers Perrin to study the potential of a mutual pool to support the private market activities of the participating firms (Towers Perrin [2004]). Although the study ultimately determined that such a mutual pool was not practical at this time (for reason described below), the methodology they employed and the information they gathered are useful to review here.

[31] See Bantwal and Kunreuther [2000], Kunreuther, Michel-Kerjan, and Porter [2003], and Kunreuther and Michel-Kerjan [2004] for discussions of ambiguity aversion and similar behavioral traits that have plagued the development of an active market in catastrophe bonds.

The goal of the workers' compensation reinsurance pool was (Towers Perrin [2004], p.2):

"…to maximize the effective use of industry-wide capacity and minimize the potential for insurer insolvency/ruin resulting from large and unpredictable terrorism events."

The key issues confronted and solutions offered included:

- The pool would provide aggregate excess reinsurance, reimbursing members for 90% of their losses above a specified member retention level. The excess pool design was favoured over first-dollar coverage because the former provided greater flexibility to individual firms and it was more efficient in using the available aggregate capital.

- Participating members would pay annual premiums to the pool as a function of the coverage they required. Risk Management Systems (RMS), a catastrophe risk modelling firm, was hired to provide examples of the premiums that would be charged based on the book of business of alternative firms. It was concluded that it was feasible to determine premiums in this fashion, which appears to belie the contention that terrorism risks are uninsurable due to modelling uncertainty; see also the discussion above in Section 2.B.3.

- It was determined that a tax-free conduit status would likely be required if the mutual pool concept were to be economically feasible. This would parallel the tax-free status provided for the quasi-public pools established in California and Florida for earthquake and wind damage coverage respectively.

- RMS also estimated the aggregate losses that would be expected from various large terrorism events. The most severe case considered was a downtown New York City Anthrax release, which was estimated to create $91 billion in aggregate losses. It was determined that the pool resources would be inadequate to cover major terrorism events, based on the estimated losses over a range of such events. It was thus recommended not to go forward with more detailed planning.

In summary, although a mutual industry pool would help smaller firms survive moderate terrorism events, the pool's resources were inadequate to help any of the firms survive a major terrorism event. Simply put, the premium income of the US workers' compensation industry is about $30 billion annually, and this is insufficient to protect the industry against major terrorism losses that are potentially three times that amount. The report thus concludes that a US government backstop for terrorism reinsurance continues to be required.[32]

3B. The Modalities for Explicit Government Interventions in Terrorism Insurance

We next turn to a review of existing modalities for explicit government interventions in terrorism insurance markets. We develop a framework for analysis by organizing the discussion in terms of the functional features of the alternative plans. More detailed discussions of the individual country plans will be available in other Reports for this project.

It useful first to distinguish the ***market micro structures*** from the ***insurance functions*** that are embedded in the alternative plans. Market micro structures refer here to the actual marketing and the sale of policies at the initial date and then the settlement of claims when losses occur. Insurance functions refer

[32] Although the report's analysis appears valid, it is worth noting that it is in the best interests of the industry to conclude that the US government provision of a reinsurance facility be continued (at zero cost to the industry).

to the alternative modalities through which coverage is defined, policy premiums are set, and risk is held. Most existing government interventions are mixed private/public enterprises with the private markets handling most, if not all, of the market micro structure functions, while the government participates in varying degrees in the insurance functions. Although we will comment on the features of alternative market micro structures in passing, our primary focus is on the alternative modalities used for coverage, price setting, and risk bearing.

3.B.1 Full Government Insurance

The most extreme intervention has the government serving as the ***primary insurer***, taking on all insurance functions, including defining the coverage, setting the prices, and bearing the risk. This is well illustrated by the complete coverage provided in Israel for injury, life, and property risks arising from terrorism. The coverage is given to all persons within Israel without direct cost. The Israeli government bears the entire risk, which is funded from general tax revenues.[33] Northern Ireland offers a similar restitution program for losses due to terrorism. Full government insurance was also provided by the United States during World War II and the Korean War, for coverage against property damage incurred from attack upon the US. Here too the government defined the coverage, bore the risk, and planned to finance the costs from general tax revenues.

Equity across individuals is a main motivation for a country to provide complete government insurance, which would seem appropriate when the losses incurred are the result of a common national policy such as a war. Free government insurance also has a positive incentive effect, since it motivates people to remain in the country and even in the regions at highest risk. For the same reason, however, complete government insurance reduces the incentive for individuals to mitigate what will be their actual losses in case of an attack. This latter point was emphasized by Hirshleifer [1953], writing about US war damage insurance introduced during the Korean War. He recommended that incentives to mitigate possible damage be created through a schedule of risk-based premiums. Hirshleifer also noted that comparable incentive effects to mitigate could be obtained by offering no government insurance or compensation at all, but he feared this would create a plan for ex post restitution for losses, which would then eliminate the desirable incentive effects.

The California Earthquake Authority (CEA), created after the 1994 Northridge Earthquake, provides another type of full government insurance. The CEA is a quasi-public entity, created by action of the California state legislature, with stand-alone status, but operating under constraints imposed by the legislation. We have already noted the fundamental differences that exist between natural disaster and terrorism risks, and we do not mean to suggest that the CEA provides a useful architecture for government intervention in a terrorism insurance market. The CEA program experience, however, provides unique insights into a insurance plan in which coverage is voluntary and explicit premiums are charged. The CEA is empowered to set premiums and to bear the risks, but under three legislated constraints:

1) The legislation determined the classes of real estate losses which are and are not covered. This created a so-called “mini policy”, which, had it been in effect at the time of the Northridge Earthquake, would have reduced the insured losses in half. More recent legislation also requires the CEA to take actions to increase earthquake risk mitigation.

[33] The coverage is provided under two different programs. The Property Tax and Compensation Fund provides property and casualty insurance, funded by a mandatory national property tax. The Law for the Victims of Enemy Action covers life and medical insurance, and is funded by the government’s standard health insurance program.

2) The legislation requires premiums be set on an "actuarial basis"; the CEA is using estimates from modelling firms to determine risk-based benchmarks for different geographic regions and structure types. In practice, the quoted CEA premiums have been "tempered," moderating the price differences across regions. While this represents premium tempering, as well political "tampering," it should be recognized that the geographic premium differentials provided by the modelling firms are themselves subject to potentially large errors of estimation.

3) The legislation required large initial capital contributions from the private insurance firms, which were thereby relieved of the need to provide direct coverage. The legislation allows the CEA to purchase reinsurance, but denies access to public funds. An immediate effect is that, based on current premium levels, CEA resources are adequate only to provide complete coverage for an event about double the size of the Northridge Earthquake. Beyond that level, policyholders would receive only partial indemnification.

Unlike the Israeli and US war damage plans considered earlier in this section, participation in the CEA plan is voluntary, and significant premiums are charged. As a result, private firms may and do compete with the CEA, although to date, they mainly offer policies for low-risk locations and structures, undercutting what are the relatively high CEA premiums for these risks. It thus appears that the CEA is not crowding out competitors who offer coverage on low-risk location and structures, while the absence of private sector competitors on high-risk properties leaves open the possibility that crowding out is occurring at these higher risk tiers.

It is also intriguing that the percentage of all California properties with earthquake coverage (with either the CEA or private firms), has declined significantly, from about 33% in 1996, when the CEA was created, to about 15% currently (California Department of Insurance [2004]). It seems that many homeowners consider the premiums to be high relative to the coverage provided; for many homes, the earthquake premium equals or even exceeds the premium for standard fire, theft, and liability coverage.[34] The CEA has been trying to raise demand by altering contract features, especially the deductible amounts, but these have not been successful to date.[35]

The CEA experience suggests it is a complex matter to determine how best to serve consumer needs for direct catastrophe insurance. The most intriguing fact is that many consumers consider the premiums charged too high to warrant insurance purchase, even though the premiums approximately equal the estimates of expected losses provided by independent modelling firms. Furthermore, the political tempering of premiums should actually increase demand, since *tempering reduces the premiums on high-risk properties, while private firms compete in providing fairly priced coverage on low-risk properties*.

[34] This result is not likely explained by consumer expectations of *ex post* aid, since the same expectations would have been present prior to the Northridge quake. This result is also not likely explained by consumer concern that the CEA will not be able to pay claims in the face of a very large event. Here, the contrary evidence comes from the Hawaii Hurricane Relief Fund (HHRF), which was structured in a manner very similar to the CEA, and faced a similar low level of demand. In an attempt to raise demand, the HHRF offered a new policy backed by higher levels of reinsurance, but also requiring a higher premium. Very little demand appeared for this higher quality coverage.

[35] The initial CEA contract required a deductible equal to 15% of the amount covered. More recently, a 10% deductible option was introduced (at a higher premium), but this has created only limited additional demand.

3.B.2 Government as Reinsurer of Last Resort for Terrorism Insurance

We next consider terrorism insurance plans in which the government serves as the reinsurer of last resort.[36] Under these plans, the government mainly provides reinsurance at the highest risk levels, while private insurers and reinsurers retain some or all of the lower tiers of risk. The sharing of risk with the private industry is achieved through a mandatory deductible limit at the lowest risk level and through coinsurance at intermediate risk levels. The current plans for terrorism insurance in France (GAREAT), Germany (Extremus), the UK (Pool Re), and the US (the Terrorism Risk Insurance Act, TRIA) all have these features, at least in general terms.[37] While these plans all share the concept of the government as the reinsurer of last resort, they differ in other dimensions, which we now analyze.

Mandatory Participation

Mandatory or automatic participation in a government plan has two primary effects, one positive and one negative:

- Mandatory or automatic participation eliminates adverse selection, a benefit for the plan.[38]

- Mandatory or automatic participation will likely crowd out private sector reinsurance for the risk layers at which the government plan provides coverage, an economic cost.

In all the country plans reviewed here, participant in the government plans is not mandatory, although in some cases it may be automatic; also in some cases the offer or provision of terrorism insurance to clients by the primary insurers may be mandatory.[39] The US TRIA plan requires insurers to offer coverage to their policyholders; all insurers then automatically participate in the government plan. French law requires that all property insurance contracts provide terrorism insurance. Participation in the GAREAT pool is not compulsory, but membership is currently automatic for insurance company members of the Fédération Française des Sociétés d'Assurances (FFSA) and mutual insurers in the Groupement des Entreprises Mutuelles de l'Assurance (GEMA); see OECD [2004]. In the UK Pool Re plan, participation is voluntary, although customers must opt for terrorism coverage for all of their properties if they wish to

[36] Information about the plans has been taken from a variety of sources, including Kunreuther [2002[, Russell [2002], US Government Accounting Office [2002], Swiss Re [2003], Kunreuther and Michel-Kerjan [2004], Michel-Kerjan and Pedell [2004], and OECD [2004]. Each country plan also has a useful web page. The French plan for terrorism insurance, GAREAT (Gestion de l'Assurance et de la Réassurance des Risques Attentats et Actes de Terrorisme), is integrated with the French plan for natural disasters CCR (Caisse Centrale de Réassurance).

[37] Many of the features that are described here for terrorism insurance are also reflected in the plans for earthquake insurance in Japan and New Zealand, and in the Florida hurricane reinsurance program, see US CBO [2002].

[38] Mandatory participation may also appear as a way to force the private sector to provide a specific type of coverage. In California, for example, firms offering home owner's insurance were required to provide an earthquake option. In France, firms offering commercial property insurance are required to include terrorism coverage. Such regulatory "tie-in" arrangements, however, break down if the private firms are prepared to leave the market entirely, in order to avoid the tie-in (which happened in California after the Northridge Earthquake and in France after the 9/11 event). On the other hand, Switzerland has a similar requirement for the provision of natural disaster (but not earthquake) insurance and this appears to be working well, without any further direct government intervention.

[39] Spain represents one case where both the provision of terrorism insurance and participation in the government plan are mandatory; see OECD [2004].

have any terrorism coverage at all. In Germany, coverage of terrorism risks and participation in the Extremus plan are both voluntary.

In all these plans, *private sector reinsurance* is generally purchased by the members to control their risks at the lowest (deductible) and intermediate (coinsurance) levels. Thus, the complete crowding out of private reinsurers could occur only at the highest risk tier, where the government serves as the unique insurer of last resort. Given that the government interventions were initiated by the failure of the private markets to offer reinsurance at this highest tier, crowding out at these risk levels was certainly not an issue initially.[40] Nevertheless, it is worth remembering that private market reinsurers are unlikely to have a major market presence in any risk tranche at which the government continues to intervene actively.

Government Plan Reinsurance Premiums

The plans differ in how premiums are set for the government's reinsurance facility. The US plan charges no *ex ante* premiums for the reinsurance facility, but has an option to require *ex post* (i.e. retrospective) compensation. Whether or not *ex* post compensation would be carried out will presumably depend on the financial status of the insurance industry at the time the decision is made. The French, German, and UK plans all charge *ex ante* premiums, with no provision for *ex post* restitution (an earlier version of the UK did have restitution). Only the UK plan uses risk-based premium charges, and these are now limited to only two geographic rating zones. For all the other plans, the reinsurance premium depends only on the insured coverage amount.

It is worth noting that government plans providing natural disaster insurance in Japan, Florida, and California all provide for risk-based pricing. The use of risk-based premiums in government-based natural disaster reinsurance plans may occur because better methods exist to determine risk-based premiums for natural disasters. Likewise, the absence of risk-based premiums in government reinsurance for terrorism risk may arise to avoid the implication that the government can judge the locations or building types that are most likely to attract an attack.

Primary Insurance Premiums

Generally speaking, insurance firms in the countries reviewed here have wide discretion to set the premiums they charge their customers for terrorism coverage.[41] In the US TRIA plan, the revised UK Pool RE plan and the German Extremus plan, the primary insurers have complete discretion to determine their premiums for terrorism coverage. In France, the reinsurance premium charged by the government plan is proportional to the total property coverage premium charged the policyholder by the primary insurer; but this still leaves the primary insurer in control of the premiums it charges its clients. In other words, the GAREAT terrorism reinsurance charge is basically a tax on all applicable property damage insurance premiums received from clients.

Primary insurers will generally use risk-based premiums to obtain compensation for the risks in their own portfolio and to pass through the cost of the risk-based premiums they are charged by private market reinsurers and by the government plans. On the other hand, to the degree that the government reinsurer charges flat premiums (which are zero in the US plan), the observed degree of risk-based pricing passed through to the consumer will be moderated. The effect is to limit risked-based pricing at the consumer

[40] Crowding out could, however, evolve over time, in the sense that the private market might have recovered were it not for the existing government program. This possibility is discussed below in Section 4.A.

[41] In the US, state insurance regulators often have significant power to approve premium levels on consumer policies (such as auto and homeowner insurance). In most cases, however, for commercial lines, which are relevant to the terrorism coverage discussed here, significant premium regulation does not occur.

level, and thus to limit the incentive for mitigation activity at the consumer level.[42] To be clear, the premiums posted by primary insurers for their clients may still include risk-based components, reflecting the need to control their own retained risks and to pass through any risk-based costs on the private market reinsurance they purchase.

Risk Coverage Limitations

The country plans all vary in terms of what defines a "terrorist act", whether chemical, biological, nuclear, and radiological (CBNR) attacks are covered, and for which insurance lines is coverage available. In the US and UK, CBNR attacks are covered as long as the respective Treasury department certifies that an act of terrorism—based on the legal definition--has occurred.[43] In France and Germany the legally set definitions of a "terrorism" event are applied directly, but Germany excludes all CBNR attacks, whereas France excludes nuclear attacks. In all countries, legal disputes may arise whether an event is act of war (in which case it would not be covered) or an act of terrorism (in which case it could be covered). The US TRIA law has the further important limitation that it does not apply to acts of domestic terrorism.

In all these countries, the government plans are directed primarily to commercial property damage. The France, Germany, and the UK plans also cover business interruption risks, whereas the US plan does not. The US plan, on the other hand, covers excess, workers' compensation and surety insurance lines, which may not be covered in the other countries. We return in a moment to the impact these various coverage limitations may have on consumer demand for terrorism insurance coverage.

Pool Structure

The French, German, and UK plans all create an explicit reinsurance pool, into which reinsurance premiums are paid, and from which compensation for losses is received (including the additional support provided by the government as insurer of last resort). This creates an automatic mutualization of the risk, which moderates the risks retained by the insurance firms (Michel-Kerjan and Pedell [2004]. In contrast, the US TRIA plan creates no *ex ante* pool, thus requiring the primary insurers to generate their own mechanisms for risk sharing. This can be seen as a positive feature if it allows the private markets to develop efficient mechanisms for risk sharing, or as a negative feature if turns out that the private markets are unable to develop such risk-sharing structures for terrorism risks.

Maximum Retained Risks

The success of any government plan will depend critically on its ability to provide dependable limits to the amount of risk that is retained within the private sector. For example, in California following the 1994 Northridge Earthquake, the insurance firms were prepared to transfer significant sums of capital (almost $4 billion in total) to the new California Earthquake Authority in order to shed any and all exposure to earthquake losses.[44]

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[42] Russell [2002] points out, for example that the reimbursement structure of the US TRIA plan will cause primary insurers to treat small and large terrorism risks very similarly. He leaves it as an open question whether this represents an intentional subsidy to large cities, perhaps based on the expected economic benefits of agglomeration.

[43] For the US plan, the government reinsurance facility does cover losses from a CBNR terrorism attack. However, a US Treasury ruling noted that while US insurance firms are required to offer terrorism insurance, they are not required to offer coverage against CBNR terrorism attacks unless separately required by State law.

[44] By contributing the capital and joining the California Earthquake Authority (CEA). the firms satisfied the state law requiring any firm offering homeowner's insurance also to offer earthquake insurance. The CEA members

For the terrorism reinsurance plans considered here, in contrast, participation in a plan reduces a firm's exposure, but still leaves varying amounts of the risk to be held in an industry pool or by the firm directly. In Germany, there are limits to the government's retention at the highest risk tier, and amounts above that would revert to the industry pool. In the revised Pool Re plan in UK, in contrast, the risk of individual insurers is now capped per event and per annum, with the cap levels depending on the firm's market share. In France, insurance firms face losses as a function of the total losses to be paid by pool members, but the French government retains all the risk at the highest tier. In the US, there is also an overall cap, beyond which neither the government nor the insurers are responsible for paying claims. Overall, the greater the amount of risk transferred from the private sector by the government plan, the greater that plan's contribution to the revival of the terrorism insurance market, but also the greater the extent to which it might crowd out future private market activity.

Sunset Provisions

Government intervention in the terrorism insurance market runs the risk that it may induce a self-fulfilling need, by crowding out otherwise feasible private market initiatives. The plans in France, Germany, and the US all have fixed termination dates within the next two years, and the UK plan is subject to periodic review. However, it may prove difficult to terminate any of these plans, particular if terminating the government plan means switching from a high level of government support to zero on a single date. In contrast, a plan in which the government's role is gradually but steadily reduced through time may have a greater chance ultimately to be eliminated. The US TRIA plan, for example, explicitly allows the possibility of steadily reducing the government's retention (see Michel-Kerjan and Pedell [2004]). More generally, it may prove useful for countries to adopt ***an explicit path to sunset***, as well as a literal and ***final sunset date***. At the same time, an understanding of the need and techniques for government intervention in the terrorism insurance markets is likely to be evolving rapidly. Thus, all sunset provisions should allow flexibility in case the evolving nature of terrorism risks requires a modification in the sunset plan.

Why Consumer Demand is So Limited

The plans for terrorism insurance described here (France, Germany, UK, and US) are all functioning, with full, if not necessarily enthusiastic, participation of the private terrorism industry.[45] It is thus a surprise to find that demand, not supply, appears to be the factor limiting the volume for terrorism insurance (excluding France, where coverage is automatically applied to applicable commercial properties). The available reports for the US show limited demand, with 20% to 36% of potential customers accepting coverage (even in New York City); see Michel-Kerjan and Pedell [2004] and US Government Accounting Office [2004a] and [2004b]. A recent survey of 2,400 US businesses by Marsh & McLennan [2004] finds that 27.3% had adopted coverage in the 2nd quarter of 2003, rising to 32.7% by the 4th quarter of 2003. Although these coverage ratios are in line with previous reports, the Marsh & McLennan report is hopeful that a positive trend is developing. On the other hand, Michel-Kerjan and Pedell [2004] report that as few as 2.75% of eligible German firms are using used the Extremus facility. It will also be instructive to see how much demand materializes in the UK, given that Pool Re has now expanded its coverage, but at the same time doubled its premiums.

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maintain limited liability with respect to earthquake losses that exceed the financial resources directly held by the CEA.

[45] Brown, Cummins, Lewis and Ran [2003] show that the stock market prices of US insurance firms dealing with terrorism risks generally declined as the passage of the US government intervention (TRIA) became more assured. This suggests that stock market investors, at least, did not consider TRIA to be a net benefit for the insurance industry.

A variety of factors have been suggested as explanations for the limited demand:[46]

- The existing terrorism plans have many exclusions; the exclusions range over acts of war, chemical, biological, nuclear, and radiological (CBNR) attacks, losses on assets held outside the country, and acts by domestic (that is, not foreign) terrorists. Although it may be intuitively appealing that reducing the coverage could significantly reduce demand, the literature on "background uncertainty" suggests a more complicated relationship. To see why, suppose coverage is initially available and purchased for protection against two risks, say Acts of War and Acts of Terrorism. Now, if Acts of War coverage were to become unavailable, then the demand for the remaining insurable category, Acts of Terrorism, will actually rise as individuals and firms attempt to control their total retained risk as much as possible.[47] The implication is that the greater the range of observed terrorism coverage exclusions, the greater the insurance demand we would expect for those terrorism risks where insurance remains available.[48]

- Commercial properties owned by large public companies, or properties with landmark or "trophy" status, face a much higher likelihood of terrorist attack than do small commercial or residential properties, based both on their strategic interest to terrorists and on location. Casualty insurance, however, may not be essential for a publicly owned company, to the extent that the incurred losses are reflected in a decline in the firm's share price, which means that the loss is automatically spread across all the shareholders.[49] Indeed, the academic literature has searched to find reasons why public corporations would purchase casualty insurance at all.[50] It is thus plausible that corporate managers may not consider it essential to purchase terrorism insurance (particularly in view of the behavioral and pricing factors we describe in the next two points).

- Behavioral factors may reduce the demand for terrorism insurance, reflecting a tendency for consumers to set very small probabilities to zero, or to assume "it won't happen to me." Kunreuther and Pauly [2004] provide a specific model based on search and transaction costs, as well references to a larger literature.

- Individuals and firms may consider terrorism insurance too costly, either because they cannot afford the premiums, or because they feel the premiums exceed the expected loss by too wide a margin. It is noteworthy that the Marsh & McLennan [2004] report, referred to earlier in the context of the limited demand for terrorism insurance coverage, attributes the recent increase in US demand to the sharply declining premium charges for the coverage. Similarly, as discussed earlier, the perception of high prices also seems to be a primary reason the demand for earthquake insurance is so low in California. Hurricane insurance in Florida, in contrast, is one catastrophe

[46] For a parallel discussion, see also Smetters [2003].

[47] See Guiso and Appelli [1998]) for a formal analysis of the impact of uninsurable risks on the demand for insurable risks.

[48] To be clear, in our example, while consumers will substitute the available Terrorism insurance for the unavailable War insurance, the total demand (War and Terrorism insurance combined) should decline when War insurance becomes unavailable.

[49] This changes if the loss can be sufficiently large to force the company into bankruptcy. In this case, it would be appropriate to buy insurance in order to avoid bankruptcy, or more specifically to avoid the extra costs that are created by a bankruptcy.

[50] In addition to avoiding bankruptcy costs, as described in the previous footnote, the academic literature notes that it may become rational for public companies to purchase casualty insurance if stock market investors interpret the stock price declines created by a casualty losses as reflecting negatively on the firm or on the firm's management in a more fundamental sense.

coverage in which the demand remains high even given the perception of high premium costs. The explanation, however, is that mortgage lenders require hurricane insurance for Florida properties, whereas they do not require earthquake insurance for comparable California properties.[51] Although mortgage lenders continue to require terrorism insurance on commercial property mortgages, the lenders appear to have become more flexible in how they enforce this requirement.

To summarize, it appears that corporate risk-spreading, behavioral factors, and high prices combine to limit the actual demand for terrorism insurance. It is an intriguing thought that if consumers and firms reveal a limited actual demand for government terrorism insurance, then this should dampen, if not eliminate, the concern for the social costs of a failed market, which created the impetus for the government intervention in the first place.

4. Limits and Drawbacks to Government Intervention in Terrorism Insurance Markets

Having reviewed how governments actually intervene in terrorism insurance markets, it is critical to consider the possible limits and drawbacks to government intervention. In this section, we review three potentially important drawbacks to government intervention in terrorism insurance markets: crowding out, mitigation effects, and emergency relief.

4.A. Crowding Out

By *crowding out*, we mean that the government intervention displaces private market activity that would have otherwise taken place. In countries such as Israel and Northern Ireland, where the government provides complete indemnification against terrorism losses at no cost, it is obvious that private terrorism insurance cannot compete. At the same time, crowding out is not really an issue in these countries since (i) in no case would private firms offer insurance while the extreme terrorist threats persist, and (ii) the government intervention arises from political as much as economic motives.

More relevant cases arise in countries such as France, Germany, UK, and US, where the government serves as the reinsurer of last resort. We now apply a simple framework which demonstrates how the existence of crowding out depends primarily on the prices for terrorism reinsurance set by the government plan and by the private market in the absence of the government intervention. We assume that consumers purchase insurance from the low cost supplier. Several alternative cases and outcomes are illustrated in Table 1.

Table 1: Crowding Out Based on Private and Government Insurance Prices

	Government Plan Price PG	Private Market Price PM	Private Market Insurance Activity (No Government)	Crowding Out
Case 1	PG = EL	PM >> EL	0	No
Case 2	PG = EL	PM > EL	Positive	Yes
Case 3	PG < EL	PM = EL	Positive	Yes
EL = expected loss for provision of terrorism insurance.				

[51] This raises the question, of course, why mortgage lenders require hurricane insurance in Florida, but not earthquake insurance in California. The answer seems to be that earthquake damage on a wood-frame house rarely exceeds the 20% equity stake required of homebuyers by mortgage lenders, whereas hurricanes readily create a complete loss. In this context, it also becomes more understandable why California consumers balk at the high deductibles required on earthquake insurance.

Case 1 in Table 1 makes two key assumptions:

1) PG = EL: the government plan price for reinsurance PG equals the expected loss EL.

2) PM >> EL: the private market price for reinsurance PM *far* exceeds the expected loss EL.

The assumption that private insurers charge significantly higher prices than the government could reflect the response of private firms to the risk of ruin and/or the effects of ambiguity aversion (uncertainty over the process generating the likelihood and location of possible future attacks). Whatever the basis, the assumption for Case 1 is that the private market price is so high that there is no demand for private insurance even in the absence of the government intervention (see column 3 in Table 1). Since no private market activity arises even in the absence of the government intervention, there is no crowding out (see column 4 in Table 1). This case becomes more likely, of course, the higher the risk premiums charged by the private market insurers. This result would also hold if private insurers refuse to provide coverage at any price (this being equivalent to charging a price so high that no coverage is demanded).

Case 2 differs from Case 1 because the private market price is no longer so high as to deter all activity in the absence of the government plan. Since the demand for private insurance is positive only when the government insurance is not offered (because PG < PM), there is crowding out. The welfare significance of such crowding out, however, is unclear because the private sector insurance is supplied only at actuarially unfair prices (that is, PM > EL). For example, if the private market's high price simply reflected inaccurately high expected losses, then the government intervention might still be desirable.[52]

In Case 3, the government plan sets a subsidized price, while the private market sets it price equal to the expected loss (in the fashion of a fully efficient market). This case also creates crowding out, and now there is a greater presumption that the crowding out indicates the government plan has created a welfare loss. However, even in this case, it could be that the government subsidy reflects an attempt to increase the supply as the result of a positive externality associated with the purchase of terrorism insurance.

These simple cases demonstrate that the welfare implications of crowding out are complex. In Case 2, where the private sector price exceeds the expected loss, crowding out may actually be desirable if the private sector price reflects private market inefficiency in providing terrorism insurance. In Case 3, where the government price is less than the expected loss, crowding out again may be desirable if the government subsidy reflects an externality in the provision of terrorism insurance. The conclusion is that welfare interpretations of crowding out phenomena require a careful analysis of the fundamental factors that create the crowding out phenomena.

The crowding out discussion has so far assumed that insurance prices are set once and for all. More realistically, private firms will reduce their prices over time, perhaps reflecting the gradual elimination of ambiguity aversion, while the government plan prices remain fixed. In this case, we would observe increasing market penetration by the private firms, essentially a beneficial *crowding in of private sector activity*. This result requires, of course, the government to maintain fixed prices at the initial level. As noted earlier, the US markets for hurricanes in Florida and earthquakes in California both appear to be evolving in exactly this way.

[52] See Barker [2003] for a more general analysis of the welfare aspects of terrorism insurance, with a particular focus on whether the government prices involve an element of subsidy.

4.B Mitigation Incentive Effects

The possibility that private sector mitigation efforts may fall as the result of a government intervention into terrorism insurance is another possible drawback to such an intervention. The economics literature analyzes the impact of insurance on mitigation based on two key forces:

1) Insurance availability tends to reduce mitigation, since insured individuals will receive indemnification for their losses independent of their mitigation effort. *Ex post* indemnification for losses incurred, as in the case of government provided emergency aid, similarly decreases the incentive to mitigate the amount of expected losses.

2) Risk-based premiums, however, provide an incentive to mitigate, which at least offsets the negative incentive created by the availability of insurance.

The failure to apply risk-based premiums in most government reinsurance programs creates an incentive against mitigation.[53] The flat pricing must thus be motivated by some other factor. For example, the government may fear that risk-based pricing, by revealing the government's information with respect to the locations and structures it knows to be at the greatest risk, would be used by the terrorists themselves. Or the government might consider it inequitable to charge higher premiums for the higher risks, given that international terrorism is the source of the risks.

The possible negative effects of the availability of insurance on mitigation requires, of course, that consumers and firms actually purchase the insurance. For example, if the government premiums are set at such high levels that no insurance is purchased, then of course there would be no negative impact on mitigation effort. This can be seen, in fact, as an extreme example of risk-based pricing, illustrating the case in which risk-based prices fully offset the negative mitigation incentives created by the availability of insurance. Similarly, limitations on the coverage, such as high deductible and coinsurance requirements, or ceilings on the maximum coverage, will all have the positive effect of creating greater mitigation effort. On the other hand, mitigation efforts will be reduced when coverage is mandatory as it is in France.

The highly publicized nature of terrorism risks may introduce several additional factors, beyond the narrowly defined economic incentives, which may influence private sector mitigation efforts. First, property owners and firm managers may decide to act to control terrorism risks in the interests of safety and welfare, independently of any direct economic incentives to do so. Second, firm employees are likely to take actions to force greater mitigation efforts by their firms if they feel their safety and welfare is in jeopardy. Finally, some of the losses created by terrorism occur at the macroeconomic and societal levels (such as simple fear), and these are likely beyond the reach of private sector mitigation efforts.

The complex process through which terrorism risks arise, especially the expected strategic intent of the terrorists, may also have a special impact on the willingness of individuals and firms to undertake actions to mitigate their future losses from terrorist risks. One key feature here is that the risk facing an individual or firm may depend in part, and possibly in large part, on the mitigation efforts taken by others, often called *interdependent risks*. The relationship between interdependent risks and mitigation activity has been studied recently by Kunreuther and Heal [2003a] and [2003b]. As one example of this approach, consider what mitigation efforts would be undertaken by an airline to protect against a luggage bomb, given that luggage is presented directly by passengers (which the airline can readily inspect) as well as transferred from other airlines (which may impossible to inspect). In this situation, if one airline suspects that the other airlines are lax in inspecting luggage, then the first airline may decide also to limit its own

[53] The programs in France, Germany, and the US provide no risk-based pricing. The UK program now creates 2 pricing zones across the entire UK, with uniform pricing across structure types.

security measures, creating a vicious circle of lax security. On the other hand, if terrorists are also known to focus on airlines with lax security, then the benefit of creating a reputation for high security may induce all airlines to spend resources on security, a virtuous circle of high security. Not only can there be quite different outcomes depending on the particulars of the situation, but the equilibrium may switch from one to another even if only a small number of firms initially change their behavior. This provides an interesting possibility for public policy, initiated either by an industry trade association or the government, in which a switch to a more positive equilibrium is initiated by inducing even a small number of firms to invest in a greater degree of mitigation.

Keohane and Zeckhauser [2003] discuss another type of interdependent risks, in which the reaction of terrorists to mitigation efforts becomes a key determinant of the mitigation efforts. They consider two alternative regimes. In one regime, terrorists are motivated to attack targets which create a large aggregate damage. Individual actions that mitigate the likely damage will create a positive externality, by reducing the overall likelihood of an attack, thus benefiting all individuals and firms in the target area. In another regime, individual mitigation efforts have the negative externality of directing the terrorist attack to another target. Behavior based on both regimes may occur at the same time.

A particularly interesting aspect of the Keohane and Zeckhauser model is that individual responses to government actions may undermine the purpose of the government action; it is as if the government action crowds out at least some of the individual efforts to mitigate losses. As an example, suppose that the government takes action to reduce the likelihood of an attack against a particular city. Individuals and firms may then respond to the reduced risk in that city by moving new activities there. This would raise the likelihood of an attack on that city, offsetting and possibly even negating the positive benefit created by the initial government action.

4.C The Impact of Emergency Relief on Insurance

Certainly in the countries for which specific plans are being evaluated here—France, German, UK and US--citizens will generally anticipate that governments will provide emergency aid and relief following a terrorism event. For example, the Victim Compensation Fund (VCF), was created by act of the US Congress to compensate victims of the September 11th terrorist attack. Overall, more than 5,500 awards were issued in an average amount slightly above $2 million each. Although the attack victims clearly would not have anticipated the attack or the creation of the VCF, individuals today who are anticipating future attacks would factor in the possibility that *ex post* aid will provided. As a further example, the US maintains a formal agency--the Federal Emergency Management Agency (FEMA)—with the express role of providing emergency disaster relief. To be clear, the primary task of FEMA is to provide victims with immediate medical care and shelter on a short term basis—with little or no interaction with any primary insurance coverage. Individuals, however, may think the relief agency also provides financial compensation for losses incurred, or that they will receive less compensation if they are insured. It is thus interesting to see the how the September 11 VCF handled this (US Department of Justice [2002, p.1):

> "While the congressional act requires certain deductions from collateral source monies—life insurance, pensions, etc. it did allow the Special Master discretion in calculating the appropriate deduction. As a result of the extensive review conducted during the comment period by the Department and Special Master, the Final Rule allows the offsets to be minimized and, in turn, increase the awards to claimants. Although the legislation does not permit the creation of a mandatory minimum pay out for all eligible claimants after the deductions, the Special Master believe it will be very rare that a claimant will receive less than $250,000."

When citizens come to expect that the government will provide *ex post* aid at no cost in the event of a terrorist attach, there are likely to be harmful ramifications in terms of crowding out and mitigation (as

discussed in the above sections).[54] *Ex post* aid is likely to create a harmful form of crowding out, since the aid can be seen as the equivalent of a zero-cost government insurance program. *Ex post* aid is also likely to create disincentives to mitigate, to the extent there is the expectation that the government will indemnify losses, whatever their size.

While these crowding out and mitigation effects of *ex post* aid programs are undesirable, realism suggests that governments will continue to provide such aid in the face of unexpected events, and that citizens will expect their government to do so. The only practical solution, therefore, is to control the details of the *ex post* aid in a way that minimizes the undesirable effects of crowding out and mitigation. For example, it is important to clarify that purchasing insurance will not reduce the payout that otherwise would be expected from *ex post* aid. It is also useful to tie aid payments in a positive way to the amount of *ex ante* mitigation that was carried out. The problem, however, is that *ex post* aid is normally provided on the basis of *emergency need*, and it may not be credible for the government to announce on an *ex ante* basis that it will not reduce award payments based on insurance in force or mitigation actions taken.

5. Policy Proposals

We now provide our conclusions in terms of a set of proposals for government intervention in the terrorism insurance markets.

5.A The Preferred Format for the Proposed Intervention

The existing government interventions in catastrophe insurance, for both natural disasters and terrorism risks, provide highly useful information. As described earlier in this Report, we observe certain features that are common to many of these plans, and which seem to be effective. On the other hand, certain aspects, particularly with regard to the government's coverage at the highest risk tranche and the government's pricing for this coverage, exhibit substantial variations across countries, at the same time that there has been no practical testing (meaning that, fortunately, no events have occurred requiring payouts from these highest risk tiers). In this section, we first summarize what we take to be the points of similarity and agreement, then we discuss the issues of pricing and coverage at the highest risk tier.

5.A.1 The Uniform Factors of Government Intervention in Terrorism Insurance

The following features are common to most government plans for intervention in catastrophe insurance markets for commercial properties and related coverages, and they appear to work well. They are listed here with only brief comment:

- The market micro structure functions, through which the sale of policies and the settlement of claims occurs, should be carried out by private market insurance firms. The private sector firms are experienced with carrying out these activities and are likely to perform them better than a new government entity. In addition, goals such as risk-based pricing and an early termination for the government intervention (discussed further below) will be best served by keeping the private firms engaged in the market.

- Government intervention should give high priority to actions that reactivate the private markets. As discussed in Section 3.A, these actions include steps to improve the access of catastrophe insurance firms to capital market resources, including the further development of the market for

[54] This is sometimes described as the *Samaritan's Dilemma*, see Buchanan [1975]. This and related drawbacks to such government intervention are discussed in Brown, Kroszner, and Jenn [2002].

catastrophe bonds. While improved capital market access has significant long-run potential, and should remain a key part of government initiatives, it is unlikely to create a rapid recovery of a private insurance market immediately following a major event. Also, as discussed in section 3.A.3, the creation of private industry mutual assistance pools should be encouraged by government action, for example, by providing such pools with tax-free conduit status. Here too, there are important long-term benefits from helping the industry make more efficient use of its capital resources, but such pools do not create the *new* capital that is required in the short-run following a major event.

- For the foreseeable future, the centrepiece of government interventions should remain a reinsurance facility. As observed in most existing government plans, the coverage should require a significant deductible requirement (at the lower risk tier) and coinsurance component (at the middle risk tiers). This format provides good economic incentives for risk management. Furthermore, plans that allow the voluntary participation of insurers and reinsurers are generally preferred, since they create a cooperative private/public partnership, in which the re-emergence of a private industry is likely to be encouraged. The pricing and delivery mechanism for the government reinsurance coverage is discussed below.

- Premium setting at the retail level should remain fully in control of the private firms. This should entail risk-based pricing, with the prices reflecting each firm's expected losses based on the risks it retains, the cost of private sector reinsurance (or other risk transfer mechanisms), and the cost of the government plan.

- The government plan should provide a clear path, or at least a strategy for a path, to termination. One credible mechanism is to require that the extent of the government reinsurance be steadily reduced, albeit at a pace consistent with the capacity of the private industry to reinsure the evolving levels of risk. It is also important to continue to encourage private firm participation, for example by not reducing the prices charged for the government coverage, even if expected losses decline.

5.A.2 The Variables of Government Intervention in Terrorism Insurance

Pricing is perhaps the most difficult question in designing a government plan for terrorism insurance. This involves both the initial level of the premium relative to the expected loss, and how the premium should be modified over time. It also involves questions whether *ex post* retrospection compensation should be included (which is comparable in most respects to a *lender* of last resort component). We begin with this question.

Ex post (Retrospective) Compensation and a Lender of Last Resort

A premium component that includes *ex post* or *retrospective* payments is a common feature in both primary and reinsurance contracts. A simple example occurs when auto premiums rise on the basis of claims made. This basic structure occurs whenever current and future insurance premiums are determined, at least in part, by the insured losses that have occurred historically. It is commonly used where the proper actuarial basis for premium determination is unclear, which includes cases where moral hazard may be an important component of expected losses. As long as the contract terms are binding, the insurer is basically acting as a lender, providing cash flow payments when the loss occurs, but receiving premium repayment in future years.

All of the government terrorism insurance plans considered here (for France, Germany, UK and US) include a component of *ex post* payments. These are explicit in the US (TRIA) plan, but arise in the other

plans as part of the required, pool-based, coinsurance payments. Such a feature is understandable, given the difficulty of determining the proper actuarial premium and the desire of the government to minimize its budgetary obligations, *as long as the arrangement is successful in attracting the needed supply of terrorism insurance by the private market firms.* The latter depends, ultimately, on whether the failure of the private market for terrorism insurance arises from the inability of the insurance firms to access the necessary risk capital on a short-term basis (for which *ex post* premiums are a useful device) or whether the supply failure arises because providing terrorism insurance is basically a *negative present value project*, in which case retrospective premiums will not increase the supply of coverage.

The concept of *lender* of last resort has precise parallels to *ex post* premium payments.[55] It could be applied to terrorism insurance if a government agency, possibly the Central Bank, stood ready to make loans to insurance firms who were in need of liquidity. The notion is that private insurance firms may refuse to offer terrorism coverage, even when premiums exceed the expected loss, due to the costs of financial distress that arise if the firm does not have access to the resources to pay future losses. Thus, a lender of last resort may serve to activate the private market for terrorism insurance at low cost to the government.

The loans might appear similar to catastrophe bonds, but (i) would be issued only after the losses occurred, and (ii) would be collateralized by the insurance firm's assets. The loans would be repaid from the insurance firm's ongoing profits. A difficulty, of course, is that the government would face potential default risk on these loans. Furthermore, it is an open question whether access to such a lender of last resort, without an insurer of last resort, would provide sufficient incentive for major insurance firms to continue to commit their capital and other resources to terrorism insurance. It should be recognized that such a loan facility is indistinguishable in its cash flow attributes from a government insurance plan in which payment for coverage is made only *retrospectively*, given that the same time pattern of cash flows apply to the loan.

Auctions for Excess of Loss Coverage

Auctions provide an alternative and potentially attractive system through which the government may provide reinsurance to the private markets. The key advantage of the auction device is that the private insurance firms play a key role in determining the price they must pay to obtain the government's reinsurance contract, in contrast to the existing programs in which the price is administratively set by the government. The system requires the government to set the total quantity of reinsurance coverage it wishes to make available. The price is then determined at that level at which the private industry demand, as revealed through its bidding, equals the government's supply. The process can be thought as similar to that used by governments when they auction Treasury bonds or mineral rights.

The auction sale would apply to contracts providing excess of loss payouts, with the government providing its reinsurance compensation when industry losses from an event exceed a specified value. The instrument could take a specific form similar to either exchange trade catastrophe options or catastrophe bonds, both of which were described earlier in Section 2.A. A number of authors have discussed such a proposal, including Lewis and Murdoch [1996 and 1999], Cummins, Lewis and Phillip [1999], Cummins and Doherty [2001], Jaffee and Russell [2003] and Smetters [2003].

A key advantage of the auction mechanism is that the private market sets the price at which it is willing to demand coverage. The devil, however, may be in the details, since the government must determine all the auction conditions, including how much aggregate coverage to offer, and the conditions

[55] The discussion in this section is based in part on Jaffee and Russell [2003].

under which new "tranche" will be available, if at all, in the future. Also, since the contracts would most likely include triggers and payouts based on *industry-wide* losses, individual firms would face basis risk.[56]

Given the difficulty of creating a completely new auction structure immediately following a terrorist attack, it is not surprising that such a format has not been attempted. However, this format becomes quite an appealing way to continue government backing, while terminating the complete coverage that was instituted immediately following the initial and unexpected attack. This approach would also help to develop the market for insurance linked securities, such as catastrophe bonds.

5.B Concluding Thoughts

Following a major terrorism act, private insurance firms are likely to suspend their terrorism insurance activities and to request government intervention in the terrorism insurance market. A positive government response will not only improve the supply of terrorism insurance, but it will be viewed as a credible and symbolic representation that the government is alive and well, and prepared to defend the country and its economy. It is in this context that the initial government intervention is likely to be both necessary and warranted. The initial intervention, however, should emphasize that the goal of government policy is not to replace the market, but rather to calm and support the market until it is again able to operate by itself.

Over time, the private industry should require a decreasing level of government intervention. Among other things, time will allow the industry to develop better capabilities to model terrorism risks, as well as to recover and then expand its capital base. The best plan would have the government intervention decrease as the private industry's potential rises, *pari passu*. Also, during this intermediate time span, the government should carry out the tax, accounting, and regulatory actions that are under its control and which will expedite the recovery of the private markets for terrorism insurance.

Ultimately, full success of the government intervention will be measured by the timely return of a well functioning private market for terrorism insurance.

[56] See Cummins Lalonde and Phillips [2003] for a discussion that suggests the basis risk created by aggregate triggers on reinsurance instruments may be manageable for insurance firms.

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