Terrorism insurance

and

Political incentives:

A framework for analysis

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Contents

Abstract

Terrorism and the associated geopolitical risk have become enduring features of the global landscape. However, various potentially targeted countries' loss control policies do not receive the attention they need and deserve. Loss control measures may not be glamorous for reelection-concerned governments as the public would see the results only if an attack actually occurred.

This paper is grounded in the literature that assesses the political and economic determinants of loss control measures and the availability of terrorism risk insurance. It will examine the effects of terrorism risk on political leadership and its decisions regarding loss control and insurance. The focus is on whether the terrorist risk insurance market and the government involvement, this latter by reducing risk and in facilitating the provision of insurance, provide appropriate financial protection against current or future threat of terrorism.

1. INTRODUCTION: SETTING A FRAMEWORK FOR ANALYSIS

While disasters have always been with us, the nature and scale of catastrophic risks have changed dramatically following the 9/11 attacks. Prior to the September 2001 attacks on the United States, insurers generally did not exclude or separately charge for terrorism risk - it was effectively covered as an unnamed peril by standard all risk commercial policies. The risk of terrorism was seen as so remote that it generally was not considered in writing insurance policies. With estimated losses of around $35 billion, the events of September 11, 2001, however, unquestionably changed this. Insurance market today not only realizes the extent of possible losses, but also the fact that these losses are caused by the growing and ever-present danger from man-made reasons – terrorism to be more precise.

Following xx, we define terrorism as the premeditated use or threat of use of violence by individuals or subnational groups to obtain a political or social objective through the intimidation of a large audience beyond that of the immediate victims. Terrorism is transnational when an incident in one country involves perpetrators, victims, institutions, governments, or citizens of another country.

Terrorism after 9/11 differs radically in form, motive, and scale from the one a few decades ago. A large majority of international terrorist groups today can be classified as extremist and religious-based, with several of them seeking to inflict mass casualties and major economic disruption to the Western countries that are viewed by many of these groups as legitimate targets. In short, mega-terrorism is now a plausible scenario—one that must be taken seriously by corporate planners and risk managers. Furthermore, the spate of terrorist attacks and near misses has belied the earlier perception about the dismantlement of Al Qaeda, and of other international terrorist groups.

Moreover, the type of target has also changed over time. Traditionally, attacks were aimed at federal targets (government, military, diplomatic). While security has increased in government buildings here and abroad, terrorist groups have switched to businesses that represent values and economic interests of Western countries. For example, in recent years, the majority of U.S. targets attacked throughout the world have been businesses (it was over 80% in 2000 and nearly 90% in 2001) (U.S. Department of State, 2004). And it seems clear that private-sector entities will remain a major target of

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[1] VanDoren, Peter; Miller, Tom; Samples, John "Government Terrorism Insurance: Déjà Vu(Doo)?", 2002, http://www.cato.org/current/terrorism/pubs/vandoren-020123.html

these terrorist organizations. Global companies usually operate in, ship to, or supply from many countries, some of them facing very unstable environments and, in some cases, repeated terrorist attacks or even civil war.

These developments have had a major impact on the market for terrorism insurance. After September 11, 2001, many businesses were no longer able to purchase insurance protecting against property losses that might occur in future terrorist attacks. Addressing this problem, Congress enacted the Terrorism Risk Insurance Act of 20021 (TRIA) to create a temporary program to share future insured terrorism losses with the property-casualty insurance industry and policyholders[2].

The governments of many countries in the developed world now provide some form of support to their private terrorism insurance market. The economic argument for this intervention is usually based on terrorism being an "uninsurable" risk causing adverse macroeconomic consequences. Facing a reduction in employment and GDP, governments act to support the private terrorism insurance market, this support being rationalized as a branch of stabilization policy, adding a new tool to the traditional channels of monetary and fiscal intervention. Although this line of argument has some dissenters (for example, Hunter (2004), Smetters (2004), CBO (2005) and in parts, Jaffee and Russell (2003), it has been powerful enough to determine global public policy.

The primary focus of this paper is on terrorism insurance and the appropriate role for government. We look at the argument for government role and explore the public policy options available to governments. But, more importantly, we look at the political motivations and compulsions of governments responding to terrorism insurance. Thus we focus on the reasons why governments select particular actions in responding to financial risks posed by terrorist threat. For instance, is the US Federal Government justified in declaring its status as an insurer of last resort for potential losses ranging from 15 to 100 billions dollars as a result of terrorist attacks[3]. This policy choice

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[2] The act requires insurers to offer terrorism insurance to their commercial policyholders, preserves state regulation of this type of insurance, and directs the Secretary of the Treasury to administer a program for sharing terrorism losses. The three-year program that TRIA created backs up commercial property and casualty insurance, covering up to $100 billion each year after set insurer deductibles. The government pays 90% of insured losses over the deductible, with the insurer paying 10%.

[3] As elaborated by Chalk, Hoffman, Reville and Kasupski, [2005], TRIA was intended to provide federal support and encouragement for the development of a private terrorism commercial insurance market following the 9/11 attacks. The legislation requires insurance companies to make certain kinds of terrorism risk coverage available to customers and, in return, provides federal reinsurance (a "backstop") for any losses thereby incurred. The government does not receive any premium for providing this reinsurance, meaning that it is effectively a subsidy. To be eligible for Treasury reinsurance, acts of terrorism must be "certified", meaning they have to be both committed by a foreign interest and result in property and casualty damage of at least $5 million. Certified losses are capped at $100 billion under the authorization of the Terrorism Risk Insurance Program (which is administered by the Treasury), with those losses exceeding this limit subject to congressional discretion (U.S. Congress, 2002, sections 102 and 103; "A Limitless Risk," 2002; Kunreuther and Michel-Kerjan, 2004b, p. 204). For attacks with insured

removes the US government by many layers from frontline insurees and generates a corresponding set of subsequent incentives for political decision-makers. We explore the economic and political justification of alternative policy choices.

Section 2 concentrates on the functioning of private insurance markets in the presence of terrorism risks. Section 3 is the main focus of the current study. Both the probability distribution of potential events and their associated damages, and their endogeneity are discussed. Moreover, a distinction is drawn between two types of endogeneity, one deriving from government's superior information on event probabilities and the other on the government's behaviour affecting the likelihood of events. Section 4 concludes and formulates further questions for study.

2. INSURANCE MARKETS: CAN PRIVATE MARKETS PROVIDE TERRORISM INSURANCE?

We explore the question of why the private terrorism insurance market fails. Clearly, if terrorism insurance is really an "uninsurable risk", the question of an optimal government alternative needs to be raised. However, if the private market, after a period of temporary stress, is independently viable, a long term program of government support is not only unnecessary, but it may actually crowd out the private market recovery. Assuming that some form of government intervention is desirable, we examine the efficiency of various forms of government support.

In principle, private insurance markets ought to operate without government intervention despite well-known market malfunctions of adverse selection and moral hazard induced by informational asymmetries. Various mechanisms (e.g. experience rating and warranties) and institutions (e.g. insurance associations to share information) of information elicitation and transmission have emerged in response to these problems and do mitigate the harmful consequences of the two problems. Therefore, if insurance markets work reasonably well, they generate incentives for efficient investment in risk mitigation measures and induce the build-up of sufficient carrying capacity to satisfy demand.

Exploring further the question of why private terrorism insurance markets fail, the direct reason primary insurers withdraw coverage following a terrorist attack is the refusal of reinsurers to underwrite this risk. In the 9/11 attack in the US, for example, no domestic US insurance company suffered a loss in excess of $1b, but three foreign reinsurers, Lloyds, Munich Re, and Swiss Re, suffered combined losses of approximately $8b, and the largest single group loss ($2.4b) was incurred by the domestic reinsurer Berkshire Hathaway. The collapse of the terrorism insurance market is thus primarily a collapse of

the reinsurance market. The existing government programs all act as substitutes for the failing reinsurance markets.

In theory the private insurance industry should not be able to provide terrorism insurance and even if insurance is not available, the diversification provided by existing equity markets prevents any serious decline in firm value. Nevertheless, immediately following a terrorism attack, the loss in surplus in the insurance industry and the potential for insurance firm bankruptcy, if that is how the risk is managed, is likely to cause serious and costly disruptions. The usual argument for government involvement in terrorism insurance focuses on economic efficiency grounds by identifying market failures that justify a government intervention (Smetters 2004). The large size of potential losses and the asymmetric information have been cited as justifications (Smetters 2004, Cave 1984). The argument is that the magnitude of loss requires that the risk be spread as widely as possible and, as the terrorism risk is a public bad, the government is the appropriate agent to spread it over all taxpayers. Furthermore, the government, as the informed agent, knows more about the probability of loss than the parties concerned.

The unique nature of the risk

Major terrorist incidents, called *mega-attacks*, fit in the field of risk management into a special category called "extreme" events. Managing and arranging post-loss financing for such low-probability, large-loss events present challenges of a different type to those for smaller and local accidents. Large terrorist attacks have the potential to destabilize entire nations, with numerous ripple effects and long-term impacts. In other words, major interests are at stake. Crisis management of such events is different, too, because it requires immediate coordination of a very large number of decision-makers who often have never worked together before and have very different agendas. Disasters also force decision-makers to confront the pressure exerted by the media's continuous live coverage. The task of securing financial protection against extreme events is also of a different order of magnitude, since catastrophic losses are typically both immediate and highly correlated—and the losses resulting from business interruption can also be very large. While mega-terrorism risk shares most of the features of low-probability, extreme risks, it also presents a set of distinctive characteristics that can seriously challenge companies' capacity to deal with this emerging threat. Following xxxx, the major arguments for potential failure of private markets in dealing with terrorism insurance are cited below.

First, terrorism losses are concentrated and the potential magnitude of the loss may be catastrophic. Terrorist access to modern nuclear, chemical and biological technologies (Shubik 2006) opens up the possibility of catastrophic losses, especially to property and

casualty insurers. While the September 11, 2001, terrorist attacks killed nearly 3,000 people and resulted in an estimated $32.5 billion in insured losses as of 2006, analysts estimate that casualties and property damage involving unconventional weapons, such as nuclear, biological, chemical, or radiological (NBCR) materials, could be substantially worse under some scenarios. For example, under a RAND Corporation simulation of a terrorist-detonated nuclear explosion in the Port of Long Beach, California, 60,000 people could die instantly, another 150,000 people could require emergency medical treatment, and losses could reach $1 trillion. There are many plausible scenarios of attacks that would lead to overwhelming losses; the possible methods of a mega-terrorist attack are limited only by terrorists' ingenuity. Consider the following illustration. The direct property losses, business interruption costs, and workers' compensation payments resulting from a five-ton truck bomb in one of the tallest high-rises in a major U.S. city could go as high as $15 billion for a single building, depending on the location and the timing of the attack. Simultaneous attacks could inflict losses in the $100 billion range.6 The use of socalled weapons of mass destruction (WMD) is even more threatening.

Second, there are substantial interdependencies and the origin of the attack and its effects do not require proximity; for example, the destruction of the World Trade Center's towers in New York City could be attributed in part to the failure of security at Logan Airport in Boston, which shows that one company's operation can be disrupted by the failure of others to take sufficient protection measures (Kunreuther and Michelkerjan, 2005-b);

Third, and related to interdependencies, actions to protect one potential target can increase the likelihood that other targets will be attacked, some types of "security externalities" which are critical to consider;

Fourth, in contrast to natural disasters, for which large historical databases and scientific studies are publicly available, data on current terrorism threats are either not available at all or partly concealed by federal agencies for national security reasons. Looking at the reinsurers, it is tempting to explain their unwillingness to underwrite the terrorism line by its unique statistical property that the probabilities of terrorist attack are imprecise.

Fifth in addition to the lack of historical data relevant to the nature of today's threat, estimating the likelihood of a terrorist attack means aiming at a moving target, resulting in *dynamic uncertainty*, which is a key feature of terrorism risk. As a result, firms face a serious problem in quantifying terrorism risk and evaluating the best strategy to protect their assets. Both the frequency and the severity of loss prove difficult to estimate. In fact, the event set is incompletely known and the nature of the attack may not even have been on the radar screen. Third, the information needed to estimate probabilities

and potential costs interact with government security and defense policies. Given the lack of useful data for modeling future events and the unavailability of relevant information concerning terrorism (due to potential intelligence sensitivities), the insurance and reinsurance industries are unlikely to develop an ability to underwrite, on their own, the complete spectrum of attack risks necessary. Thus the economy is unable to fully internalize the terrorism risk.

Sixth, is uncertainty about the *timing of an attack*. From the eight years that separated the first World Trade Center bombing in 1993 and the 2001 attacks, one could infer that terrorist groups program their attacks far in advance and strike when the public's attention and concern about terrorism have receded;

Finally, and of great importance, when it comes to sharing the watch and responsibilities, a government's actions here and abroad directly affect the level of risk imposed on businesses and citizens (security measures, intelligence, foreign policy).

All of these characteristics have influenced the insurance programs established by different countries to provide financial protection against terrorism.

Imprecise probabilities may well lead to behavioral responses such as ambiguity aversion, see Kunreuther et al (1995). However, such a behavioral response is not fatal to the operation of this market. By adding an ambiguity premium, or, in the case in which insurers are Bayesian, an imprecision premium, the provider of insurance could be compensated for the uncertainty surrounding the estimates of the probability of loss. Moreover, many large risks such as (for example) earthquake losses in California, are underwritten by reinsurers, even though the probability assessments in this case are recognized to lie within very broad bands.3 With respect to the second issue, it is not clear why an insurer cannot hold a diversified portfolio of risks some part of which is terrorism risk. It is true that all of the group life insurance policies on the North Tower of the World Trade Center were held by one small insurance company, but that was a voluntary business choice by the company, not a statistical imperative. Viewed from a reinsurer's global perspective, there seems nothing intrinsic to the risk of terrorism which makes this line non-diversifiable and therefore uninsurable on this score. Of course, it is true that terrorism losses can be large, and size itself is an issue in questions of insurability, see Gollier (2002). Any one insurance entity, even a global reinsurer, has finite resources. When the size of a potential loss is large enough, the subdivision of loss, the essential economic explanation for why insurance works, could still leave any one insurance company with an unmanageably large fraction of the loss relative to its finite reserves. In this case, a major event could bankrupt the reinsurer. Given the deadweight costs of bankruptcy, it thus may be imprudent to write such coverage. Whether or not the size of potential terrorism insurance losses fall in this category is an empirical question.

A key informational requirement for well-functioning insurance markets is a reasonably good knowledge of the expected losses from a particular coverage[4]. This means that insurers ought to know the probability distribution of the insured events and the losses emanating from these events (Rowlands & Devlin 2006). However, terrorism risk diverges from this scenario by its irregularity that yields little distributional information and by potentially spectacular variations in damages. In fact, in the pre 9/11 period very few could have even imagined of an event as spectacular as an aerial attack on Twin Towers let alone determine its probability. As a result, there may appear a gap between the insurance coverage supplied and the actual damage for particular risks to be covered[5]. This gap is thus essentially created by the uncertainty surrounding terrorism. It must, however, be noted that this uncertainty is somewhat endogenous in terrorism risk, unlike in the case of natural catastrophies. Section 3 studies this latter distinction.

According to Brown and Kroszner (2002), "... recent acts of terrorism forced insurers to abandon prior beliefs about the likelihood of and probable losses from terrorist attacks. In the absence of historical data, current actuarial models of terrorism risks cannot dependably estimate the frequency or severity of terrorist events" and, therefore, are unreliable[6]. This, compounded by the endogeneity of the terrorism risk, creates a market failure (Boardman 2002). Insurers show reluctance to take on this seemingly open-ended risk as investors cannot absorb the high liabilities associated with terrorism. Part of the problem is that insurers lack the ability to spread this large risk widely enough to make it acceptable to investors and hence the end product affordable to buyers. As primary insurers remain averse to exposing themselves to potentially catastrophic but markedly uncertain terrorism losses, lack of reinsurance then seems to lie at the other end of this problem[7]. Consequently, government reinsurance, if available, is the ultimate domestic spreading of the risk to all citizens.

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[4] At the most basic level, an insurance company weighs revenue against costs to determine the insurance coverage it will supply. A fundamental aspect of insurance is the selection, measurement and management of risk exposure. The risk selection process includes the methods by which insurers measure the potential for losses from individual risks, determine which policyholders to accept and insure, and to what extent and at what price they are willing to provide coverage. So, insurers' evaluations of risk, and their ability to manage it, are key factors in determining the supply of insurance in the market. On the demand side, a business evaluates its risk exposure, manages its risk through efforts to mitigate losses, transfers the risk of the loss (*e.g.*, to insurers), and bears a portion of the risk of loss itself (*e.g.*, self-insurance).

[5] Low frequency, high severity events have proven to be particularly challenging financing problems for private insurance markets. Insurance works best for smaller, more frequent events, where it is possible to gather sufficient statistical data to support actuarial pricing estimates and provide for risk diversification.

[6] They can predict a likely range of insured losses resulting from the damage if specific event parameters such as type and size of weapon and the location are specified, however, are unable to predict the probability of such an attack. On the other hand, perfect terrorism insurance coverage should estimate losses from future terrorism attacks, while considering all sorts of terrorism (domestic and international, conventional and WMD). Such a model should be able to sort both the frequency and the severity of attack, employing the advice of terrorism experts and combining those with historical information. Such a method will be beneficially employed because historical data alone on terrorist activities is thought to be too sparse to be useful without additional analytic information...

[7] Reinsurance is a vitally important element of the insurance industry's capacity to provide coverage to policyholders. As a mechanism for spreading the risks taken by insurance companies, reinsurance allows primary

Figure 1 below summarizes the terrorism insurance framework. Government as last resort insurer and the ultimate spreader of risk is also seen as affecting the likelihood of terrorist attack. This last role of government forces political decision-makers into the quandary of compromising security measures for releasing information that, in all likelihood, would improve insurance market decision-making.

The large recapitalization that was required for the US insurance market to handle a similar attack in the aftermath of September 11 attacks required either government intervention to spread the risk or, remaining within the private sector, time to build capital. As the timing and the severity of such catastrophic events threaten insurer solvency, carriers frequently responded to catastrophic events by cutting back coverage significantly or substantially increasing premiums, as, for example, they did after the gulf crisis. This is because terrorism was not yet recognized as a distinct peril by insurers (despite the previous attempt to destroy the World Trade Center in 1993), and therefore was neither excluded nor priced as a stand-alone policy (Dixon and Reville, OECD 2005). The dynamic nature of terrorism risk adds to the uncertainty of managing the risk into the future. Understanding the true nature of the threat posed by terrorism is key to managing the risk arising from it. The June 2005 Treasury Department report[8] was complimentary about the role of modeling in developing a terrorism insurance market by embodying this understanding in decision-support tools.

POLITICAL FACTORS

Government's policy response to terrorism insurance involves deep political considerations. The impact of terrorism on political decisions depends critically on the expected terrorism costs inflicted on the economy. Theory and the limited empirical evidence suggest, ceteris paribus, a negative association between terrorist activity and economic growth[9].

More specifically, terrorism may pose at least three problems for politicians. First, terrorism increases the demand for security. Governments, the conventional suppliers of security, typically respond by an increase in security measures, such as legislation, enforcement, defence and intelligence, each of which is contested and creates other

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insurers to accept large risks and, by reinsuring a portion of those risks, to protect themselves from a potentially catastrophic loss. Reinsurance provides a way to insure large risks without exposing a single insurer to the possibility that its entire capital base would be wiped out because of a single event.

[8] It recognized that modeling has greatly improved the ability of insurers to identify and quantify the severity of an event, enabling them to better assess their accumulations of risk and to more effectively underwrite coverage. The science of modeling attack frequency has also evolved through four years of experience and better information about numbers of attack attempts and interdiction rates by the security forces. (Assessment: The Terrorism Risk Insurance Act of 2002'; The United States Department of the Treasury, Report to Congress, June 30, 2005)

[9] Political instability and terrorism normally have strong adverse effects on economic prosperity. See Abadie, Alberto and Gardeazabal, Javier, "The Economic Costs of Conflict: A Case Study of the Basque Country", *American Economic Review*, March 2003, 93(1).

problems, for instance conflict with civil liberties. Second, stronger security regulations imply that the implied investment in loss control by the private sector imposes costs as any regulation entails decision constraints for private decision-makers. Third, there is the risk of a political fallout from a direct destruction of goods, physical and financial assets. Attacks with potentially large economic and social consequences are naturally preferred by terrorists in order to destabilize a given country by focussing the attacks on key pillars of the economy such as financial centers, transport and other infrastructure. Since the economic impact of a terrorist act is hardly predictable, unlike in the case of routinely insurable losses, governments generally face larger risks as potential insurers of last resort or as Pigouvian interveners in insurance markets. The government response both preceding and succeeding a terrorist incident is scrutinized by the 24/7 media coverage, puts enormous pressure on governments in the short run and can have unexpected political consequences, like in Spain after the Madrid bombings.

The endogeneity of government role in terrorism insurance is well illustrated by what the counter-terrorism officials in Britain call the four "Ps" of fighting terrorism: prevent the radicalisation of Muslims; pursue terrorists and disrupt their plots; protect targets to make attacks harder; and prepare government agencies to minimise the impact of any attack (The Economist Jan 28, 2010).

All countries are vulnerable to the disruption of industry supply chains and to the destruction of particular modes of transport. Terrorist ability to inflict substantial damage on such relatively soft targets could be inflated by the unwillingness of the private sector and of the government to recognize the existence of such soft targets and the possibility of insurance market failures. Terrorists' keen interest in attacks with magnified economic consequences (Frey 2006) highlights the importance of institutions that buffer the economic consequences of such attacks. In particular, insurance plays two crucial roles. First, it provides funds to compensate possible losses, sustain business operations during disruption, and rebuild damaged and destroyed assets and infrastructure. Thus the availability of adequate terrorism insurance coverage against future terrorist attacks will allow countries to sustain economic activity on track in the aftermath of destruction. Second, properly designed insurance contracts can provide incentives for hardening the targets and thus lower risks.

This framework paper first looks at terrorism coverage by the insurance industry and its potential consequences on the economy and then on the role and responsibility of the government in mitigating the risk of terrorism (through preemption and deterrence) and in managing loss control (through deterrence and last resort insurance). Thus, complicating government decisions regarding intervention in insurance markets, government loss control policies heavily interact with policies related to probability of loss. For example, if the government were to subsidize insurance for given security

measures, subsidies would affect loss control choices as well as deterrence measures taken by the private sector. This latter effect consists of whether moral hazard is induced. If these latter were to weaken (strengthen) then insurance subsidies end up generating perverse (correct) incentives for improved security. This is why the market transmission mechanism, from government subsidies to firms' security responses, is crucial in an analysis of government policies. If insecurity resulted in response to insurance subsidies, it would generate negative externalities through industry or network interactions. As for the insurer of last resort, such an intervention also depends on the aforementioned transmission mechanism. Consequently, government intervention in an otherwise failing terrorism insurance market may be justified by risk reduction and potential enhancement of commercial activity. Below, we review some related industry studies in relation to government security policies.

In general, government's anti-terrorism security budget is allocated between antiterrorist capabilities and insurance. However, given the decreasing returns to direct risk mitigation measures, the attempt to spread the remaining risk through insurance is a correct response because the existence of insurance generates improved ex ante expectations of uninterrupted economic activity. Thus, government subsidies for terrorism insurance or its role as insurer of last resort in response to a failing insurance market serves as a complement to policies of deterrence. Both policies lower the cost of insurance to industry and may reactivate a market that might otherwise fail. If empirically justified, this government intervention might also diversify risk through terrorism insurance and, interestingly, will increase the efficiency with which the existing capital is deployed by inducing, through insurance markets, the industries most exposed to terrorism to purchase adequate coverage.

What does all this mean in terms of **political incentives**? The more governments invest in deterrence and insurance, the less effort and money they will need to devote to terrorism recovery and, evidently, the less will be their political capital losses. Thus, to prepare the nation's economic infrastructure for the possibility of a catastrophic terrorist attack, government programs need to be multi-prong in nature. Any program must be designed with the goal of minimizing exclusions or gaps which would undermine the purpose of the program. In particular, an optimal allocation of investments between insurance and deterrence is called for. Of course, governments are already heavily involved in regulating and supervising the insurance markets, including direct regulation of insurance premiums in specific cases (e.g. automobile and life insurance) and indirect regulation by legislating liability rules. Moreover, governments may provide either implicit or explicit insurer-of-last-resort functions such as in natural catastrophes (Rowlands & Devlin [2006]). The insurance transition from natural catastrophes to terrorist attacks, beyond the potentially similar scales of fear and destruction, requires

adapting to the fundamental strategic human element in terrorism such as from information to intelligence.

Counterterrorism policy: The substitution effect

The government's role in terrorism insurance is likely to be endogenous for another reason as well – because of the likely substitution effect in the behaviour of terrorists as a response to its counterterrorism policy. This substation effect is predicted by the rational actor model of terrorist behavior (Enders and Sandler 1993) which assumes that terrorists use their scarce resources so as to maximize the expected value of their utility. Thus, for a given set of preferences, terrorists will make choices that are most likely to bring out their most preferred outcomes. The predictions of this model have generally proven to be consistent with the data.

The terrorist group has access to a finite set of resources including financial assets, weapons and buildings, personnel, and entrepreneurial abilities. Given its resources a rational terrorist group selects the set of activities that maximizes the expectation of its attaining the shared goal. Since terrorists can "save" their resources for future attacks, rational terrorists will time their attacks to enhance their overall effectiveness. The choices made by the group will be influenced by the prices of the various terrorist and nonterrorist activities. The full price of any particular attack mode includes the value of the resources used to plan and execute the attack, and the cost of casualties to group members. Certain attack modes are more likely to expose the group's membership to capture than others. The price of a suicide bombing includes the direct costs of the bomb, the costs of grooming the perpetrator to ensure that the attack takes place, and the cost to protect the group's security for failed attacks. At the other end of the spectrum, threats and hoaxes typically require few inputs. The key feature of any antiterrorism policy is that it can influence the prices, resource supplies and the payoffs faced by terrorists. Enhanced airport security increases the logistical complexity of a skyjacking and raises its price. If, at the same time, governments do not increase security at ports-of-entry, attacks relying on contraband become relatively cheaper. Similarly, if immigration officials make it more difficult for terrorists to enter the United States, a terrorist group might attack US interests located abroad (for example, tourists and firms). Hence, a government policy that increases the price of one type of attack mode will induce a substitution away from that mode into other logistically similar incident types.

Enders and Sandler (1993, 2004) summarize the four key propositions of the model as:

PROPOSITION 1. *An increase in the relative price of one type of terrorist activity will cause the terrorist group to substitute out of the relatively expensive activity and into terrorist and nonterrorist activities that are now relatively less expensive.*

PROPOSITION 2. *Terrorist attack modes that are logistically similar and yield similar basic commodities will display the greatest substitution possibilities. Since the effects of complementary events are mutually reinforcing, an increase (decrease) in the price of one activity will cause that activity and all complements to fall (rise) in number.*

PROPOSITION 3. *An increase in the price of all terrorist activities or a decrease in the price of nonterrorist activities will decrease the overall level of terrorism.*

PROPOSITION 4. *For normal goods, an increase (decrease) in the resource base will cause a terrorist group to increase (decrease) the level of nonterrorist activities.*

The implications of this substitution effect on the political calculus of the government is particularly stark for the case of non-benevolent governments that optimize the social welfare function of a subset of the population.

Measuring the economic costs of terrorism

The economic costs of terrorism are probably the easy to measure for direct costs. According to the Bureau of Economic Analysis (2001), the total direct economic cost of 9/11 is estimated at more than $40 billion. Yet, the US economy experienced a number of additional economic costs that are indirectly attributable to 9/11. The cost of pain and suffering and the value of lost output as a result of injuries are very difficult to value. Much of the federal government's current budget deficit is due to additional military and security expenditures necessary to fight the "War on Terror". Likewise, business firms had added new security measures and incurred additional insurance costs to protect themselves from another catastrophic terrorist attack. In a sense, the fear of terrorism acts like a tax on the entire economy. Given the impossibility of calculating and summing the various direct and indirect costs of terrorism, researchers have used other means. An alternative way to measure the full cost of terrorism is to compare the overall economic performance of countries or regions with high levels of terrorism to countries with low levels of terrorism. Due to lack of appropriate panel studies, far less is known about the macroeconomic costs of terrorism than the costs to specific countries and specific industries. The panel data estimates suggest that the costs of terrorism to overall economic growth are virtually zero.

It is government responsibility to assure the safe environment for the proper functioning of markets in general but especially so in times of crisis. This fiduciary as well as fiscal responsibility requires the spreading of the risk as wide as possible because terrorism is typically not aimed at specific businesses or property owners but at governmental policies that represent the whole population.

Governments typically invest in deterrence capabilities against terrorist acts as these are public bads and, beyond the grief, cause major disruptions to the economy, directly through physical damage or indirectly through lowering expectations. These government investments fall into the general defence and security realms, those that are governments' nearly exclusive jurisdictions. Such defence and homeland security programs thus support the mitigation of terrorist attacks, both in preventing such attacks and potentially mitigating the magnitude of any attack that does occur. As shown in the trapezoidal box in Figure 1, they can be broadly classified into ex ante and ex post deterrence measures as well as preemption. Whereas ex post deterrents and preemption primarily lower attack probabilities, ex ante deterrents consist of hardening targets and, hence, lower losses should an attack occur as well as providing further deterrence. Such fundamental involvement squarely lands the government in insurance markets because these measures significantly influence attack probabilities and, hence, the price of insurance provided, of course, insurance is supplied. This constitutes the first endogeneity of terrorism risk.

A further important problem concerns the information asymmetry originating from the government's role as primary security provider. A significant part of the information (i.e. intelligence) required to predict a terrorist event is likely to remain classified and unavailable to those outside government security agencies. True, the government is obliged to communicate the estimated danger signals correctly but, given the different levels of risk aversion, the private sector's actions might be different under full information. In fact, one of the arguments in support of a federal role in the provision of terrorism reinsurance is that the government is the most informed source of information about terrorism risks. This is the second endogeneity of terrorism risk. The government may well be in possession of such intelligence or other information regarding likelihood or nature of future terrorists acts, but it may be difficult for the government to share such information with the insurance and reinsurance industries as well as their customers.

A twofold problem of signalling arises from whether the government would share its intelligence information. First, if the government is unwilling to provide the market with more sensitive intelligence information (i.e. signal-jamming), it might choose to provide/subsidize insurance (directly, as reinsurer or insurer of last resort). But this, in turn, might undermine incentives for loss control. At the same time, governments must be ready for information leaks and, also, for inferences based on any policy changes that might be construed as changes in the intelligence information held by the government. If interpreted as bad news, the leaks or policy changes may create panic and distortions thus impacting the economy negatively. Second, moral hazard may be induced when the insurers, better acquainted with information-processing, might use the leaks or policy changes to shift the risk away from shareholders towards

policyholders[10]. In other words, private insurers might recognize new potential losses and introduce new practices and limitations to further limit as much of their loss exposures as possible.

In general, major macroeconomic losses could follow from a failure of terrorism insurance markets. The spillover effects on the overall economy are likely to be great for terrorism, since the direct losses could well be greater than for example from natural disaster events and, the failure to stop the attack will be seen as a failure of the government, while the terrorists may well aim their attacks to maximize the overall impact on the economy. Thus, insurers will be less willing to bear terrorism risks when they fear that the realized losses will coincide with negative macroeconomic periods. For further elaboration on that, one can see the report of Dwight M. Jaffee (OECD 2005). Government intervention targeting these potential market failures can improve the overall market outcome by mitigating, if not eliminating losses.

3. GOVERNMENT POLICY RESPONSE

In the light of various aspects of the terrorism insurance markets discussed above, governments have economically justifiable reasons to intervene. However, the analysis would not have been complete without laying out explicitly the nature of the government under consideration, one maximizing some social welfare function or, rather, pursuing objectives related to ideological or electoral goals.

Three kinds of endogeneity affect government decisions regarding an intervention in terrorism insurance markets. The first relates to short-term security measures of the government. For instance, the probability of a terrorist attack would be lower if border controls were tighter, the airport and seaport security measures were tighter, the communications eavesdropping was more intensive, etc. Moreover, imposition of security standards and other regulations (see Figure 1) may serve as ex ante deterrents, hence hardening the targets and, also, resulting in expected loss decreases. Secondly, again introduced above, the government has the ability, being privy to intelligence information, to manipulate this information by withholding or leaking it. Finally, the third relates to long-term security measures aiming to erode the pool from

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[10] Of course, in the absence of any formal government policy toward terrorism losses, it is quite likely that, in the event of a major terrorist attack, the government will step–in in order to provide aid and assistance to the victims of the attack. Moreover, after an incident, it is politically quite difficult for the government to offer differential compensation to victims based on how much they had worked to mitigate the risk of attack before hand. In other words, the government is likely to be as generous to an individual or organization that took no precautionary steps, as it is to an individual or organization that invested heavily in preventative measures. Knowing that this free, implicit insurance exists, the concern is that private entities will not have appropriate incentives to engage in risk mitigation. This form of moral hazard is the crux of the so–called "Samaritan's Dilemma" (for more information on this see Buchanan, James. "The Samaritan's Dilemma", in Edmund Phelps, ed. "Altruism, Morality and Economic Theory", Russell Sage Foundation: New York, 1975).

which terrorist organizations recruit. Development aid, democracy promoting measures and diplomacy fall into this category where, for example, a success seems to have been recorded in the IRA oppositional terrorism case through years of hard work (Cragin & Chalk 2003).

These endogeneities open up the possibility for government to behave opportunistically, exploiting its abilities to behave not quite so benevolently. Therefore, an analysis of political decision-makers' motivations is in order.

In the debate over terrorism risk insurance, much concern is expressed about government intervention in a competitive insurance market beyond an initial period of recapitalization or a transition period of adjustment to terrorism risk. The insurance industry, however, is always and everywhere a sector subjected to heavy government regulation by courts and legislatures. Typically, both entry into and exit from the industry are controlled by government licensing and regulation. The form of product and often the price in most lines of risk insurance to a certain extent are also subject to regulation. So, the latitude of insurer actions in many aspects of their business is to a large degree a function of solvency regulations. It is also an industry where various government actions require or encourage the pooling of certain risks, and where, in many cases, the insurable risk is itself created and defined by government mandate. For example, the mandating of insurance coverage, as in automobile insurance, is one way the government is involved the insurance markets. Through their judiciary, governments also affect insurance markets by the manner in which they establish awards in liability cases. In addition, governments may provide deposit insurance for the financial system either directly or through a quasi-governmental public agencies (Rowlands & Devlin 2006).

Figure 2 below illustrates the policy tools available to the government as well as their articulation with various phases of terrorist conspiracies. By and large, the long-term measures stand apart from the rest for two reasons. First, because electoral cycles are shorter than the gestation periods of these measures, governments may not face strong incentives to focus on long-term policies. Second, similarly, short-termist governments would have no willingness to concentrate on such measures. Thus both reasons suggest that long-term measures will tend to be unpopular with electorally concerned decision-makers.

Moreover, terrorism insurance is of similar electoral invisibility. Cynically, one is thus tempted to transpose the same conclusion that terrorism insurance would also be unpopular with politicians. It is interesting to observe, that most countries faced with a significant terrorism risk recognize the partnership between the private sector and the public sector and have some degree of government participation in the private insurance market, from the full recovery of terrorism losses offered by Israel, to

government pools set up in several countries, such as United Kingdom, Australia, France, Spain, Germany, the Netherlands and other. However, terrorism risk is, as explained in the previous section, negatively related to the whole set of government anti-terrorism measures. Interestingly, government as last resort insurer has been implemented in various countries[11] and, for that reason, the reasons must be investigated.

Since governments are mandated to play a fiduciary role for its citizens, terrorism risk forces them to adopt national programs to help manage the related economic risk. In different countries a mix of government and private sector involvements characterizes such programs (GAO 2002). For example, many European governments (Spain, France, UK, Germany, and Switzerland) have taken an alternative approach to that of the US Terrorism Risk Insurance Act and its extension TRIEA. Instead of providing zero-premium re-reinsurance themselves, they financially back terrorism insurance and the reinsurance pools created by insurers. This creates an automatic mutualization of the risk, which moderates the risks retained by the insurance firms (Michel-Kerjan and Pedell 2004). The pools, which are a way of sharing risks among insurance companies, are typically intended to be permanent. With a pool system, individual insurers pay the first layer of claims, and the mutual reinsurance pool pays higher layers. Generally, the government picks up losses once a pool's resources are exhausted. However, the government's explicit liability is usually capped (US Congress CBO Paper 2005)[12]. On the contrary, the US TRIA and TRIEA create 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

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[11] In Austria, the *Osterreichischer Versicherungspool zur Deckung von Terrorrisiken* was created in October 2002 by the Austrian Insurance Association as a purely private co-reinsurance pool. The French *GAREAT* is a reinsurance pool offering reinsurance protection to direct insurers provided that they cede the terrorism risk forming part of all qualifying policies within their portfolio. The French state acts as reinsurer of last resort, offering unlimited protection through the Caisse Centrale de Reassurance. *Extremus Versicherungs AG*, a specialist insurance company writing only large property risk against terrorism, was established in Germany in September 2002. It benefits from a limited participation offered by the German State. The Netherlands' *Herverzekeringsmaatschappij voor Terrorismeschaden*, established in 2002, is a dedicated reinsurance company writing terrorism risks. A "Terrorism Cover Clause" was added to all new and/or amendable policies providing for overall terrorism exposures to be limited to Euro 1 billion per year. In Spain, terrorism is traditionally part of a series of risks known as "extraordinary risks", which have special insurance treatment within a system that includes other political risks and natural catastrophes. Coverage for extraordinary risks in certain classes of insurance is mandatory and is available from the *Consorcio de Compensacion de Seguros*. All extraordinary risks can legally be covered by private insurance companies. Otherwise, CCS will automatically take charge of the extended cover. CCS is supported by an unlimited State warranty if the losses are above its own capacity for payment. *Pool Re* is a mutual reinsurance company authorized to transact reinsurance business in the United Kingdom. The scheme covers losses resulting from an Act of Terrorism, as defined in the enabling Act of Parliament, the Reinsurance Act 1993. Pool Re's Retrocession Agreement with HM Treasury provides funding in the event that it exhausts all its financial resources following claim payments. The government, therefore, is acting as lender of last resort (OECD 2005).

[12] Pools can be efficient ways to handle layers of risk that are hard to price. Some analysts believe that in the case of terrorism, the highest layers of risk—covering catastrophic losses—may be difficult to price effectively. However, pools can be sustainable if they set prices that differentiate between the relative risks of various properties. Post-event surcharges can cover some of a pool's losses, with the government assuming the catastrophic losses. (US Congress CBO Paper 2005)

sharing, or as a negative feature if turns out that the private markets are unable to develop such risk-sharing structures for terrorism risks (OECD 2005).

Such policies will normally aim at achieving two major goals. First, they will help keep the economy going in the face of continued terrorist threats by supporting businesses to secure their products, by not hesitating to invest resources in R&D and future market development. And, second, they will strive to minimize the potentially severe economic disruption resulting from a future terrorist attack. Incidentally, such pool insurance policies consist of a triple layer of deductibles, the first paid by insurees, the second by insurers and the third by the pool when the government, the insurer of last resort kicks in. The coverage is ultimately incomplete because government liability is capped.

The government of the country exposed to terrorism risk possesses two broad policy options to lessen the economic risk: Enhancing insurance coverage against losses or investing in measures of mitigation to reduce the probability of loss and the probable loss itself. Typically, a combination is formulated knowing that these options are rich combinations of policies in themselves. Ideally, a benevolent government would invest in risk mitigation up to the point where the marginal benefit of additional mitigation (i.e. marginal fall in expected losses) is equal to the marginal benefit of insuring against that risk (i.e. marginal fall in economic disruption as a result of an attack plus other benefits accruing) and, also, equal to the opportunity cost of public funds. However, the reality of a government being somewhere in between Benevolent and Leviathan, an analysis of political incentives becomes critical in understanding the actual measures taken by a government. For example, the preemptive war initiated by the Bush administration in Iraq can not be explained by benevolence because, on the basis of existing evidence at the time of invasion in 2003, as the 9/11 Commission Report (2004)[13] showed, the expected marginal benefit of the war was well short of expected marginal benefits from other measures. As a war of choice, the Iraq invasion has been commonly dubbed as "a diversion in the war on terror"[14]. The Report thus suggests that the Bush administration was not exactly the benevolent government (Brown, Kroszner & Jenn 2002).

What exactly are the incentives for a government to invest in terrorism risk insurance? Since properly written terrorism risk insurance contracts will provide incentives for risk mitigation, a government will have to consider its reallocation of funds from risk mitigation towards insurance with the full understanding that government's role is to complement, if necessary, the private insurance markets and not to supplant them. The 2002 US Terrorism Insurance Act clearly demonstrated the primacy attributed to private markets by setting out a transitional plan yet ultimately supporting the functioning of the private markets by spreading the potential catastrophic losses as widely as possible

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[13] http://www.gpoaccess.gov/911/pdf/fullreport.pdf
[14] Senator John Kerry, Presidential Debate with President George Bush , Thursday, September 30, 2004

through government as the last resort insurer. In terms of government's net benefits, public funds committed to supporting private insurance markets may reap benefits in terms of less need to invest in risk mitigation due to increased insuree risk mitigation measures induced by insurance contract provisions. Private markets, as opposed to the government, would have strong incentives to efficiently tailor contracts to insurees and, also, to implement them credibly. Thus, political incentives would critically depend on this transmission mechanism, from government insurance support programs down to how terrorism risk insurance induces terrorism risk mitigation at the insuree level.

The incentives for risk mitigation provided by terrorism risk insurance contracts can be separated into two categories (Brown, Kroszner & Jenn 2002). First, there are incentives to invest in security measures (private intelligence, target hardening, security devices, etc.) to lower the current risk and, then, those that would affect the development of future policies and projects. The first type of risk mitigation measures might include an enhanced security presence that could deter an attack (such as perimeter protection, alarm and warning systems, redesigned installations, etc.) and collection of intelligence information that would help limit damage should an attack occur (such as a correct understanding of types of potential attacks and customized fortification). The second type of incentive for risk mitigation might influence decisions regarding the location, size and nature of future projects and the policies in general. These latter would replicate the former measures from amongst a much wider choice set, i.e. options unavailable in the short run would no longer constrain choices in the long run.

Related to intelligence, there is a tradeoff between efficient intelligence transmission and other government objectives. For instance, government procedures would normally discourage straightforward intelligence sharing as it could undermine the intelligence gathering itself and because granting some businesses enhanced intelligence information would be unjustifiably discriminatory. Intelligence sharing at the individual business level could also lead to panic through "word of mouth" propagation distortions and result in economic problems in case of a leak should a panic ensue. Thus, although an attack may not be prevented, government may be able to alleviate damage through inducing security measures at business levels which, in turn, may undermine terrorists' ability to carry out an actual attack. For example, the recent debate on terrorism compensation policy in the United States has focused almost exclusively on TRIA and TRIEA. Broader questions about whether insurance is the best mechanism for addressing terrorism risk have rarely been addressed(Dixon and Reville, 2005)

The Politics of Government intervention

The problem arising is, therefore, whether a non-benevolent government would be able to exploit the information advantage opportunistically when it intervenes in the insurance markets. This information asymmetry, if and when it exists, generates a dilemma for the government. Government unwillingness or inability to share information will typically undermine terrorism insurance markets (Rowlands & Devlin 2006) simply because markets won't be able to price the risk appropriately. However, failing insurance markets are potentially costly to the government simply because, should an attack occur, government's refusal to engage in remedial action and compensation is not a credible threat to force a reactivation of insurance markets. Moreover, since the government plays a unique, unavoidable and probably exclusive role in mitigating terrorist risks, reelection-concerned politicians will have the incentive to invest in the proper level of loss control, surely ex post but, to a certain extent, ex ante as well[15]. Thence, more mitigation reduces the likelihood of having to make politically unpopular compensation decisions like raising taxes or cutting other spending, or producing larger deficits after a terrorism loss[16]. In case government investment in loss control and risk mitigation is low, a wide range of business activity could be put on hold, scaled down or cancelled as potential providers of financing may simply be unwilling to expose their capital to terrorism (Brown, Kroszner & Jenn 2002). Thus a federal insurance backstop in place in advance provides for the timely and orderly payout of claims to the victims of terrorism, thereby minimizing the economic fallout from a possible terrorist attack. This assurance about ex post economic safety ought to generate ex ante economic confidence and, as a result, some motivation to re-election concerned decision-makers.

The intervention in insurance markets could be seen from a slightly different angle as a counterterrorism measure in the broadest sense "as it does not directly deter attacks, but does reduce the ability of attacks to cause fear, which reduces their effectiveness" (Dixon et al. 2004). The important premise for any intervention in insurance markets, either by providing the backstop or subsidizing insurance, is that the expected loss is no longer exogenous to government decisions. Thus no intervention ceases to be an option as government security policies influence the expected loss. For example, ex ante pre-funded mechanisms will aim at providing more efficient and rapid allocation of the compensation funds, so by helping the economy recover after an attack, government can reduce economic vulnerability to terrorism.

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[15] Risk mitigation through prevention, the hardening of targets to minimize losses arising from an incident, and effective remediation, all involve investments that are costly.

[16] Of course, an argument for government intervention is the Samaritan's dilemma noted earlier: Many subjects in the economy will rationally forgo insurance since they believe the government will bail them out after a major loss. In theory, subsidized government insurance could encourage some "freeriders" without insurance to purchase insurance before a loss actually occurs. Many households and firms, though, may continue to assume that the government will bail them out even if they don't buy insurance. Still, subsidized insurance should increase coverage if some participants believe that they can get a better deal relative to the free bailout (Smetters 2004).

The ongoing discussion assumes non-benevolent governments. Of course, the truth being somewhere between benevolence and non-benevolence, governments partially motivated by social welfare objectives would aim at internalizing the public bad externalities of terrorism risk by providing the risk-spreading service against large losses as insurer of last resort. Thus, in general terms, insurance and compensation for terrorism losses have implications for national security. This link with national security is typically absent from insurance and compensation policy for other disasters, such as earthquakes and hurricanes. As a general rule, the provision of national security is an accepted role for government. Thus the connection of terrorism compensation and insurance policy with national security provide another rationale for public involvement in markets for terrorism insurance. (Dixon and Reville 2005) But we are not going to limit our framework for further analysis only on this - For an extensive discussion of the challenges of insuring terrorism, see Kunreuther and Michel-Kerjan 2004a, 2005. For a discussion of other issues and options that should be considered in discussion of government interventions in the market for terrorism insurance, see Dixon et al. 2004 and Kunreuther and Michel-Kerjan 2004. In general, the above mentioned research states that the compensation system can alter incentives to reduce physical vulnerability to terrorism.

As RAND suggests, based on their research, no broadly accepted standards for protecting against terrorism attacks currently exist in the private sector, and interdependencies between firms and national security ramifications make it very difficult to determine the appropriate risk mitigation and security measures. Some progress might be made on identifying the appropriate types of security measures by developing national security standards through a public process that weighs the broad social and national security implications of different standards. At one extreme, firms could be required to adopt such standards as a condition of buying terrorism coverage. Alternatively, the standards could be voluntary, and insurers could be allowed (or perhaps required) to provide premium discounts to firms that adopt such practices. (Dixon and Reville, 2005)

Intervention is, as we have seen above, strongly supported on political and economic grounds, but the politics of intervention complicates the simple analysis. The politicians have to balance the national security and economic considerations in order to find the right portfolio of measures available to them in order to counter the threat of terrorism as well as maximizing their re-election prospects. Government involvement will undoubtedly reduce the impact of an attack and also deter potential terrorist actions by internalizing the public bad.

The portfolio of measures at government disposal can be classified into four groups, the first without "direct" involvement with insurance markets and the rest right through (see

Figure 2 above). First, as part of what is normally called public protection, government can enhance intelligence activities and security measures. These latter could be target-hardening as ex ante deterrence and preemption based on intelligence information. The legislation based enforcement is an ex post measure but its consistent and persistent application reinforces ex ante deterrence. Second, government may opt for insurance subsidies (preferably through insurers so as to minimize transaction costs), an explicit policy as insurer of last resort and an implicit understanding that it will remedy losses beyond just public infrastructure should a terrorist attack result in catastrophic loss. Third, insurance markets can be bypassed through direct security standards that, indirectly, reduce insurer liabilities upon loss or simply through reducing the likelihood of terrorist attacks. This standards-based approach reallocates liabilities by imposing due care standards onto industry. Finally, long-term root-cause measures against terrorism risk, such as winning over constituencies that might otherwise support terrorist groups, would lower expected losses by lowering the incidence of terrorist cell formations.

Although these instruments are substitutable in the long run, their short-run substitutability is debatable. For instance, public protection and insurance market intervention tend to be complements where terrorism risks persist and hence insurance demand is high, in which case the two policies are to be implemented in tandem. Since the presence of terrorism risk (a public bad) characterizes a second-best world, further investment in public protection would be welfare-enhancing provided it is not outweighed by a reduction, at the margin, in loss control through insurance.

If insurance and self-protection were to be substitutes from the perspective of the individual firm, a policy aimed at encouraging the purchase of insurance will discourage self-protection. Understandably, government insurance subsidies may induce moral hazard. However, well-functioning insurance markets ought to alleviate the moral hazard problem through properly designed contracts conditional on self-protection measures. Questions regarding such an insurance market distortion through subsidies must, however, be assessed taking into account the fact that the initial situation is a second-best world induced by terrorism risk, the public bad. Thus put into context, subsidies may be optimal provided potential government failures do not outweigh the welfare-enhancement through a reactivated insurance market. Therefore, even in the presence of public protection, some amount of insurance subsidization remains optimal. Moreover, in many important cases, subsidies and public protection are actually complements (Lakdawalla & Zanjani 2004).

The opportunity cost of insurance intervention and the cost of non-intervention

It is argued that lack of terrorism coverage increases the variance of corporate cash flows, notably in the construction and real estate, transportation, and tourism industries.

This increase in volatility leads to an increase in the cost of capital, a reduction in supply, and therefore adverse macroeconomic consequences. Given that there may be grounds for government intervention at the extreme tail of the loss distribution, the question arises what would happen if the government in fact did nothing. In the US, Hubbard and Dean (2004) have argued that removal of the government subsidy granted by TRIA will lead to a annual GDP loss of 0.3%-0.4% in perpetuity. The Hubbard and Dean study assumes that if the government subsidy is removed, terrorism insurance will continue to be offered, but the premium rate will double. This doubling of the rate leads to a) a reduction in consumer wealth and hence a reduction in consumption; b) an increase in the cost of capital and hence a reduction in investment; c) an increase in the cost of labor and hence a reduction in employment.

The analysis of Hubbard and Dean, however, can be challenged on both empirical and theoretical grounds. On empirical grounds, a doubling of terrorism premiums following removal of the subsidy seems highly unlikely. The Hubbard and Dean conclusion of a premium doubling in the absence of TRIA is also contradicted by the detailed expected loss analysis by the ISO. Based on work by their modeling arm AIR, ISO divides the US into 3 risk tiers, with distinctly different degrees of reliance on the TRIA subsidies[17]. ISO calculated for 2005 that the government premium subsidy provided by TRIA was 30% in Tier 1, 5% in Tier 2 and zero in Tier 3, see, for example, CFA (2004). These numbers will have been further reduced by the unexpectedly large growth in premiums, so that the only tier likely to be affected in any material way by the government subsidy is Tier 1, and even here, withdrawing this subsidy would only cause premiums to go up a maximum of 40%. Thus the Hubbard and Deal premise of a premium doubling seems to be upward-biased. Regardless of the magnitude of the subsidy, however, the analysis in Hubbard and Deal seems flawed on the grounds of basic economic theory. Any increase in premium is not a loss to society but is rather a transfer from the wealth of the stock holders of the insured company to the stockholders of the companies providing the insurance. If investors are optimally diversified, this is the same person, so this is a wash. If investors hold consequences, but these will be second order. By the same token, the Hubbard/Deal study provides no analysis of the effect of the subsidy on the taxpayer who provides the resources. As noted by the CBO (2005b). "Indeed, the cost—in terms of risk and uncertainty— of having the federal government provide terrorism reinsurance is approximately the same as the cost of having the private sector provide it. With a Federal program, however, that cost is shifted from shareholders of insurance companies and owners of commercial properties to taxpayers."

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[17] Tier 1 High Hazard—New York, San Francisco, Washington, D.C., Chicago; Tier 2 Moderate Hazard—Boston, Seattle, Los Angeles, Houston, Philadelphia; Tier 3 Low Hazard—Remainder of U.S.A.

Optimally, the net marginal benefit of government security policy must be equal to the net marginal benefits of other government policies and, also, equal to the marginal cost of public funds. This general statement must, however, be qualified by potential hijacking of policies in a world where public choice considerations affect decisions beyond the comparison of net social benefits and towards individual and group benefits.

For instance, if the government cannot correct failures in the market for protection, it can improve welfare by manipulating the price of insurance which would affect the private demand for protection. Where insurance and self-protection tend to be complements, insurance subsidies would correct underprovision of self-protection[18], as opposed to spending in public protection to mitigate terrorism risk[19]. However, as we saw above, the increase in insurance will discourage investments in self-protection if the two are substitutes.

A persistent terrorism risk implies, ceteris paribus, that the owners of assets at risk should adopt measures to reduce their losses, for example by hardening the target through investing in security systems. By subsidizing insurance, the government would weaken their investment incentives unless insurers imposed compensating incentive contracts. However, the government could take steps to reduce the adverse effects that subsidies has on mitigation activities. Charging premiums for reinsurance would internalize moral hazard by inducing insurers to offer steep incentives to insurees. The 2002 US Terrorism Risk Insurance Act envisages no premia for government reinsurance but the deductibles and the cap on coverage substitute for premia. Thus insurers bear the initial losses in return for a reduction in potential total loss. The government bears the risk of losses over a certain amount that ought to reflect insurers' resource constraint.

The possibility of insurance and self-protection being complements (since neither policy can completely eliminate the public bad externalities, it makes sense to pursue them together) creates a favorable environment where insurance subsidies will encourage self-protection. For example, if insurance companies provide information to private agents that allows them to target their own protection better, then policies that increase the take-up of terrorism insurance and lower its price will also boost self-protection. These measures might include offering subsidies for the purchase of terrorism insurance or providing more risk sharing within the insurance industry in the form of lower "deductibles" for insurance companies, or considering mandatory requirements for companies that own or operate systems vital to the functioning of critical infrastructure to carry adequate levels of insurance. With lower individual company deductibles, if the

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[18] A Pigouvian tax is a tax levied to correct the negative social side-effects of an activity. Unlike most taxes, which are inefficient because they result in a deadweight loss, Pigovian taxes improve overall economic efficiency.

[19] A budget-balancing subsidy raises insurance consumption, because its only direct effect is to lower the marginal cost of insurance.

entire industry's backstop remains the same, the price of terrorism insurance is likely to fall without increasing costs to taxpayers (RAND. 2005).

OPTIMAL GOVERNMENT INTERVENTION

Here we consider two issues.

A. Should Government Support be Permanent or Temporary?

In some countries e.g. Spain, and the UK, government support for the terrorism industry is permanent. In other countries, e.g. the US, France, and Germany, the enabling legislation contains sunset clauses. This raises the question of whether government support should be permanent or temporary. In policy discussions, this question has unfortunately been answered with an apparently reasonable but actually false argument that since the threat of terrorism has now become permanent, so should a government subsidy. Indeed if we agree with the many terrorism experts who do believe that we will live under the threat of global terrorism for many years to come, this is all the more reason for making a subsidy temporary. The provision of permanent government subsidized reinsurance removes all incentives for the private sector to develop alternative risk transfer mechanisms13 and all but guarantees that the private sector will never be able to handle mega catastrophes. What is needed are measures designed to encourage financial innovation by the private sector, and this requires sunset provisions on subsidies. On the other hand, even if private insurers and reinsurers develop financial instruments to cope with a $100b loss, it is unreasonable to suppose that the loss itself will not be disruptive. In equity security markets, for example, there are circuit breakers to slow trading on days of large losses, and in money markets, the Central Bank stands ready to deal with losses due to runs on commercial banks. Responsible governments, therefore, need to stand ready to deal with the surplus depletion which would inevitably follow a mega loss. But this does not at all require that governments offer free reinsurance.

Jaffee and Russell (1997) argue that the fundamental problem caused by catastrophic loss is a temporary difficulty in raising new external capital to remedy which, all that is needed is for a government to state that it is prepared to make temporary funds available, acting to the insurance industry as a lender of last resort, a role which governments have long played with respect to the banking system.

B. Should Government Support be Free or Priced?

How a government raises the funds to provide this capital is a standard problem in public finance, but again by analogy with central banking, there is no reason why a loan should be free to the recipients. The arguments for providing risk transfer at prices which reflect the underlying probabilities of loss are very powerful. Not only does risk based pricing provide the correct incentives in choosing risky projects, it also provides

the correct incentives with regard to mitigating the loss. It is therefore surprising that governments which support the provision of terrorism insurance typically do not apply risk-based pricing, and in the US, there is no pricing at all, TRIA relying instead on taxes and levies on general insurance as a source of funding.15 The shifting of the burden to the general taxpayer is facilitated by the fact that this item is off budget. Again the analogy with central banking is worth considering. Central banks stand ready to provide liquidity, but at a price (the discount rate) and under strict conditions. Nothing in this precludes the existence of a private market in liquid funds, and in fact the Federal Funds market serves this role. Comparably, a government agency could be charged with making capital available to the private insurance and reinsurance market under strict conditions, one of which would be that the loan was temporary, and a second of which would require the loan to be priced. With these conditions, nothing would prevent the existence of a private markets which would perform the same function.

One argument sometimes raised against risk-based pricing of terrorism insurance is the difficulty of assessing the probability of loss. There are, however, at least two responses. First, the government could auction access to its reinsurance facility, thus allowing the market participants to determine the price.17 Second, when acting as a lender of last resort, a government which wishes to charge the market rate does not need to assess terrorism risk, only the credit risk, i.e. if it makes a temporary loan to an insurance company, how likely is it that the loan will be repaid? Credit risk is not independent of terrorism risk, in that another attack would place a strain on an insurance firm's ability to repay a loan, but following 9/11 no major insurance company went into bankruptcy suggesting that credit risk may be quite low.

In this paper we have argued that private insurers are capable of handling terrorism losses up to the magnitude of those incurred on 9/11. In the US, this fact underlies the structure of the TRIA government subsidy program, which now provides no support for industry losses at or below the $39b magnitude. Moreover, we have argued that, to first order, even if terrorism insurance became unavailable, the equity market alone would provide enough of a risk transfer mechanism, the decisions by large widely held firms being largely unaffected. The benefits of insurance flow primarily from the distortions brought about by agency problems and tax favoring of debt. Thus, in our view the case for a permanent program of government support to the insurance industry has not been made. On the other hand, the large transfers of ownership of capital which a terrorist attack would inevitably cause, will put a temporary strain on financial markets, and there are valid arguments for governments taking steps to ease this strain. This can be done most easily by a permanent program which provides temporary loans to the insurance industry until such time as its surplus is replenished. Put simply If these loan are offered at a market rate reflecting credit risk, all the benefits of risk-based pricing continue to flow.

4. CONCLUSIONS AND EXTENSIONS

Governments possess various but interacting policy options. For one, if insurance and self-protection are substitutes, moral hazard exists where an increase in insurance availability due to subsidies will discourage investments in self-protection. If they are complements then the policy suggestion is reversed. Thus an efficient response must be based on an exact estimate of the empirical relationship between insurance and self-protection. For another, public protection produces public goods or, at worst, serious positive externalities. It is then likely to be a substitute for self-protection and, thence, to generate moral hazard. However, an intimately related empirical question is whether such positive externalities generated outweigh the substitution effect. Further research is needed to understand the extent to which politicians are willing to subsidise insurance or directly invest in deterrence capabilities.

Although government provision of incentives to take precautions may (or may not) reduce vulnerability to attacks, alternative policies that reduce panic, social fragmentation, economic uncertainty, or economic ripple effects will reduce the impact of terrorist attacks (Dixon et al. 2004). "The advantage of having a clearly defined policy in place prior to a terrorist event is that such a policy can be formulated in a manner that fosters economic incentives for firms and individuals to take efficient preventative measures, sharing the responsibility for preparedness. Moreover, a predefined policy ensures that participants and victims of different attacks are comparably treated … an existing structure can also help to speed compensation to companies, thus eliminating a possible financial loophole in their budget" (Brown, Kroszner & Jenn 2002). Long-standing and ongoing investments could assure the public that steps are made towards risk mitigation and better loss control. However, since public confidence can never be taken for granted after a major terrorist act, public officials could start from a credible foundation built upon a cooperative effort to incorporate safety into every aspect of the society. A quick compilation of lessons learned in the immediate aftermath of an attack is further reassurance that corrective actions are forthcoming.

A few essentials for policy-makers are in order. First and foremost, in a highly charged political context and with powerful interests lobbying, all policy comparisons with limited resources will be contested. Second, the effectiveness and the opportunity costs of specific policies need to be thoroughly evaluated. Third, policies need take into account both resource gaps and governance gaps. Thus, security (ex ante) and aid (ex post) provisions need be formulated simultaneously. Finally, policies should evaluate and address incentive structures and, hence, the policy transmission mechanisms. Lest we forget, terrorists are not irrational or simply hateful.

The long-term availability of affordable terrorism risk insurance to safeguard the assets of businesses is a crucial productive input into economic growth as a fundamental incentive to invest is the safety of returns. Best seen in international investment debates, risk-averse investors will ask for a premium against risk. Terrorism creating worst uncertainties, one of the major factors facilitating economic growth is the provision security against terrorist risk inflicted on businesses. However, from the current situation, a couple of stylized facts seem to emerge. First, there does not appear to be strong evidence that private insurers will be able to provide significant relief from terrorist risks on their own. One of the constraints on a more efficient terrorism insurance market is the absence of information, which constrains both insurance purchasers from choosing the best mix of risk management tools as well as insurance companies seeking to establish the appropriate pricing and conditions for different contracts (Rowlands & Devlin 2006). Second, there seem to be a number of compelling reasons for government to remain a key actor in mitigating the risk. The government can choose any one or a combination of three main directions: Through subsidies or reinsurance backup, by sharing of intelligence information with the insurers or by being there as insurer of last resort in the case of a loss larger than what the private insurance market can handle.

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Many companies that suffered the 9/11 attacks were actually covered against their losses. Reinsurers, most of them European companies, were responsible for about two-thirds of these losses. Having their capital bases severely hit, most reinsurers decided to reduce their terrorism coverage drastically or to eliminate it. Thus, in the immediate aftermath of September 11, 2001, insurers in the U.S. and other countries found themselves with significant amounts of terrorism exposure from their existing portfolio, with limited possibilities of obtaining reinsurance to reduce the losses from a future attack. The few insurers that continued to provide coverage to their clients charged very high prices. The result of such changes, as remarkable as it now seems, is that one year after 9/11, when national security had became the priority number one on the U.S. national and international agendas, the country's commercial enterprises remained largely uncovered at home (Hale, 2002). If another large-scale attack had occurred at that time, the impact on the economy would have been much more serious. This time the economic losses would not have been spread over a large number of insurers and reinsurers worldwide but, in the absence of massive government funding, sustained by the firms themselves.