Optimal Liability for Terrorism[*]

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Abstract

This paper analyzes the normative role for civil liability in aligning terrorism precaution incentives, when the perpetrators of terrorism are unreachable by courts or regulators. We consider the strategic interaction among targets, subsidiary victims, and terrorists within a sequential, game-theoretic model. The model reveals that, while an 'optimal' liability regime indeed exists, its features appear at odds with conventional legal templates. For example, it frequently prescribes damages payments from seemingly unlikely defendants, directing them to seemingly unlikely plaintiffs. The challenge of introducing such a regime using existing tort law doctrines, therefore, is likely to be prohibitive. Instead, we argue, efficient precaution incentives may be best provided by alternative policy mechanisms, such as a mutual public insurance pool for potential targets of terrorism, coupled with direct compensation to victims of terrorist attacks.

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1   Introduction

The four years since the September 11 terrorist attacks have wrought monumental changes. In addition to its staggering human toll, 9/11 effected a profound transformation in America's priorities concerning national security, civil liberties, and the role of law. The attacks set into motion a social and political reshuffling as dramatic as any that this country has witnessed in the post-war era. Much of this upheaval continues to play out today.

Early policy debates after September 11 addressed immediate exigencies, ranging from the appropriate governmental role in compensating those suffering losses,[1] to ensuring homeland security,[2] to the appropriate trade-off between national security and civil liberties.[3] While these concerns remain significant today, a new issue has emerged: the proper role of liability. Literally hundreds of individual claimants have opted out of the victims compensation fund (VCF),[4] and are currently pursuing their claims in federal court. Under the Air Transportation Safety and System Stabilization Act (which also created the VCF itself), any court adjudicating the cases of opt-outs must apply principles drawn from state common law.[5] The historical rarity of similar terrorist acts in the U.S. has placed significant strains on courts deciding how to extend existing common law principles to the terrorism context, making the resulting litigation relatively unpredictable. Despite this unease, a significant amount of terrorism-related litigation is currently moving through the legal system. As recently as October 2005, for example, a civil jury in New York found the Port Authority principally liable

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[1]See, e.g., the Terrorism Risk Insurance Act of 2002, 116 Stat. 2322, P.L. 107-297 (Nov. 26, 2002).

[2]E.g., the U.S. Patriot Act, H. R. 3162 (2001) (codified in scattered sections of Title 18 of the U.S. Code).

[3]Three recent (and important) Supreme Court cases have centered on this question. See Rasul v. Bush, 542 U.S. 466 (2004); Hamdi v. Rumsfeld, 542 U.S. 507 (2004), and Rumsfeld v. Padilla, 542 U.S. 426 (2004).

[4]See Virgilio v. City of New York, 407 F.3d 105 (2nd Cir. 2005) (holding that litigation and claims under the VCF are mutually exclusive, and that any party who makes a claim under the VCF waives all potential civil liability claims, except possibly against the terrorists themselves).

[5]See Air Transportation Safety and System Stabilization Act § 408(b)(2), Pub. L. No. 107-42, 115 Stat. 230 (2001) (codified at 49 U.S.C. § 40101). The Act also contained a provision capping exposure of airline defendants in any civil action to the level of insurance carried by the airlines. Id at § 408(a). Later, similar caps were imposed for the city of New York, aircraft manufacturers and persons with a proprietary interest in the WTC. See Aviation Security Act § 201(b), Pub.L. No. 107-71, 115 Stat. 597 (Nov. 19, 2001).

for deaths and injuries resulting from the 1993 truck bomb that detonated in the basement of the World Trade Center.[6]

Consequently, the policy issues underlying post-terrorism litigation deserve immediate and reasoned consideration, if only because they have now pressed themselves upon us. Unfortunately, these issues have thus far received paltry attention in the emerging literature on terrorism risk. This paper attempts to fill that void, exploring whether and how civil liability might play an important policy role in the wake of the 9/11 attacks, and in anticipation of others like them.

On first blush, civil liability seems an odd vehicle for addressing the harms stemming from terrorism, particularly since the agents most directly responsible—terrorists themselves—are usually beyond the reach of civil and criminal courts. If the law is unable to provide effective incentives for those who cause harm, common sense would suggest civil liability is a poor institutional choice. Indeed, even though litigation is capable of accomplishing other goals such as spreading risk, without a meaningful deterrence role litigation is a weak substitute for more direct insurance mechanisms (which are capable of spreading risk more efficiently).

Closer inspection, however, yields a more complex view of liability's role. While the threat of liability often cannot deter terrorists directly, it can shape the incentives of those who experience harm. For example, the threat of legal liability may induce various types of 'targets' (such as bridges, buildings, public fora, and attractions) to alter their precautions on behalf of licensees, permittees, and other bystanders likely to be affected when a target is successfully attacked. Moreover, compensation through liability can influence individual "passers-by" in their decisions about whether to venture out into public fora, where to congregate, and how to protect themselves if exposed. Finally, the credible threat of liability may affect the strategic interaction among targets that "compete" to avoid the attention of terrorists. Because terrorism is a central locus for numerous precautionary activities in the

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[6]The case is now proceeding to the damages phase, where the Port Authority will face joint and several liability exposure. See New York Times, Port Authority Found Negligent in 1993 Bombing, Section A, Page 1, Column 6 (October 27, 2005).

face of a collective risk, it is perhaps less surprising that courts are seriously entertaining the viability of these claims.

In this paper, we ask whether and how civil liability can improve incentives to take precautions against terrorism. To frame the discussion, we introduce a formal, game-theoretic model of behavior in which terrorists, potential targets, and other collateral victims all take the legal system as a given and take actions that maximize their own individual expected welfare. (We assume throughout that terrorists are beyond the reach of the civil courts.[7])

Our analysis suggests that, while it is possible to envision a liability system that promotes fully efficient precautionary incentives, its contours would tend to diverge substantially from existing doctrinal templates in at least three ways. First, the "flow" of damages payments may differ considerably from what seems plausible under existing tort law: for example, we demonstrate that under relatively general assumptions, an 'optimal' liability regime would not allow bystanders to recover against a damaged target for their injuries; however, such a regime might well allow the affected target to recover against affected bystanders. Second, an optimal liability regime would allow damaged targets and unaffected targets to sue one another, and, under plausible assumptions, would allow *unaffected parties* to state a claim for damages against affected targets. Finally, under an optimal liability regime, it is generically the case that the amount of damages defendants would pay need not coincide with the actual harm suffered by the plaintiff, and might prescribe damages even if the plaintiff has suffered no harm.

From a pragmatic perspective, the unconventional forms of liability that our analysis suggests likely render an efficient civil liability regime an unattractive and politically infeasible approach, particularly if some alternative mechanism could provide similar incentives. Therefore, we argue that a more direct and plausible mechanism for efficiency would be a

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[7]We also assume that the state plays a limited role of establishing the applicable legal doctrines (and potentially helping to underwrite public insurance). In particular, we do not inquire whether the liability/insurance landscape affects governmental policy decisions that may affect terrorist activity. See, e.g., Levmore and Logue (2003), who argue that such exposure, in the context of terrorism, is unlikely to have significant effects on governmental action ex ante.

form of social insurance (not unlike the 9/11 victims' compensation fund, but without the ability to opt out). Indeed, such a scheme would more naturally decouple compensation from harm (Choi and Sanchirico, 2002), and would have the added benefit of spreading risk more efficiently than liability.

1.1   Basic Intuition

While the formal analysis appears later, it is worthwhile to explore the intuitive underpinnings of our argument here. There are three sets of externalities presented by terrorism. Addressing them all would create an unwieldy and likely infeasible liability regime, but failing to correct them all leaves inefficient decisionmaking in place.

The first externality is the conventional one that a target (such as the owner of an office building) may not do enough to protect a collateral victim (such as a passer-by) who might be injured in the event of an attack. On its own, this motivates the most intuitive form of liability rule, in which a target owes a duty to compensate a collateral victim. If the building is an efficient harm-avoider, such a liability rule encourages the building to take due care in ensuring the safety of those inside and around it. If this were the only incentive problem, the solution would be standard and straightforward.

However, the strategic behavior of terrorists subverts the effectiveness of this simple liability rule. Since terrorists' payoff likely increases in the number of casualties they inflict, collateral victim patronage increases the risk faced by targets. Patrons, however, do not account for the way their actions "draw fire" onto targets or each other. The result, even in the absence of any liability rule, is inefficient over-patronage of targets by victims. Introducing liability payments from targets to victims generally exacerbates this externality. Therefore, while there may be corrective justice or insurance rationales for compensating individual passers-by, and reasons to encourage targets to invest in safety, decoupling these transfers from one another may well be efficiency-enhancing.

Moreover, strategic terrorists also create incentive problems that involve targets' interactions with one another. The simple liability rule posited above does not correct this problem. If terrorists are strategic maximizers, then the protection decisions of one target can significantly affect the risk faced by others, even if thousands of miles away. For example, erecting a new building in a high-risk zone will "draw fire" away from other structures, yielding benefits to their owners. Conversely, a decision by an existing target to self-protect by hardening itself may make other buildings more attractive targets. As a result, targets under threat from terrorism might either overinvest or underinvest in protection. If liability is to address these incentive problems, it must afford legal claims between affected targets and unaffected targets.

Given these incentive problems, we find that the optimal liability regime[8] has three key features. First, it forces targets to internalize the losses of individual victims, but optimally redirects all of those payments to a third-party (in the case of our model, unaffected targets). Redirection avoids exacerbating the over-patronage problem. Second, it forces victims to pay for the risk they draw onto targets and each other, but also redirects at least some portion of these payments toward third parties. Finally, it requires targets to internalize any externality risk they impose upon one another (and their respective populations of individual victims). The combination of legal actions that would support the above set of transfers, as noted above, would present significant implementation difficulties within our current court system.

Our analysis contributes to the literature in a number of ways. Most centrally, it builds on a growing literature concerning terrorism externalities and, more generally, crime externalities. Several authors have observed that investments in observable crime-prevention or passive avoidance of crime-ridden areas shifts crime risk onto others (Clotfelter, 1978; Shavell, 1991; Hui-Wen and Png, 1994; Freeman et al., 1996; Hakim and Rengert, 1981; Mc-

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[8]By *optimal,* we implicitly wish to convey something less than first best – in which the terrorist's activity level could be directly controlled by the courts/regulatory system. Our benchmark for social optimality, then, is whether the liability system can implement activity levels by victims and targets that are socially optimal constrained by the impossibility of regulating terrorist actors.

Namara, 1994; Newman et al., 1997). These negative externalities to protection are perhaps even more pronounced in the context of terrorism (Woo, 2002b; Lakdawalla and Zanjani, 2005).

Complicating this strand of analysis is the existence of important positive externalities. Ayres and Levitt (1998) have pointed out that *unobserved* protection against crime may also have positive spillovers, since others in a close proximity may also benefit from precautionary acts. Similarly, Kunreuther and Heal (2003) have discussed the case of "interdependent security," where self-protection by one target directly reduces risk for others. For example, effective baggage screening by one airline lowers risk for all other airlines to which a passenger might connect. In addition, Keohane and Zeckhauser (2003) have noted that if terrorists prefer to strike densely populated targets, avoiding such areas has positive externalities. While these and related observations have also been applied to the study of terrorism insurance (Gron and Sykes, 2002; Lakdawalla and Zanjani, 2005; Levmore and Logue, 2003) and public policies to deter terrorism (Powell, 2005), the literature has not specifically considered the appropriate role for liability alongside (or in lieu of) insurance. We attempt to fill that void here.

Our analysis also contributes to another strand of literature in law and economics, which concerns the difficulty of using liability rules to regulate non-contractible "cooperative" investments among self-interested parties (e.g., Holmstrom, 1982; Che and Hausch, 1999). In such contexts, it is frequently impossible for simple liability schemes to induce efficient investments absent some mechanism that "busts the budget" between the investing parties – i.e., a joint tax in the event of a loss and/or a joint subsidy in the event of a gain.[9] Although a popular theoretical mechanism for busting the budget in litigation contexts is through "decoupling" (e.g., Polinsky and Che, 1991), where the defendant's payment may be larger or smaller than the plaintiff's recovery, it is often difficult to implement in practice. Our

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[9]See, e.g., Cooter and Porat (2002) (exploring the notion of "anti-insurance"), or Schwartz and Watson (2001) (exploring renegotiation costs as a potential source of efficient commitment in contractual settings).

analysis reveals that complex litigation may function as a form of "stealth" decoupling without requiring additional apparatus to bust the budget. In settings involving an *overlapping series of multi-sided investments,* complex litigation may provide a way to "decouple" the rents created/destroyed within a particular multi-sided investment, redirecting them in the form of damages to another party to the litigation (who plays no role in the joint investment problem at hand, but might in others). In some situations (such as the framework we study), an optimal system of budget-balanced, *strict liability* payments exists, even though such a system would be suboptimal were we to constrain our analysis to a single joint investment problem within our framework.

1.2 Caveats and Preview

There are two caveats to our analysis that deserve explicit mention before proceeding. First, we abstract from the effects of risk-aversion by considering risk-neutral actors. Although this assumption simplifies our technical analysis considerably, there are other, more substantively central, reasons for it. If liability is to play a role independent of public and private insurance provision, it must be by improving the incentives of actors who might otherwise externalize costs and benefits onto others. Risk-aversion would produce an additional insurance "rationale" for a liability regime, but it would be a spurious one, as this role is best played by an active insurance market. In our estimation, then, the unique role of legal liability should be to shape incentives, while the insurance market is the best vehicle for spreading risk.

The second caveat to our analysis is that we assume terrorists to be beyond reach of the courts. To be sure, there may be some situations where perpetrators of terrorism are subject to civil or criminal litigation, such as the convictions of Oklahoma City domestic terrorists Timothy McVeigh and Terry Nichols, or the recovery against the Libyan government for the PanAm bombing over Lockerbie, Scotland. Although adding this possibility would be

relatively simple, we have chosen not to do it for three reasons. First, it is inconsistent with what most believe to be the most central and salient characteristic of *most* (though certainly not all) terrorist acts: the lack of effective jurisdiction over those most responsible for the harm.[10] Second, even if some of the assets of terrorists were reachable through the tort system, they are likely to be limited relative to the size of the harm, effectively making terrorists judgment-proof. Finally, even if terrorists' attachable assets were significant, there would be little of interest left to study here, since the resulting framework would lend itself to a more standard economic analyses of tort law (Shavell, 1987).

Our analysis proceeds as follows. In Section 2, we briefly explore the relevant legal issues surrounding terrorism litigation, and conclude that two sorts of civil liability claims seem at least plausible (though still highly uncertain) under common law tort templates: Victims (such as bystanders and owners of nearby structures suffering collateral damage) might sue attacked targets for inadequate precaution; and attacked targets themselves might sue un-affected targets for "excessive" precautions. Other types of claims range from exceedingly speculative to absurd, and therefore would probably be unavailable under existing tort principles. In Section 3, we then move to characterize the socially efficient liability regime in this environment. We demonstrate that while there exists a scheme that replicates the social planner's optimal allocation, it necessitates transfers that are starkly inconsistent with the forms of liability that appeared plausible in Section 2. We illustrate, nevertheless, that such transfers can be replicated (perhaps more plausibly *and* efficiently) outside of the judicial system, through public and private insurance schemes. Section 4 considers various caveats and extensions to our analysis, while Section 5 concludes. (An Appendix to this article contains the proofs of the various claims).

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[10]It should be noted that currently, a civil lawsuit brought by survivors of the 9/11 attacks is moving forward against alleged financiers Osama Bin Laden's al-Qaeda terror network and Afghanistan's former Taliban regime. Those accused include the country of Sudan, three members of the Saudi royal family, various Islamic charities, along with seven financial institutions and the Bin Laden family's Saudi construction firm. Even if this suit ultimately succeeds (on vicarious liability grounds), it is doubtful that in general the financiers of terrorism are well placed to monitor and deter terrorists themselves.

2 Terrorism and Tort Law

As noted in the introduction, the 9/11 litigation has constituted an open invitation for courts to play precedent-setting roles in determining how and whether to allocate private action recovery rights in the wake of a terrorist act, when the terrorists themselves are beyond the legal system's sphere of influence. Our economic analysis demonstrates that the optimal liability regime involves unusual combinations of plaintiffs and defendants. This section explores the doctrinal grounds for those possible claims, and whether or not they would be likely to succeed under existing tort doctrine. We consider four types of civil litigation: (1) suits brought by harmed individuals (such as bystanders) against affected targets (such as buildings); (2) suits brought by targets against one another; (3) suits brought by targets against harmed individuals; and (4) suits brought by unaffected targets against affected targets.[11] We conclude that there may well be good precedential analogies for the first type of action, and perhaps the second; however, the third and fourth are decidedly poor fits within modern American tort law, which may thus preclude the implementation of the optimal liability regime.

2.1 Harmed Individuals Against Attacked Targets

Perhaps the most conventional form of liability claim comes from harmed individuals (or their heirs) against the targets of terrorist attacks, alleging inadequate precaution. The kernel of each of their claims would be, in essence, a common law tort claim consisting of establishing that the target owed a duty to take reasonable steps to protect the safety and well-being of victims; that the target breached this duty; that this breach caused actual and foreseeable harm to the victims; and that such harm can be capitalized into provable

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[11]As noted above, we are excluding claims against terrorists themselves and the government. See supra TAN __-__.

damages.[12]

Some of these elements are likely indisputable in the wake of a terrorist act. For example, the damages suffered by the various victims of the 9/11 attacks have been well-documented, estimated (conservatively) to be just under $10 billion. Moreover, assuming it were well-understood how (and whether) terrorists respond to precautions, one could likely articulate a reasonable standard of care for target-level precautions, and perhaps even make plausible inferences about whether a failure to undertake them caused the victims' injuries.

One could imagine, however, that plaintiffs might face a more strenuous challenge in demonstrating that a target's "duty" would extend to terrorist acts (as opposed to general issues of building safety). Because it is an issue of law, demonstrating a lack of a cognizable duty is perhaps one of the strongest weapons that defendants have available in disposing of litigation. Indeed, many courts are unwilling to allow cases to go forward in discovery and litigation until the plaintiff establishes that a duty exists. Although courts have traditionally conceived of duty relatively loosely, state courts have recently begun to constrain the universe of contexts in which a defendant owes a duty to potential victims. For example, a recent strand of cases has begun to limit the application of duty to risks that are not reasonably foreseeable.[13] Another strand of recent cases have eliminated the concept of duty from situations that involved inherently risky activities, in which a victim has been found to have assumed the risk of a harm occurring by placing him/herself in harm's way (such as spectators injured at baseball games, injured skiers, or gun operators).[14] Both of these trends might plausibly extend more generally, precluding liability for particularly unlikely or speculative causes of an injury (such as in terrorism claims). Within the current 9/11 litigation, however, Judge Wallerstein has thus far embraced a relatively capacious view of

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[12]The approach is slightly different for products liability claims (such as those filed against Boeing). The differences, however, are not material for our discussion.

[13]See, e.g., Strauss v. Belle Realty Co., 482 N.E.2d 34, 36 (N.Y.C.A. 1985); Washington v. City of Chicago, 720 NE2d 1030 (Ill. 1999).

[14]See Hamilton v. Beretta U.S.A. Corp., 750 N.E.2d 1055 (2001) (holding that gun manufacturers owe no duty to victims of gun violence); see generally Esper and Keating (2005).

duty, allowing claims against manufacturers, the airlines, and the WTC towers to proceed.[15]

Another potential impediment that victims face in pursuing targets for conventional tort liability is the doctrine of proximate cause. This doctrine limits liability exposure to situations where there is a reasonably foreseeable connection between the defendant's action and the resulting harm (See, e.g., *Palsgraff v. Long Island Railroad*[16]). A central issue that is likely to loom large within terrorist litigation contexts is the issue of an "intervening act" that nullifies proximate cause. A significant body of case law holds a negligent defendant not liable if a subsequent actor's injurious actions interceded in the causal chain between the defendant's act and the plaintiff's injury.[17] In the terrorism context, intervening acts of terrorists or rogue governments also play significant roles. The instrumentality of injury in cases of terrorism is not a natural disaster or inevitable chain of events, but a calculated decision by a strategic player to inflict deliberate harm on others.[18] It is precisely these sorts of cases in which the proximate cause doctrine may have considerable limiting power. The proximate cause limitation is a distant conceptual cousin of the similar concept noted above that is working its way into "duty" cases.[19] However, unlike the doctrine of duty, proximate

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[15]In re Sept. 11 Litig., 280 F. Supp. 2d 279, 298 (S.D.N.Y. 2003).

[16]162 NE 99 (1928). In *Palsgraff,* the plaintiff's injury had been caused by an unlikely chain of events sparked by the defendant's negligent actions. Notwithstanding the factual conclusion that the defendant's breach of duty was the first proverbial domino in a clear causal chain, Justice Cardozo held that the case could not go forward, since the it was not reasonably foreseeable that the type of harm suffered by the plaintiff would result from the defendant's alleged act of negligence.

[17]In a well-known products liability case, for example, a plaintiff sued an automobile manufacturer to recover on a manufacturing defect that caused the plaintiff's spare tire to fall off his SUV while driving on the freeway. Although initially unharmed, the plaintiff was injured when a third party's vehicle rear ended the plaintiff's vehicle while he was retrieving the tire. The New Jersey Court of Appeals reversed a trial court judgment for the plaintiff, holding that the intervening act of negligence (both of the victim and of the third party driver) was sufficient to break the chain of causation begun by the manufacturing defect. Yun v Ford Motor Co., Sup. 276 N.J. Super. 142, 647 A.2d 841 (1994); See also Brown v. United States Stove Co., 98 N.J. 155, 171-5, 484 A.2d 710 (1984) (manufacturer relieved of liability if superseding intervening cause);

[18]See, e.g., Port Authority of N.Y. and N.J. v. Arcadian Corp., 189 F.3d 305 (3d Cir.1999); Gaines-Tabb v. ICI Explosives USA, Inc., 160 F.3d 613 (10th Cir.1998); In re Korean Air Lines Disaster of September 1, 1983, No. 83-3442, 1985 WL 9447, 1985 U.S. Dist. LEXIS 17211 (D.D.C.1985).

[19]Indeed, Esper and Keating (2005) criticizes the spillover of the foreseeability doctrine on exactly these grounds. One potential difference, cited by Judge Wallerstein, is that in the duty context the foreseeability inquiry is a general one, while in the proximate cause context, it focuses on a specific chain of events that gives rise to a particular *type* of injury.

cause is a factual inquiry that courts generally do not determine at the onset of litigation. Consequently, prospective plaintiffs would rather be forced to litigate foreseeability issues at the proximate cause stage (with the benefit of discovery and a jury) than at the onset of litigation.

In sum, it appears that individuals who suffer harm can plausibly state a cause of action for damages against various "targets" of the attacks (such as buildings, airlines, aircraft manufacturers, and so forth). At the same time, however, they are likely to face two significant challenges in pressing civil liability claims: withstanding an adverse "duty" determination at the onset, and demonstrating proximate causation at trial. While their chances are far from certain, a recognizable template for such actions at least exists within American tort law.

A similar analysis pertains to "collateral" targets (such as buildings on juxtaposed parcels) that suffer damage because of their proximity to the primary target. Such cases bear a close resemblance to the individual-on-target case described above. Indeed, in many respects, collateral targets are indistinguishable from individual victims who find themselves at the scene of an attack. Consequently, in what follows we will tend to treat these cases as equivalent.

2.2   Attacked Targets Against Unaffected Targets

A second plausible tort cause of action might involve suits by damaged targets against other *undamaged* targets, possibly even those thousands of miles away. While such an action seems peculiar on first blush, it can make sense (as we show later) if one could establish that the latter's precautionary acts imposed additional harm on the attacked target by diverting terrorists to relatively less protected targets.

Although there are few templates within American tort law relating to terrorism to substantiate such a claim, affiliated areas of law may provide a ready analogy. One area

that analogizes reasonably well to terrorism liability is the law pertaining to liability after natural disasters, such as a flash flood. In at least some respects, this analogy is a plausible one, since – much like target hardening – protective measures by a property owner against a flood (such as the building of a dyke) can enhance the risk borne by others by increasing their susceptibility to flooding. The doctrinal analogy, moreover, is inherently interesting because the law governing diffuse surface water is in a state of doctrinal flux, and existing legal templates for addressing such problems suggest a wide range of possible legal responses.

One approach favored by a number of states is frequently referred to as the "common enemy" doctrine, which holds that a landowner is free to use any and all methods to dispose of surface runoff without fear of liability to her neighbors.[20] Another group of states, in contrast, follow what has become known as the "civil law" doctrine.[21] This rule is essentially the polar opposite of the common enemy doctrine, and in its pure form imposes *strict liability* to his neighbors when his actions to protect his land cause harm to his neighbors. These two approaches, sometimes in modified variations, appear to have been adopted in just over twenty states each each.[22]

In addition, a smaller number of courts have come to embrace a third doctrine known as the "reasonable use" doctrine. This doctrine, which is somewhat of a younger than the other two described above,[23] lies between them substantively and essentially is a negligence rule: an owner may make reasonable use of his land and in so doing, alter the drainage of surface water up to the point that the alteration causes unreasonable interference with his

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[20]See, e.g., Keys v. Romley, 64 Cal.2d 396, 50 Cal.Rptr. 273, 412 P.2d 529 (1966); Yonadi v. Homestead Country Homes, Inc., 35 N.J.Super. 514, 114 A.2d 564 (App.Div.1955), petition denied 42 N.J. Super. 521, 127 A.2d 198 (1956); Butler v. Bruno, 115 R.I. 264, 341 A.2d 735 (1975); Carland v. Aurin, 103 Tenn. 555, 53 S.W. 940 (1899).

[21]The name emanates, apparently, from the fact that the only civil law jurisdiction in the US, Louisiana, is credited with being the first state to embrace it. See Orleans Navigation Company v. New Orleans, 1 La. (2 Mart. [O.S.]) 214 (1812).

[22]See Keys v. Romley, supra (counting jurisdictions); and Annot. 93 A.L.R.3d 1193, 1207-11 (1979).

[23]Though a relatively recent phenomenon nationally, the original seeds of the reasonable use doctrine can be found in New Hampshire during the 19th century. Swett v. Cutts, 50 N.H. 439 (1870); Bassett v. Salisbury Manufacturing Co., 43 N.H. 569 (1862).

neighbors' use of their land.[24] In many respects, the reasonable use doctrine replicates the basic templates of nuisance law for surface water hazards,[25] and it is treated as such by the Restatement of Torts.[26] Although still a minority position among jurisdictions (embraced in just under ten jurisdictions), it is widely perceived to be growing quickly in its influence.[27] In these states, however, the duty and proximate cause hurdles discussed above are likely to recur. In sum, then, the prospects for suit by an attacked target against other unattacked targets appear to vary significantly from nil to appreciable, depending on the jurisdiction.

2.3   Attacked Target Against Harmed Individuals

A third potential sort of claim involves a suit brought by a damaged target against individuals (such as bystanders) who were harmed by the terrorist act. While certainly counterintuitive, it is at least conceivable (in light of the above discussion) why such a claim might emerge: A large population of individuals congregating at a target, the argument goes, presents a natural attraction for terrorist attention, if terrorists care (inter alia) about how many individuals an attack might reach. While individual victims recognize the fact that their presence at a site marginally increases the odds of a terrorist act, they do not fully internalize the additional cost that their presence imposes on the target itself (or on each other), which is also subject to enhanced risk of attack. Consequently, the argument goes, affected targets argue that the risk of attack was substantially caused (or at least enhanced) by the presence of victims at the site.

While nothing prevents an affected target from asserting this type of claim against victims in theory, it seems implausible that such actions would be successful in practice, for a number

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[24]See Enderson v. Kelehan, 226 Minn. 163, 32 N.W.2d 286 (1948); Armstrong v. Francis Corp., 20 N.J. 320, 120 A.2d 4 (1956); Pendergrast v. Aiken, 293 N.C. 201, 236 S.E.2d 787 (1977); Butler v. Bruno, 115 R.I. 264, 341 A.2d 735 (1975); Annot. 93 A.L.R.3d 1193, 1216-21 (1979).

[25]Pendergrast v. Aiken, 293 N.C. 201, 236 S.E.2d 787 (1977).

[26]Restatement (Second) of Torts, § 833 (1979).

[27]It is also beginning to infiltrate the other two doctrines, which in some jurisdictions have begun to embrace some components of fault.

of reasons. First, in order to proceed against individuals, it would appear necessary to file a separate action against each one, a process that imposes substantial fixed costs on the target plaintiff for each suit filed. The extent of damages that the plaintiff has suffered as a result of each *individual* defendant's actions are likely to be both speculative and small in magnitude, since any individual victim imposes only incremental risks on a target. It therefore seems plausible that the cost of filing suit against each bystander victim defendant would greatly exceed the prospective damages that a plaintiff-target might reasonably expect in such a suit.[28] Second, to the extent that individuals are in a contractual relationship with the targets (such as employees and lessees at the WTC), the target can use the terms of such relationships to regulate her exposure by limiting the extent to which these contractual counterparties are present on site.[29] Finally, and perhaps most saliently, because of the human element of tragedy that attends death and injury of individual victims, it would almost certainly be politically unpalatable for a target-plaintiff to proceed against a population of sympathetic victims, notwithstanding what optimal deterrence theory may dictate. It is telling that to our knowledge, no such actions have actually been filed in the 9/11 litigation.[30]

2.4   Unaffected Targets Against Attacked Targets

Finally, and for the sake of completing the permutations at play, one might consider the possibility that unaffected targets could bring suit against attacked targets. Here, it is difficult to imagine what tort theory an unaffected target might have at its disposal. Indeed, unaffected target-plaintiffs would face a seemingly insurmountable burden demonstrating

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[28]These problems become even more intractable under a negligence standard. Indeed, because numerous victims are likely to act independently of one another in an uncoordinated fashion, it would be difficult to determine which sub-population of defendants was responsible for violating the negligence standard – i.e., that point at which the marginal social cost of an additional victim at a site exceeds the marginal social benefit. See section __, infra.

[29]This argument, obviously, does not apply to bystanders, passers-by, and others not in contractual privity with the target – a distinction we revisit below.

[30]Although not discussed in the text, it also seems quite implausible (and self-defeating) for harmed individuals to make claims against one another for overpopulating a site.

that they suffered any harm whatsoever (either actually or proximately); similarly, such a plaintiff would be unable – virtually by definition – to prove damages. Add to this the politically unsavory notion of an undamaged target collecting from a damaged one, and it seems relatively certain that actions such as this will fail.

2.5 Synthesis and Analytic Typology

Our analysis of existing templates in tort law has been necessarily brief, but it does generate a general framework for thinking about the likely tort claims that harmed individuals and targets are likely to encounter after a terrorist act. First, for most courts wading into this terrain, it is overwhelmingly likely that the terrorist actors themselves cannot be made to answer for their own activities, limiting the court's response to a type of "second-best" allocation of rights among the terrorists' victims and targets (actual or potential). Second, suits by harmed individuals against affected targets appear to be the most viable jurisprudentially, but they are likely to face stiff challenges on both duty and proximate cause grounds. Third, suits by damaged targets against unaffected targets for alleged excessive precautions are unorthodox, but find at least some plausible analogical templates within existing case law. Here too, though, duty and proximate cause arguments may present significant obstacles, depending on jurisdiction. Fourth, it appears extremely unlikely (for both practical and economic reasons) that damaged targets can sue individual victims for "overpopulating" the site and drawing terrorists' fire. And finally, it seems wholly implausible that unaffected targets could bring successful claims against attacked targets.

How, then, are courts likely to resolve the uncertainty regarding duty and causation? Based on a doctrinal analysis alone, it is difficult to make predictions with absolute certainty. However, the doctrines discussed above are thought to rest heavily on policy considerations about the nature and effects of liability. And, one important set of policy considerations concerns how liability affects individual incentives, and in turn allows policymakers to nav-

igate a large set of trade-offs between social costs and social benefits implicit in acts of terrorism precautions. In the section that follows, then, we posit and analyze a formal model of behavior that makes these costs and benefits explicit.

Before proceeding, however, we pause briefly to consider the role of contractual relations among the potential parties. As noted above, at least some individuals harmed by a terrorist attack are likely to be in a contractual relationship with the target. In such situations, at least where the contractual vehicle functions well, the terms of their contract may be able to deal with at least some of the collective action problems between the aforementioned parties. Entry fees, rental/lease terms, capacity restrictions, conditions of occupancy, office management, and other contractual mechanisms allow the parties to affect – either directly or indirectly – a large set of precautionary activities at a given target without the aid of tort law. In contrast, other parties, such as bystanders, are not in a contractual relationship with targets (or one another), and tort law is likely to be a more effective vehicle for completing the market. In addition, there may yet be other parties (such as subway or food court patrons), who are in a *limited* contractual relationship, which may not be sufficiently rich to allocate terrorism risk reliably.

In what follows, then, we will tend to distinguish between (1) individuals who are in either no contractual privity with targets or a relatively monolithic one, from (2) individuals who have a relatively nuanced contractual relationship with targets. To the extent that the latter group specifically contracts with terrorism risk in mind, courts may wish simply to effectuate those risk allocations. We therefore treat this latter group in what follows as roughly coterminous with the "target" in the analysis that follows, concentrating principally on the former group, who we label as individual "victims."[31]

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[31]Notably, to the extent that targets and their contracting parties do not account for the welfare of bystanders or other targets, courts may still wish to impose liability on them as a collective unit.

3   An Incentive-Based Model of Terrorism, Precautions, and Liability

As noted in the previous section, an important goal of liability policy is to improve the allocation of resources by providing individuals with efficient incentives in a "second-best" world where the perpetrators of terrorism are beyond courts' jurisdiction. While pure incentive problems are far from the only policy goals in the case of terrorism — problems of efficient risk-bearing and the provision of public goods like national security are also significant factors — incentive provision is both important in the overall policy landscape and uniquely amenable to a liability solution. In this section, we explore the incentive problems created by terrorism and how a liability system could solve them.

As noted above, our analysis considers a number of different types of parties: Actual or potential targets hit by a terrorist attack; collateral targets (such as adjacent buildings) that are not targeted themselves but suffer significant damage from their proximity to the affected target; individual victims (such as vendors or employees) who are in contractual privity with targets; and victim bypassers who are not in contractual privity with targets. In order to simplify our analysis, we will lump targets together with others that are in relatively nuanced contractual privity with targets, assuming that they will allocate their joint risks efficiently amongst themselves.[32]   These groups will simply go under the banner of "Targets".   We will also lump together collateral targets with bystanders, since their legal claims would be similar (see above), and since neither is likely to be in contractual privity with the targets. We will refer to these groups generically as "Victims."[33]

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[32]This group includes owners of buildings, landmarks, shopping centers, government offices, well-known business, and the like, that might be the locus of a terrorist's targeting activities. It may also (depending on the nuance of their contractual relationship) including lessees, employees, and the like. As noted in the text, there is perhaps less to be gained by tort claims when complete contracts can be written by rational, welfare-maximizing agents.

[33]This definition abuses terminology somewhat, since *all* affected individuals/groups/entities can be appropriately thought of as 'victims'; we have used a narrower definition here to distinguish between primary victims ("Targets") and secondary victims (our use of "Victims" stated in the text). The key distinction is that targets can directly control the level of protection against terrorism, while victims cannot, save for

As already noted, a key assumption running throughout our analysis concerns the impossibility of reaching the terrorists themselves who are the most directly responsible for the injury suffered. Also, and as already noted, we exclude as impractical any suits brought against an individual victim for his/her incremental contribution to the likelihood of an attack. With these caveats in mind, our formal analysis proceeds in three stages. First, we develop an economic environment in which terrorists, targets, and victims interact with one another. Second, we characterize equilibrium behavior within this framework in the absence of liability and describe its welfare effects. And finally, we ask whether a prudently designed liability system could improve upon this equilibrium in welfare terms. In order to focus solely on incentives (rather than insurance), we assume that all players in our model are risk-neutral.

3.1 Framework

Consider a single terrorist group contemplating whether to attack one or more of N particular targets. The targets are assumed to be evenly spaced along a circle of (normalized) circumference 1 and have respective locations of $\left\{ \frac{1}{N}, ..., \frac{N}{N} \right\}$.[34] Successful attacks depend on planning and preparation. To that end, terrorists invest in preparation against each target i, denoted as r_i, where $i = 1, 2, ..., N$. The terrorist group has total resources R to allocate among attacking targets, as well as a non-violent activity (e.g., political rallies, bake sales, etc.) that yields an expected payoff of $\Gamma(A)$, where Γ is twice differentiable, increasing, and strictly concave. Terrorists allocate their resources to maximize their expected utility, described specifically below.

In the event of a successful violent attack, a potential target is assumed to suffer a loss L, assumed (for simplicity) to be identical across targets. In addition, however, each target i

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relocating themselves away from high-risk areas. Consistent with the discussion in note 32, victims are assumed unable to write complete ex ante contracts with targets.

[34]This distribution is not relevant to the terrorists, but is to the victims, as we describe below.

may also have v_i victims present on site. From the attack, the terrorist group gains utility of $B(L, v_i)$ for each target i that is successfully attacked, where $B(.)$ is assumed to be increasing in both its arguments.

Targets can reduce their probability of loss by investing in self-protection, but their decision problem is influenced by the behavior of terrorists and victims. In particular, the probability of a successful attack against target i is a function of terrorist preparation r_i and target protection s_i, as in $\rho(s_i, r_i)$, where we make the intuitive assumptions that $\rho_s < 0$, $\rho_r > 0$, $\rho_{ss} > 0$ and $\rho_{rr} < 0$. We also assume that self-protection measures thwart the marginal effectiveness of terror investments, so that $\rho_{rs} < 0$. Against a "harder" target, terrorists have to spend more resources to increase their probability of success by a given amount. Victim behavior influences the incentives of terrorists to attack a particular target. Given the anticipated decisions of victims and terrorists, targets minimize the expected sum of protection costs, uncompensated losses, and damages (if any) that must be paid to victims and/or other potential targets.

Finally, "victims" also suffer in the event of an attack if they find themselves near (or inside) an affected target. In contrast to targets, however, victims have no control over the on-site protection decisions of targets. The only way victims can protect themselves is to locate in safer areas. Victims' initial locations are assumed to be distributed uniformly around the unit circle, and indexed by $k \in (0, 1]$. They can choose to "stay at home" or patronize one of the N targets. They derive utility $G_0 > 0$ from their outside option of staying home. The spatiality of the model reflects the fact that victims might have heterogeneous preferences across location, even holding terrorism risk constant. Patronizing any target i provides the payoff of $G > G_0$, but requires her to "travel" the distance $\left| k - \frac{i}{N} \right|$, and to bear travel costs of $\gamma \left(\left| k - \frac{i}{N} \right| \right)$. We assume that $\gamma(0) = 0, \gamma' > 0$, and $\gamma'' > 0$. Consequently, γ is invertible, and we therefore define the function $\theta(y)$ to denote $\gamma^{-1}(y)$.[35] Subsidiary victims

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[35] Note that $\theta(0) = 0, \theta' > 0$, and $\theta'' < 0$. We also make a technical assumption that $G - G_0 < \gamma\left(\frac{1}{2N}\right)$, so that the victims who are furthest away from any target will simply choose to stay home, even in the absence of terrorist risk. Relaxing this assumption, we conjecture, has little effect on our results.

maximize the net payoff from their patronage decision, taking account of both travel costs and uncompensated injury from possible terrorist attacks (described in more detail below).[36]

Figure 1 below captures the sequence of the game. Because target decisions are most likely to be durable (e.g., building a skyscraper), we assume that primary targets move first, and that they each install their self-protection level s_i upon moving. After observing target self-protection, victims move second, setting aggregate patronage levels, v_i, for each target. After observing both self-protection measures and patronage at each target, terrorists move last. We assume that the actions taken by each actor are observable to all involved.Note that this description fully defines a sequential game under complete information.

3.2   Equilibrium and Welfare in the Absence of Liability

To analyze equilibrium behavior in this game, we begin by characterizing predicted play in the benchmark case where no party can seek compensation through the tort system. This reveals the externalities that an optimal liability regime must address, but it is also a plausible outcome in its own right, as pending terrorism litigation may ultimately prove unsuccessful. To characterize the equilibria of the game, we employ standard backward induction techniques, beginning with the terrorists, then moving to the secondary victims, and then finally moving to primary targets.

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[36]Our framework implicitly assumes that victims capture all the gross surplus (G) from their decision to patronize a target. This assumption seems natural, since the lack of a contractual relationship makes it difficult for the target to extract any of the victim's surplus. Nevertheless, all of our results would follow if we assumed that the target captured some portion of the victims' surplus (so long as the patronizing victims as a whole retained some complementary portion of it).
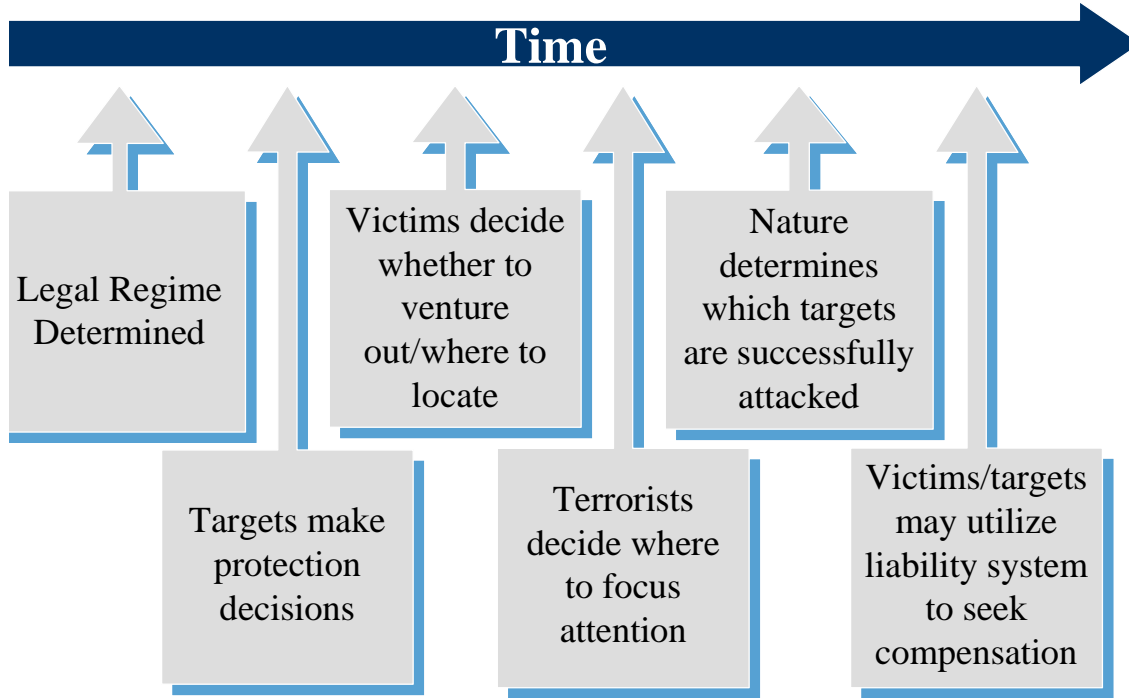
Figure 1: Sequence of moves.

3.2.1 Terrorists

Terrorists observe $\vec{s} = \{s_1, ..., s_N\}$ and $\vec{v} = \{v_1, ..., v_N\}$, and allocate their own resources $\vec{r} = \{r_1, ..., r_N\}$ to solve the following problem:

$$\max_{\{\vec{r}, A\}} \Gamma(A) + \sum_{i=1}^{N} \rho(s_i, r_i) B(L, v_i)$$
$$s.t. \quad A + \sum_{i=1}^{N} r_i \leq R \tag{3.1}$$

Given the concavity of ρ in r_i, for any given $\{\vec{s}, \vec{v}\}$ the first order conditions of this problem are both necessary and sufficient for a unique maximum, and are as follows:

$$\Gamma'(A) = \rho_r(s_i, r_i) B(L, v_i), \forall i \in \{1, .., N\} \tag{3.2}$$

The interpretation of these conditions is fairly standard. The terrorists allocate resources so that the expected marginal productivity of investments is equal across all targets and the non-violent activity. Thus, for example, when one target increases its own protection, it becomes marginally less attractive to terrorists. This shock to their rates of return then induces terrorists to shift resources toward their other alternatives: attacking different targets and investing more in the nonviolent activity. Similarly, if a specific target is patronized by more victims, then that target becomes more attractive to the terrorist group, causing it to shift resources marginally away from other targets and the nonviolent activity, and toward the more-patronized target.

Formally, these intuitions can be summarized in the following lemma.

Lemma 3.1. *Under an optimal allocation of resources by the terrorist group, and for a given $\{\vec{s}, \vec{v}\}$, r_i is uniquely defined, strictly decreasing in s_i and v_{-i}, and strictly increasing in s_{-i} and v_i. Moreover, for all j, A is strictly increasing in s_j and strictly decreasing in v_j.*

The uniqueness follows directly from the global concavity of the terrorists' decision problem, conditional on victim and target decisionmaking. The effect of the underlying parameters on terrorist behavior is proven in Lakdawalla and Zanjani (2004).[37] Perhaps the most important aspect of Lemma 3.1 is the fact that the resource allocation for a given location i can turn, in part, on actions taken by victims and targets at *different* locations $(-i)$. For example, enhanced protection efforts by a remote target (s_{-i}) can shift risk *toward* target i as the terrorist group removes marginal resources from the better-protected target and reallocates them to others. Similarly, greater patronage at a remote target (v_{-i}) can shift risk *away from* target i as the increased patronage makes the remote target more attractive, and the terrorist group attempts to increase its resource expenditures there.

In what follows, we shall refer to these cross-target effects as "risk-shifting," since activities at one target tend to shift risk onto (or away from) other targets. In contrast, the

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[37]Lakdawalla and Zanjani (2004) proves the result for s_i; the result for v_i is symmetric.

changes that patronage/self-protection have in channelling terrorist efforts into (or away from) nonviolent activities we will call "deterrence," because it reduces the total level of investment in violent terrorism that society must bear. Both target protection and victim precaution have risk-shifting and deterrence effects. Target self-protection both enhances deterrence on the margin (a positive externality) and shifts some marginal risks onto other targets (a negative externality). Similarly, a reduction in victim patronage contributes to deterrence (a positive externality) and shifts risk onto other targets (a negative externality).

Analysis of the terrorist's first order conditions also yields the following result:

Lemma 3.2. *Under an optimal allocation of resources by the terrorist group, and for a given* $\{\vec{s}, \vec{v}\}$, $\left|\frac{\partial r_i}{\partial s_i}\right| > \left|\sum_{-i} \frac{\partial r_{-i}}{\partial s_i}\right|$ *and* $\left|\frac{\partial r_i}{\partial v_i}\right| > \left|\sum_{-i} \frac{\partial r_{-i}}{\partial v_i}\right|$ $\forall i$.

Essentially, Lemma 3.2 states that deterrence and risk-shifting are generally always present simultaneously. Self-protection by a target reduces terrorist activity against that target by more than the additional activity it diverts to other targets. Thus, while target hardening does shift risk, it has a net deterrent effect in the aggregate. Similarly, victim patronage transfers risk to other targets, but it also draws resources away from the non-violent activity, and thus erodes net deterrence in the aggregate.

3.2.2 Subsidiary Victims

Having characterized the unique optimal choice for the terrorist group, we now consider how subsidiary victims behave in light of the terrorist's anticipated strategy profile. It is important to distinguish precisely between victims' internal costs, and the costs that they externalize onto targets. The latter externalities would form the basis for an optimal liability scheme, if one is to be formed.

Recalling the incentives and cost structure faced by each victim, each victim considers what target (if any) she will visit during the period, an action we denote by h. For each victim at location k, $h(k) = i$ denotes a decision by that victim to spend time at target i. In addition,

victims can choose to spend time away from all targets (i.e., they "stay home"), an activity we denote by $h(k) = 0$. Thus, the action set for victims is given by $h(k) \in \{0, 1, ..., N\}$. It is easily verified that $v_i = \int_{h(k)=i} dk$ denotes the size of the sub-population patronizing target i, for $i \in \{1, ..., N\}$.

As noted above, victims receive payoff G from patronizing any target (rather than staying home), but must also bear travel costs of $\gamma\left(\left|k - \frac{i}{N}\right|\right)$, to patronize that location. In addition, however, all victims suffer personal losses should their patronized target be successfully attacked (in addition to any loss suffered by the target itself). In particular, each subsidiary victim spending time at that target suffers a negative shock D to her welfare. Consequently, the net payoff to victim k from patronizing target $i \in \{1, 2, ..., N\}$ is

$$G - \gamma\left(\left|k - \frac{i}{N}\right|\right) - \rho(s_i, r_i) D \tag{3.3}$$

while the net payoff for the outside (safe) activity remains constant at G_0. Note, however, that victims do not account for the losses of targets, even though they may be partly responsible for the risk that targets face.

Assuming that all targets have a positive number of victims (which will be confirmed in equilibrium), the identity of the "marginal" victim, k^*, who is indifferent between patronage at target i and staying at home, is given by the following expression:[38]

$$G - G_0 = \gamma\left(\left|k^* - \frac{i}{N}\right|\right) + \rho(s_i, r_i(v_1, ..., v_N)) D, \ i = 1, ..., N \tag{3.4}$$

This expression implies that victims located within the radius $\theta(G - G_0 - \rho(s_i, r_i(v_1, ..., v_N)) D)$ of target i will patronize it. Note that the right-hand side of the above expression is strictly increasing in k^*, so the interval $[-k^*, k^*]$ is uniquely defined. Aggregate patronage of each

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[38]The reader will note that this set of first order conditions leaves out the constraint that $\sum_{i=1}^{N} v_i \leq 1$. This constraint will tend not to be binding so long as victims find it optimal to spend at least some time in the outside activity. We will constrain our analysis to parametric contexts where this condition is satisfied in what follows.

target i is then given by[39]:

$$v_i = 2\theta \left(G - G_0 - \rho\left(s_i, r_i(\overrightarrow{s}, \overrightarrow{v})\right) D\right) \tag{3.5}$$

All else equal, victims will tend to move toward more protected targets and avoid less protected ones. Moreover, since an increase in protection by any one target decreases aggregate risk, it will also increase the aggregate number of victims who patronize at-risk targets. Formally, we have:

Lemma 3.3. *Under an optimal allocation of resources by the terrorist group and optimal choices by victims, and for a fixed $\{\vec{s}\}$, the patronage of any target i, v_i, is uniquely defined, strictly increasing in s_i and v_{-i}, and strictly decreasing in s_{-i}. Moreover, for all i, $\left|\frac{\partial v_i}{\partial s_i}\right| > \left|\sum_{-i} \frac{\partial v_i}{\partial s_{-i}}\right|$.*

The results of Lemma 3.3 are analogous to the argument made by Lemma 3.2. An aggregate reduction in risk increases the aggregate number of victims choosing to venture out to targets. This reaction is likely to have a significant effect on target activities. While, as demonstrated above, self-protection can shift risk onto other targets, these gains come at the cost of drawing in additional subsidiary victims, who are attracted by the enhanced fortifications. On the margin, then, targets must weigh the private benefits they receive by shifting risks and effecting deterrence, against attracting more victims (and thwarting their own precautions) on the other.

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[39] And consequently, the total number of potential victims who pursue the safe option is:

$$v_0 = 1 - \Sigma \cdot v_i = 1 - \sum_{i=1}^{N} 2 \cdot \theta \left(G - G_0 - \rho\left(s_i, r_i(\overrightarrow{s}, \overrightarrow{v})\right) D\right)$$

3.2.3 Targets

We now step back to the initial stage of the game, in which primary targets have the opportunity to make self-protection decisions. Recall that in the event of a successful attack, target i suffers losses L, but may invest resource s_i to dampen the probability of a successful attack. Like the other parties, primary targets behave strategically, and understand the nature of the subsequent structure of the game analyzed above: i.e., once targets' investments are sunk and observed, victims will then optimize across locational choices, and then the terrorists will optimize across investments in attacking targets and carrying out nonviolent political activity.

Consequently, each target i makes protection decisions that maximize its expected payoff, solving the following:

$$\min_{s_i} \rho(r_i(s_i, s_{-i}), s_i) \cdot L + s_i \tag{3.6}$$

This problem has the first order condition for each target i :

$$\underbrace{\rho_s\left(r_i, s_i\right) \cdot L}_{Direct\ Effect} + \underbrace{\rho_r\left(r_i, s_i\right) \cdot \frac{dr_i}{ds_i} \cdot L}_{Indirect\ Effect} + \underbrace{1}_{MC} = 0 \tag{3.7}$$

The intuition behind this condition is relatively straightforward. On the one hand, increasing s_i imposes a direct marginal cost of 1 on the target, reflected in the final term on the left hand side of (3.7). On the other hand, by enhancing self-protection, the target is able to affect the probability of an attack in both direct and indirect ways. A larger value of s_i *directly* reduces the probability of an attack by acting on the $\rho\left(.\right)$ function, represented by the first term on the left hand side of (3.7). In addition, however, a larger value of s_i has indirect effects by altering the strategies of victims and terrorists, and changing the equilibrium value of r_i in the continuation game, represented by the second term on the left hand side of (3.7) .

Note that the direct effect depicted in (3.7) is strictly negative, and thus there are always

direct benefits to investing in precautions. However, the indirect effect is somewhat more complicated to sign, since the equilibrium partial derivative $\frac{dr_i}{ds_i}$ has multiple, countervailing effects. The decomposition of this derivative yields the following:

$$\frac{dr_i}{ds_i} = \overbrace{\frac{\partial r_i}{\partial s_i}}^{-} + \overbrace{\frac{\partial r_i}{\partial v_i}\frac{\partial v_i}{\partial s_i}}^{+} + \overbrace{\sum_{j \neq i}\frac{\partial r_i}{\partial v_j}\frac{\partial v_j}{\partial s_i}}^{+} \tag{3.8}$$

Equation (3.8) represents the equilibrium impact of target 1's own protection on its own risk. In general, the sign of this term is ambiguous: For, on the margin, a target's own protection may not make it safer, because it may draw in enough victims to offset the effect of protection. In any interior equilibrium, however, the marginal impact of self-protection on terror investments must be negative, or targets would not expend valuable resources on it. The external effects of protection on other targets though remain ambiguous in equilibrium.

By placing on ρ sufficient technical regularity conditions,[40] one can show that, $\frac{dr_i}{ds_i} < 0$ for all values of s_i, $\lim_{s_i \to \infty} \frac{dr_i}{ds_i} = 0$; and $\lim_{s_i \to \infty} \frac{dr_i}{ds_i} = -\infty$. However, these conditions are merely sufficient for the optimal choice to be finite and strictly positive. They do not guarantee the global concavity of the target's problem. To guarantee concavity (and a unique local optimum), it is necessary to make one additional assumption:

Assumption A1: *The following condition holds everywhere:*

$$\rho_{ss}(r_i, s_i) + [2\rho_{rs}(r_i, s_i) + \rho_{rr}(r_i, s_i)] \cdot \frac{dr_i}{ds_i} + \rho_r(r_i, s_i) \cdot \frac{d^2 r_i}{ds_i^2} < 0 \tag{A1}$$

Condition (A1) is merely the second order condition for global concavity. It is possible to weaken this assumption, at the expense of complicating the analysis somewhat. In particular, violation of (A1) implies that there may be multiple local minima from which to choose, and it may be possible that the optimal protection choice might "jump" from one local minimum

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[40]The derivation is available from the authors.

to another with a perturbation in the economic environment. Assumption A prevents such jumps from occurring.

3.2.4 Equilibrium

By construction, we have shown that for a given $\vec{s}$, the optimal strategies of the subsidiary victims and targets are uniquely defined. Moreover, we have demonstrated that the optimal s_i for each target is almost always unique. We now show that, under the conditions described earlier, there is only one symmetric equilibrium, according to the following:

Proposition 3.4. *If Assumption A1 holds, there is a unique symmetric equilibrium of the no liability game, which is characterized by (3.7), (3.5), and (3.2).*

The symmetry comes from the even spacing of targets and victims, the equal value of each target, and the symmetric position of the targets in choosing their strategies simultaneously. Let the symmetric equilibrium described by the above system with no liability be denoted by $\left\{ s^{NL}, v^{NL}, r^{NL} \right\}$. In what follows, we constrain our attention in all cases to this family of symmetric equilibria.

Intuitively, we can make a few general predictions about the efficiency characteristics of the symmetric equilibrium. First, in the absence of any liability regime, there are likely to be too many victims at each target, since each victim does not internalize the cost of the risk she imposes on targets. Second, targets are likely to misallocate self-protection resources, since they do not account for external effects on other targets, and they do not fully internalize the welfare of on-site subsidiary victims. Hence, targets, may expend too much or too little on protection (depending on which of these effects dominates).[41]

Efficiency within our model most naturally reduces to maximizing the summed total expected payoffs of victims and targets (net of loss), conditional on the incentive compatibility

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[41] These intuitions will be important for our later analysis, since they suggest that the optimal liability regime involves forcing net *payments* by victims to the population of targets, and payments among targets that depend on the net externalities associated with protection.

constraints of the terrorists.[42] To simplify the notation, note that the number of victims at target i satisfies $\frac{v_i}{2} = k_i^* - \frac{1}{N}$, and thus target i is populated by victims over the interval $[-\frac{v_i}{2}, \frac{v_i}{2}]$. Therefore, total surplus of all victims in the neighborhood of target i (whether they patronize or not) consists of the sum of each victim's individual surplus:

$$VS\,(i) = \left(\frac{1}{N}\right) G_0 + 2 \cdot \int_0^{\frac{v_i}{2}} (G - G_0 - \gamma\,(x) - \rho\,(s_i, r_i)\,D)\,dx \tag{3.9}$$

Target surplus consists of expected losses net of protection:

$$-\sum_{i=1}^N (\rho(s_i, r_i)L + s_i) \tag{3.10}$$

A 'socially optimal' allocation of resources, then, would maximize the social surplus of victims and targets, taking as given the optimal responses of terrorists:[43]

$$\max_{s_i, v_i} \sum_{i=1}^N \left[2 \int_0^{\frac{v_i}{2}} (G - G_0 - \gamma(x) - \rho(s_i, r_i)D)\,dx - (\rho(s_i, r_i)L + s_i)\right] \tag{3.11}$$

subject to the incentive compatibility constraint:

$$\Gamma'(A) = \rho_r(s_i, r_i)B(L, v_i) \tag{3.12}$$

Constraining our analysis to a symmetric equilibrium, this problem simplifies to one of choosing $\{\hat{v}, \hat{s}, \hat{r}\}$ to maximize surplus for a representative target, so that the social welfare

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[42]Note that this formulation does not include the welfare of terrorists, which seems most natural in this context. It also does not include any other social benefits of reducing terrorist behavior that are not visited on prospective victims or targets. We explore the relaxation of this definition below.

[43]Recall that our definition of social optimality takes terrorists' actions / reactions a constraint (as they are assumed outside the regulatory structure). Thus, in reality, this is a type of constrained second best. Observe also that we are implicitly according equal weight to the welfare of targets and victims.

function becomes,

$$\Psi\left(\hat{r},\hat{s},\hat{v}\right) = 2\int_0^{\frac{\hat{v}}{2}} \left(G - G_0 - \gamma(x) - \rho(\hat{s},\hat{r})D\right)dx - \rho(\hat{s},\hat{r})L - \hat{s} \tag{3.13}$$

and the social planner's problem reduces to,

$$\max_{\hat{v},\hat{s}} \Psi\left(\hat{r},\hat{s},\hat{v}\right) \tag{3.14}$$

subject to

$$\Gamma'(A) = \rho_r(\hat{s},\hat{r})B(L,\hat{v})$$

One way to conceive of the terrorist's incentive compatibility constraint is in reduced form, so that the planner chooses both $\hat{s}$ and $\hat{v}$ knowing that terrorists will react optimally, according to the functional $\hat{r}\left(\hat{s},\hat{v}\right)$. The conditions for efficiency are:

$$\underbrace{-\left(\rho_s + \rho_r\frac{d\hat{r}}{d\hat{s}}\right)(\hat{v}D + L)}_{\text{Marginal social Benefit of }\hat{s}} = \underbrace{1}_{\text{MC of }\hat{s}} \tag{3.15}$$

$$\underbrace{\left(G - G_0 - \gamma(\frac{\hat{v}}{2}) - \rho(\hat{s},\hat{r})D\right)}_{\text{Marginal social Benefit of }\hat{v}} = \underbrace{\left(\rho_r\frac{d\hat{r}}{d\hat{v}}\right)(\hat{v}D + L)}_{\text{Marginal social Cost of }\hat{v}} > 0 \tag{3.16}$$

where

$$\frac{d\hat{r}}{d\hat{v}} = \left[\sum_j \frac{dr_i}{dv_j}\right]_{\substack{r_i=\hat{r} \\ v_i=\hat{v}}} > 0;$$

$$\frac{d\hat{r}}{d\hat{s}} = \left[\sum_j \frac{dr_i}{ds_j}\right]_{\substack{r_i=\hat{r} \\ s_i=\hat{s}}} < 0$$

The efficient protection decision accounts for the impact of protection on *total* social losses $(\hat{v}D + L)$, which includes both victim and target losses. The efficient allocation of

victims in (3.16) results in strictly positive surplus for the marginal victim. Comparing (3.16) to the analogous condition (3.5) characterizing private decisionmaking in a symmetric equilibrium, we see immediately that the socially optimal level of victim patronage is strictly less than the privately optimal level. Indeed, when the marginal victim makes her patronage decision, she does not consider the effect her presence has on the risks of others. Analysis of the problem leads to the following proposition, where the symmetric equilibrium in the no-liability case is given by $\left\{s^{NL}, v^{NL}, r^{NL}\right\}$.

The efficiency properties of self-protection decisions by targets, on the other hand, are more complex. Protection may be inefficiently high or low, because it involves both *positive* externalities for potential victims, but *negative* externalities on other targets. Since the private marginal benefit of protection is $-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right) L$, the key comparison comes down to whether the social marginal benefit (which equals unity) is less than the private marginal benefit evaluated at the social optimum. If social benefit is less than private benefit, targets are engaging in too much protection. This condition is equivalent to:

$$\frac{1}{L} < -\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)\bigg|_{\{\hat{r},\hat{s},\hat{v}\}} \tag{3.17}$$

On the other hand, should this strict inequality hold in the opposite direction, the targets engage in too little protection. Simplifying this condition, we have the following:

Proposition 3.5. *Absent a liability regime, and if assumption A1 holds, victims always over-patronize targets relative to the social optimum, so that $v^{NL} > \hat{v}$. Targets, on the other hand, may overprotect or underprotect, and in particular they over-protect ($s^{NL} > \hat{s}$) if and only if, at the social optimum $\{\hat{r}, \hat{s}, \hat{v}\}$:*

$$\frac{1}{L} < -\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)\bigg|_{\{\hat{r},\hat{s},\hat{v}\}} \tag{3.18}$$

The condition in the above proposition can be equivalently characterized as: the external

marginal benefits of protection in equation 3.15 are negative.

3.3 Liability, Behavior, and Welfare

We now explore the equilibrium with liability rules. In order to consider the effects of liability, suppose that target i has been successfully attacked, and has suffered damages L. Moreover, the v_i victims at the target have also suffered damages D each. We now consider each of a family of compensation schemes. In each case, all targets but the attacked target must make a transfer payment to target i in the amount of $\tau_{-i}(s_i, s_{-i})$. Target i, in turn, is required to make a transfer payment $\theta_i(s_i, v_i)$ to the injured victims. (We do not consider systems under which targets bear liability for other targets' victims, because these are subsumed by the system we consider).[44]

Perhaps the simplest form of liability to consider is a form of strict liability – transfer payments that are mandatory upon proof of harm. We will consider a family of liability functions, in which each target bears some responsibility for liability of an attacked target, and each target bears some responsibility for damages incurred by its own victims. Thus, unaffected targets' liability to an affected target i would be given by:

$$\tau_{-i}(s_{-i}, s_i) = \alpha L \tag{3.19}$$

where the policy parameter α captures the fraction of a target's loss compensated by other targets. Under this formulation, the total amount received by i is therefore:

$$\sum_{j \neq i} \tau_{-i} = (N - 1)\alpha L \tag{3.20}$$

---

[44]A payment from target B to the victims at target A can be effected by a transfer from target B to target A, coupled with one from target A to its victims.

The liability of the attacked target to its own subsidiary victims is:

$$\theta_i \left(s_i, v_i \right) = \beta D v_i \tag{3.21}$$

where the policy parameter β represents the fraction of an individual's damages compensated by the target. Note that both of these parameters can be either positive or negative, at least in theory (though, as noted above, there may be practical limitations on expecting that β would ever take on negative values – a possibility we address below).

The introduction of liability rules such as those above obviously distorts both targets' and victims' choices. In the presence of these transfers, and in the case of 2 targets, the representative target's strategic choice becomes:

$$\max_{s_i} - \left[\rho(r_i, s_i) \cdot \left((1 - (N-1)\alpha) L + \beta v_i D \right) + \sum_{j \neq i} \rho \left(r_j, s_j \right) \alpha L + s_i \right] \tag{3.22}$$

Consequently, the target's optimal choice has the following first order condition:[45]

$$- \left(\rho_s + \rho_r \frac{dr_i}{ds_i} \right) \left((1 - (N-1)\alpha) L + \beta v_1 D \right) - \rho(r_i, s_i) \beta D \frac{dv_i}{ds_i} - \sum_{j \neq i} \left(\rho_r \frac{dr_j}{ds_i} \right) \alpha L - 1 = 0 \tag{3.23}$$

Similarly, with victims, the market-clearing conditions also change to reflect the damage payments that victims might expect. Under the above liability regime, this market-clearing condition becomes:

$$
\begin{aligned}
G - G_0 - \gamma \left(\frac{v}{2} \right) - \rho \left(s_i, r_i \right) (1 - \beta) D &= 0 \Leftrightarrow \tag{3.24} \\
G - G_0 - \gamma \left(\frac{v}{2} \right) - \rho \left(s_i, r_i \right) D &= -\rho \left(s_i, r_i \right) D \beta
\end{aligned}
$$

---

[45]Note that in the case of $\alpha = \beta = 0$, this condition reduces to:

$$- \left(\rho_s + \rho_r \frac{dr_i}{ds_i} \right) L - 1 = 0$$

which coincides with the no-liability FOC derived above.

The terrorist's structural conditions for maximization remain unchanged, as terrorists are assumed to be beyond the reach of the tort system.

Under a liability regime, then, the social planner will now anticipate these distortions and solve the following:

$$\max_{\hat{v},\hat{s}} \Psi\left(\hat{r},\hat{s},\hat{v}\right) \tag{3.25}$$

subject to

$$\Gamma'(A) \;\; = \;\; \rho_r(\hat{s},\hat{r})B(L,\hat{v})$$

$$\text{Equation} \qquad (3.23)$$

$$\text{Equation} \qquad (3.24)$$

Analysis of this problem yields the following proposition:

Proposition 3.6. *If the policy choice of α and β is unconstrained, and if (A1) holds, then the optimal strict liability regime (α^*, β^*) is unique and implements the constrained second-best allocation of the social planner's problem, $\{\hat{r},\hat{s},\hat{v}\}$. The optimal liability regime is given by:*

$$\beta^* \;\; = \;\; \left. \frac{-\left(\rho_r \frac{d\hat{r}}{d\hat{v}}\right)(\hat{v}D + L)}{\rho\left(s_i, r_i\right)D}\right|_{\{\hat{r},\hat{s},\hat{v}\}}$$

$$\alpha^* \;\; = \;\; \left. \frac{-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)(L + \beta^* \hat{v}D) - \rho(r_i,s_i)\beta^* D\frac{dv_i}{ds_i} + \left(\rho_s + \rho_r \sum_j \frac{dr_i}{ds_j}\right)(\hat{v}D + L)}{\left[-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)((N-1)L) + \sum_{j\neq i}\left(\rho_r \frac{dr_j}{ds_i}\right)L\right]}\right|_{\{\hat{r},\hat{s},\hat{v}\}}$$

Moreover, under this regime, $\beta^* < 0$, and thus targets always would have potential cause of action against their subsidiary victims, but not vice versa. The net transfer of resources from unaffected targets to affected targets is ambiguous in sign, but increases with the extent of risk-shifting: that is, moving inversely in $\frac{dr_j}{ds_i}$ and in $\frac{dv_i}{ds_i}$.

Perhaps the most surprising aspect of the above proposition is its implications for victims.

Indeed, the socially optimal liability rules require that victims reimburse affected targets in the event of an attack, and not vice-versa. This counter-intuitive result is due to the negative externality victims impose on targets: as noted above victims tend to free-ride off the protection investments of targets, failing to account for the enhanced risk their patronage places on other victims and the target itself.

As noted in Section 2, however, it is difficult to believe that allowing a cause of action against subsidiary victims is a viable policy choice for regulators. Indeed, not only will those defendants be more likely to be judgment-proof, but they will have also suffered significant injuries (or death) themselves, a fact that makes it difficult (perhaps prohibitively so) for a cause of action against victims to be politically palatable. To account for this tension, we introduce one more constraint on the regulator's problem, in which she is confined to choosing only nonnegative values for β. Adding this constraint to the regulator's problem immediately yields the following proposition:

Proposition 3.7. *If the policy choice of α and β is constrained so that $\beta \geq 0$, then the optimal strict liability regime (α_c^*, β_c^*) does not implement the constrained second-best social planner's optimum, but instead implements $\{r_c, s_c, v_c\}$, where $v_c > \hat{v}$ and $r_c > \hat{r}$. Here, the optimal liability regime is given by*

$$
\begin{aligned}
\beta^* &= 0 \\
\alpha^* &= \frac{-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right) L + \left(\rho_s + \rho_r \sum_j \frac{dr_i}{ds_j}\right)(\hat{v}D + L)}{-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)((N-1)L) + \sum_{j \neq i}\left(\rho_r \frac{dr_j}{ds_i}\right) L}
\end{aligned}
$$

Under this regime, targets neither have a cause of action against their subsidiary victims, nor do victims have a cause of action against targets. The net transfer of resources from unaffected targets to affected targets is positive if and only if, at the social optimum,

$$
\frac{1}{L} < -\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)\Bigg|_{\{\hat{r}, \hat{s}, \hat{v}\}}
$$

and increases with the extent of risk-shifting: that is, moving inversely in $\frac{dr_j}{ds_i}$ and in $\frac{dv_i}{ds_i}$.

Note that the constraints above might be too generous, relative to existing legal templates. Since transfers from a harmed target to unharmed targets seem legally infeasible, it may be appropriate to impose the additional constraint that $\alpha \geq 0$. Under this added constraint, if the optimal α from Proposition 3.7 were negative, the best feasible liability structure would be no liability rules at all ($\alpha = \beta = 0$).

The next subsection discusses some of the core intuitions behind the above two propositions.

3.4   Intuition Behind Results

The optimal liability regime is built to solve three basic problems, each of which contributes to the form of the optimal transfer payments described above. The easiest way to understand the results in toto is to isolate each of three market failures: (1) Failure of targets to account for the interests of victims; (2) External effects of targets on other targets; and (3) External effects of victims on targets and other victims. Below we show how each of these factors is captured in the above results. We concentrate on the two target case for expositional reasons (though the results carry forward to the N target case).

3.4.1   Accounting for Victims

The first and most conventional source of market failure is the inability of targets to account for the interests of their subsidiary victims, absent a liability regime. To focus attention on this problem, we will suppose that there are no external effects of target behavior, $\frac{dr_2}{ds_1} = 0$, and that victim behavior has no external effects on targets, $\frac{dr}{dv} = 0$.

In this case, the optimal liability transfers reduce to:

$$\alpha L = -vD \tag{3.26}$$

$$\beta = 0 \tag{3.27}$$

In the event of an attack, the target of interest pays the unaffected target the value of victim losses, but no other transfers are made. Victim behavior has no external effects on targets, and target behavior has no effects on other targets. The only inefficient margin of decisionmaking is the target's private return to protection, which excludes the expected losses of victims from an attack and thus fails to match the social return to protection. To correct this problem, the optimal liability rule requires that the target pay for victim losses.

Note, however, that this payment does not go to victims. In this environment, victim decisionmaking is exactly efficient: victims do not shift external risk onto targets. Transfers to victims would only be distortionary. Moreover, note that the payment being made *to* the unaffected target is largely incidental. We could just as easily have required that the target pay the government a fine equal to victim losses. In this particular case, the money received by the unaffected target has no impact on its incentives, because the unaffected target cannot manipulate the risk of attack. In this case, the unaffected target functions as nothing more than a repository for the payment made by the damaged target. Therefore, this liability rule can be equivalently implemented as a fine paid by the affected target, where the fine is set equal to the value of victim losses. This reinforces the importance of decoupling liability for victim losses from payments to victims.

3.4.2 External Effects Among Targets

We now consider external effects among targets, or the possibility that $\frac{dr_2}{ds_1} \neq 0$. Without loss of generality, consider the case of target substitution, where $\frac{dr_2}{ds_1} > 0$, so that protection expenditures by one target cause terrorists to substitute to another target. In this case, the

optimal liability transfer becomes:

$$\alpha L = vD \overbrace{\frac{\rho_s + \rho_r \frac{dr_1}{ds_1}}{\rho_r \frac{dr_2}{ds_1} - \left(\rho_s + \rho_r \frac{dr_1}{ds_1}\right)}}^{-1 \leq \cdot \leq 0} + L \overbrace{\frac{\rho_r \frac{dr_2}{ds_1}}{\rho_r \frac{dr_2}{ds_1} - \left(\rho_s + \rho_r \frac{dr_1}{ds_1}\right)}}^{1 \geq \cdot \geq 0}$$

$$\beta = 0$$

Since victim behavior involves no external effects, there continues to be no reason to transfer resources to or from victims. However, the fine paid by the affected target is now partially offset by a transfer from the unaffected target. The logic here is that the behavior of the other targets contributed in part to the losses experienced by victims. As a result, the bill for victims' losses is borne jointly. Similarly, there is also a transfer from the unaffected target to the affected one, to compensate it for its own losses caused by risk-shifting. This transfer is a fraction of the target's own losses, and represents the way in which these losses are also borne jointly.

This type of arrangement might be difficult to implement through the courts, because judges might be reluctant to hold a target liable for being too secure. However, a mutual insurance pool presents us with a feasible way of implementing this policy. The pool can be designed to exploit the fact that the transfer from one target to another is always less than $vD + L$.

To take the simplest structure—one that lacks any insurance features—suppose that all potential targets of terrorism contribute $vD + L$, total damages in the event of an attack, to a pool. If an attack does not take place, their money is refunded. If an attack does take place, the affected target receives back the amount $vD + (1 + \alpha)L > 0$; this results in a net transfer to the affected target of size αL. The pool will necessarily have enough funds on hand to make this transfer, because $\alpha L \leq vD + L$. Remaining funds in the pool are then refunded to the unaffected targets.

If $\alpha L > 0$, the affected target receives a net transfer, and the pool can also incorporate

an insurance feature. If there are N targets, each can contributes $\frac{vD+L}{N}$ to the pool. In the event of an attack, the affected target can then be paid αL, and the remainder can be refunded to the unaffected targets. If N is large, this approximates the efficient outcome.

3.4.3 Externalities from Victim Behavior

Finally, we analyze the externalities in victim behavior. If terrorists value casualties, so that $\frac{dr_1}{dv_1} > 0$. This results in inefficiency, because victims do not consider the impact of their behavior on the risk faced by targets.

Adding the victim externalities introduces a transfer from victims to the affected target, to account for the risk they shift onto the target: $\beta = -\left(\frac{\rho_r}{\rho} \frac{\partial \hat{r}}{\partial \hat{v}}(\hat{s}, \hat{r}) \right) \left(\frac{\hat{v}D+L}{D} \right)$. This transfer from victims to targets aligns victims' private margins with social margins, but it actually introduces distortion into target decisionmaking. When $\beta = 0$, the private returns to protection are exactly equal to the social returns. Nonzero β eliminates this result. As a result, equation 5.6 incorporates a transfer payment that purges the effect of β from the target's decision problem, by causing targets to disgorge a component of this payment to other targets (capitalized within the transfer payment going between affected and unaffected targets).

In other words, payment by victims leads to efficient behavior for them, but channeling this payment to targets can distort targets' incentives. A better solution might be to impose payments or fines—or, more realistically, offer only incomplete insurance to risk-averse victims—on victims, while at the same time maintaining a mutual pool among targets to correct problems in their decisionmaking.

4 Caveats and Extensions

Before concluding, we turn briefly to two caveats and/or extensions of our model. First, we consider alternative liability regimes (such as negligence). We then consider the effect of

more general "public good" dimensions of target hardening – i.e., the possibility that more impervious targets may create a general benefit for society because people feel 'safer.'

4.1 Alternative Liability Approaches

The discussion above has focused exclusively on relatively simple "strict" liability rules versus no liability. In many ways, this makes sense, given the fact that these two options are well represented among states (see Section 2 above). Moreover, so long as the regulator's choice is unrestricted (i.e., β can be either positive or negative), we demonstrated that a strict liability system can replicate the outcome of the social planner's problem. However, other possible variations exist – particularly variations on negligence rules – and we turn brief attention such variations here.

Consider first the possibility of a simple negligence regime governing both target liability to other targets and target liability to victims. Under a target-on-target regime, liability of an unaffected target to an affected one turns on whether the that targets have exceeded a prescribed threshold level of precautions, s^N. Only if an unaffected target's expenditures exceed this level will liability be found. Thus, with appropriately large sanctions, it is always possible to induce targets to implement no more than the prescribed level of precaution.

On the other hand, implementing a negligence regime for victims is extremely problematic. Indeed, as has already been demonstrated, when victims respond to target-hardening by increased patronage, the case for any liability at all becomes difficult to defend on efficiency grounds. Equivalently, then, the optimal negligence scheme would place the negligence standard at zero, so that all firms satisfied it.

Nevertheless, one could envision – at least in theory – a negligence regime that was based on liability of victims to affected targets. Under this view, victims would be liable to an attacked target whenever their aggregate patronage of the target exceeded some prescribed threshold level. But such an approach is even less satisfactory on pragmatic grounds than

strict liability of victims to targets. First, just as with strict liability, victims may be liquidity-constrained, and not in a position even to make damages payments to targets. Second, because each victim contributes only a portion of the overall congestion in a given target, it is virtually impossible to implement a negligence rule for victims: indeed, this would require identifying the victim(s) that effectively "caused" overall patronage to exceed the level that is prescribed by the negligence standard.

Consequently, the optimal negligence rule in our model would look very much like the optimal strict liability rule: victims would have no cause of action against attacked targets, but attacked targets would have a potential cause of action against other targets if the degree of risk-shifting were sufficiently high.[46]

4.2 Public Goods

In focusing on incentive effects, we did not discuss the role of public goods in protection against terrorism (see Lakdawalla and Zanjani, 2005). If society is particularly interested in the patronage of certain landmark buildings or downtown areas, there may be social reasons to compensate victims in the event of a terrorist attack. Similarly, if there is a public good associated with the construction of landmark buildings that might be more heavily targeted by terrorists, society may have incentives to encourage such building by providing additional protection against terrorism.

These types of victim compensation plans can be deployed in conjunction with liability arrangements. Perfectly insuring victims against losses has undesirable incentive effects, but partial compensation from society to victims may promote the public good while still retaining efficient incentives to avoid high-profile targets.

Similarly, there may be public goods associated with building in high-profile downtown areas. This may justify transfers, perhaps in the form of subsidized terrorism insurance,

---

[46]A similar set of arguments would apply to other variations on negligence, such as comparative and contributory negligence. We therefore omit them in our analysis.

from society to the targets of terrorism. Such transfers can be incorporated into the mutual insurance pool described above, by allowing taxpayers to contribute to the pool and thus implicitly underwrite insurance against terrorist attacks.

5   Concluding Remarks

This paper has considered the appropriate role of civil liability in the wake of a terrorist act, under the assumption that terrorists themselves (and those controlling them) are beyond the reach of courts. We have demonstrated that it is possible in theory to design a liability regime that induces an efficient allocation of precaution. In practice, however, such a regime required would extremely difficult (if not impossible) to implement. In particular, under plausible conditions, the optimal liability regime involves transfers *from* victims to affected targets, and possibly even *from* affected targets to unaffected targets. Such transfers seem unlikely (and even absurd) under traditional doctrinal templates within tort law. Moreover, they would offer few (if any) advantages over a simpler approach involving mutual insurance for targets and direct compensation to victims.

There are a number of relatively simple extensions to our analysis that, we conjecture, would complicate it but not reverse our findings. Introducing risk-aversion into our model, for example, would likely have only minor effects for our incentive story, but might make litigation a more attractive insurance vehicle. At the same time, of course, introducing risk aversion would also make *insurance* an even more attractive insurance vehicle, since it spreads risks more efficiently across individuals.

Similarly, introducing incomplete information would also likely have ambiguous changes on our results. Indeed, if agents were widely uninformed or misinformed, liability probably would have even less of a role to play, since (a) it is not clear what incentives agents will respond to, and (b) judges are likely to be similarly afflicted by a lack of information, inhibiting their ability to apply liability rules appropriately. On the other hand, asymmetric

information might provide some grounds for a liability regime that shifts much of the risk onto the party (or parties) with the best information. A significant difficulty with such an approach in this context, however, is the task of identifying a well-informed agent. Apart from the government, it is not clear which agents in society have above average information about the risk of terrorism or the effectiveness of protective investments.[47]

There is, however, one crucial distinguishing feature of terrorism that we have not considered at great length: the "public good" value of national security or prestige. Terrorism policy is made in the context of a war effort, where terrorists seek to undermine national confidence and security. Because defeating that goal may constitute a public good, victim compensation may be an appropriate and welfare-enhancing way to induce individuals to continue with normal life in the face of terrorism risk. Moreover, as noted above, if security has a sufficiently large public good value, then the optimal liability regime may align more coherently with existing tort law templates. But even so, if one were convinced that the public good value of security were this important, it is difficult to understand why targets alone should pick up the tab. Direct compensation from the government, in fact, may still be preferable to liability. Contributing to this conclusion is the government's own set of terrorism incentives: although not analyzed above, government actions themselves often influence terrorism risk, perhaps more than any other private actor we have considered; payments from the government may sometimes make general sense on pure incentive grounds as well.

Viewed in this light, the September 11 Victims' Compensation Fund was well-conceived, but may not have gone far enough to preclude opt-out tort claims. In the end, more research is likely needed on public goods provision as it relates to terrorism and liability incentives. This paper hopefully provides a helpful first step.

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[47]Although not explored at length here, relaxing the assumption of symmetric distributions of targets and victims would be unlikely to change our qualitative conclusions, which emanate exclusively from *marginal* optimization conditions. Asymmetrically distributed targets, however, might imply the optimality of target-specific liability parameters (α and β) however, but whose qualitative characteristics would still correspond to the propositions above.

Appendix

This appendix clarifies (in very rough form) some of the variable construction from the text, as well as providing proofs of the propositions (when necessary).

A.1 Variable Construction

A.2 Terrorist Comparative Statics

In the two-target case (the N-target case is virtually identical), the terrorists' first order conditions can be written as:

$$\Gamma'(A) - \rho_r(s_1, r_1)B(L, v_1) = 0 \tag{5.1}$$
$$\Gamma'(A) - \rho_r(s_2, r_2)B(L, v_2) = 0 \tag{5.2}$$
$$R - A - r_1 - r_2 = 0 \tag{5.3}$$

Assuming a symmetric equilibrium with two targets (i.e., $r_1 = r_2 = r^e$) and differentiating with respect to s_1 yields the relationships between terror investments and target protection:

$$
\begin{aligned}
\frac{\partial r_1}{\partial s_1} &= \frac{\rho_{rs}B(\Gamma'' + \rho_{rr}B)}{(\Gamma'')^2 - (\Gamma'' + \rho_{rr}B)^2} < 0 \\
\frac{\partial r_2}{\partial s_1} &= \frac{(-\Gamma'')(\rho_{rs}B)}{(\Gamma'')^2 - (\Gamma'' + \rho_{rr}B)^2} \geq 0 \\
\frac{\partial A}{\partial s_1} &= \frac{\rho_{rs}\rho_{rr}B^2}{(\Gamma'')^2 - (\Gamma'' + \rho_{rr}B)^2} > 0
\end{aligned}
\tag{5.4}
$$

These expressions also demonstrate the implication of deterrence cited in the text: $\left|\frac{\partial r_1}{\partial s_1}\right| > \left|\frac{\partial r_2}{\partial s_1}\right|$

The comparative static relationships between victim choices and terrorist decisions are similar. In the symmetric two-target case, differentiating with respect to v_1 reveals that:

$$
\begin{aligned}
\frac{\partial r_1}{\partial v_1} &= \frac{\rho_r B_v(\Gamma'' + \rho_{rr}B)}{(\Gamma'')^2 - (\Gamma'' + \rho_{rr}B)^2} > 0 \\
\frac{\partial r_2}{\partial v_1} &= \frac{(-\Gamma'')(\rho_r B_v)}{(\Gamma'')^2 - (\Gamma'' + \rho_{rr}B)^2} < 0 \\
\frac{\partial A}{\partial v_1} &= \frac{\rho_r B_v \rho_{rr}B}{(\Gamma'')^2 - (\Gamma'' + \rho_{rr}B)^2} < 0
\end{aligned}
\tag{5.5}
$$

These expressions demonstrate that an increase in protection by any one target increases the aggregate number of victims exposed to terrorism: $\left|\frac{\partial r_1}{\partial v_1}\right| > \left|\frac{\partial r_2}{\partial v_1}\right|$

A.3 Victim Comparative Statics

Differentiating the equilibrium condition for the marginal victim yields the following expressions:

$$
\begin{aligned}
\frac{dv_1}{ds_1} &= \frac{d}{ds_1}\left[2\theta\left(G - G_0 - \rho\left(s_i, r_i(\overrightarrow{s}, \overrightarrow{v})\right)D\right)\right] \\
&= 2\theta'\left(G - G_0 - \rho\left(s_i, r_i\right)D\right) \cdot \left(-\rho_s D - \rho_r D\left[\frac{\partial r_1}{\partial v_1}\frac{\partial v_1}{\partial s_1} + \frac{\partial r_1}{\partial s_1}\right]\right) \\
&\Leftrightarrow \\
\frac{dv_1}{ds_1} &= \frac{2\theta'\left(G - G_0 - \rho\left(s_i, r_i\right)D\right) \cdot \left(-\rho_s D - \rho_r D \cdot \frac{\partial r_1}{\partial s_1}\right)}{1 + 2\theta'\left(G - G_0 - \rho\left(s_i, r_i(\overrightarrow{s}, \overrightarrow{v})\right)D\right) \cdot \rho_r D \cdot \left(\frac{\partial r_1}{\partial v_1}\right)} > 0
\end{aligned}
$$

$$
\begin{aligned}
\frac{dv_1}{ds_2} &= \frac{d}{ds_2}\left[2\theta\left(G - G_0 - \rho\left(s_i, r_i(\overrightarrow{s}, \overrightarrow{v})\right)D\right)\right] \\
&= 2\theta'\left(G - G_0 - \rho\left(s_i, r_i\right)D\right) \cdot \left(-\rho_r D\left[\frac{\partial r_1}{\partial v_1}\frac{\partial v_1}{\partial s_2} + \frac{\partial r_1}{\partial s_2}\right]\right) \\
&\Leftrightarrow \\
\frac{dv_1}{ds_2} &= \frac{2\theta'\left(G - G_0 - \rho\left(s_i, r_i\right)D\right) \cdot \left(-\rho_r D\frac{\partial r_1}{\partial s_2}\right)}{1 + 2\theta'\left(G - G_0 - \rho\left(s_i, r_i\right)D\right) \cdot \left(\rho_r D\frac{\partial r_1}{\partial v_1}\right)} < 0
\end{aligned}
$$

These equations also imply the result given in the text, that:

$$
\left|\frac{\partial v_1}{\partial s_1}\right| > \left|\frac{\partial v_1}{\partial s_2}\right| = \left|\frac{\partial v_2}{\partial s_1}\right|
$$

A.4 Equilibrium for Victims

The victims' first order conditions are:

$$
\begin{aligned}
\gamma\left(v_1\right) + \rho\left(s_1, r_1\left(v_1, v_2, s_1, s_2\right)\right)D - \Delta_G &= 0 \\
\gamma\left(v_2\right) + \rho\left(s_2, r_2\left(v_1, v_2, s_1, s_2\right)\right)D - \Delta_G &= 0
\end{aligned}
$$

which have an associated Jacobian:

$$
J = \left[\begin{array}{cc} \gamma'\left(v_1\right) + \rho_r\left(s_1, r_1\right)D \cdot \frac{\partial r_1}{\partial v_1} & \rho_r\left(s_1, r_1\right)D \cdot \frac{\partial r_1}{\partial v_2} \\ \rho_r\left(s_2, r_2\right)D \cdot \frac{\partial r_2}{\partial v_1} & \gamma'\left(v_2\right) + \rho_r\left(s_2, r_2\right)D \cdot \frac{\partial r_2}{\partial v_2} \end{array}\right],
$$

which in turn has determinant:

$$
\begin{aligned}
|J| &= \left(\gamma'\left(v_1\right) + \rho_r\left(s_1, r_1\right)D \cdot \frac{\partial r_1}{\partial v_1}\right) \cdot \left(\gamma'\left(v_2\right) + \rho_r\left(s_2, r_2\right)D \cdot \frac{\partial r_1}{\partial v_1}\right) \\
&\quad - \left(\rho_r\left(s_1, r_1\right)D \cdot \frac{\partial r_1}{\partial v_2}\right) \cdot \left(\rho_r\left(s_2, r_2\right)D \cdot \frac{\partial r_2}{\partial v_1}\right)
\end{aligned}
$$

Evaluated at a symmetric equilibrium, we know that $r_1 = r_2 = r_e$; $s_1 = s_2 = s_e$, $v_1 = v_2 = v_e$, $\frac{\partial r_1}{\partial v_1} = \frac{\partial r_2}{\partial v_2} = \frac{\partial r_i}{\partial v_i}$; $\frac{\partial r_1}{\partial v_2} = \frac{\partial r_2}{\partial v_2} = \frac{\partial r_i}{\partial v_j}$. And thus we have:

$$|J| = \left(\gamma'(v_e) + \rho_r(s_e, r_e) D \cdot \frac{\partial r_i}{\partial v_i}\right)^2 - \left(\rho_r(s_e, r_e) D \cdot \frac{\partial r_i}{\partial v_j}\right)^2$$
$$> 0$$

where $i = 1, 2$. We can sign this determinant as positive since, as demonstrated above, $\left|\frac{\partial r_i}{\partial v_i}\right| > \left|\frac{\partial r_i}{\partial v_{-i}}\right|$.

Now consider how a change in s_1 affects equilibrium values of v. The vector of s_1 derivatives of the victims' market clearing condition is:

$$\begin{bmatrix} \rho_s + \rho_r \frac{\partial r_1}{\partial s_1} D \\ \rho_r \frac{\partial r_2}{\partial s_1} D \end{bmatrix}$$

Note that both of these terms are positive. The substituted Jacobian is therefore:

$$J = \begin{bmatrix} \rho_s + \rho_r \frac{\partial r_1}{\partial s_1} D & \rho_r(s_1, r_1) D \cdot \frac{\partial r_1}{\partial v_2} \\ \rho_r \frac{\partial r_2}{\partial s_1} D & \gamma'(v_2) + \rho_r(s_2, r_2) D \cdot \frac{\partial r_2}{\partial v_2} \end{bmatrix},$$

which, when evaluated at a symmetric equilibrium, has determinant:

$$|J_1| = \overbrace{(\gamma'(v_e)\rho_s)}^{(-)} + \overbrace{(D\rho_r)}^{(-)} \left(\overbrace{\gamma'(v_e)\frac{\partial r_i}{\partial s_i}}^{(-)} + \overbrace{\frac{\partial r_i}{\partial v_i}\rho_s}^{(-)} + \overbrace{D\rho_r}^{(+)} \overbrace{\left[\frac{\partial r_i}{\partial v_i}\frac{\partial r_i}{\partial s_i} - \frac{\partial r_i}{\partial v_j}\frac{\partial r_j}{\partial s_i}\right]}^{(-) \quad (-)} \right)$$

If the square bracketed term is weakly negative, then $|J_1| < 0$. But this is clearly satisfied, since we know from above that the own partials on r_i have higher absolute value than the cross partials on r_i. Thus, we have:

$$\frac{\partial v_1}{\partial s_1} = -\frac{|J_1|}{|J|} = -\frac{(\gamma'(v_e)\rho_s) + D\rho_r\left(\gamma'(v_e)\frac{\partial r_i}{\partial s_i} + \frac{\partial r_i}{\partial v_i}\rho_s + D\rho_r\left(\frac{\partial r_i}{\partial v_i}\frac{\partial r_i}{\partial s_i} - \frac{\partial r_i}{\partial v_{-i}}\frac{\partial r_j}{\partial s_i}\right)\right)}{\left(\gamma'(v_e) + \rho_r(s_e, r_e) D \cdot \frac{\partial r_i}{\partial v_i}\right)^2 - \left(\rho_r(s_e, r_e) D \cdot \frac{\partial r_i}{\partial v_j}\right)} > 0$$

Now consider comparative statics on v_2. The substituted Jacobian is:

$$J_2 = \begin{bmatrix} \gamma'(v_1) + \rho_r(s_1, r_1) D \cdot \frac{\partial r_1}{\partial v_1} & \rho_s + \rho_r \frac{\partial r_1}{\partial s_1} D \\ \rho_r(s_2, r_2) D \cdot \frac{\partial r_2}{\partial v_1} & \rho_r \frac{\partial r_2}{\partial s_1} D \end{bmatrix},$$

which, when evaluated at a symmetric equilibrium, has determinant:

$$|J_2| = \rho_r D \left(\gamma'(v_e)\frac{\partial r_i}{\partial s_j} - \frac{\partial r_i}{\partial v_j}\rho_s + D\rho_r\left[\frac{\partial r_i}{\partial v_i}\frac{\partial r_j}{\partial s_i} - \frac{\partial r_i}{\partial v_j}\frac{\partial r_i}{\partial s_i}\right]\right)$$
$$= \rho_r D \left[\left(\overbrace{\gamma'(v_e)\frac{\partial r_2}{\partial s_1}}^{(+)}\right) - \left(\overbrace{\frac{\partial r_i}{\partial v_j}}^{(+)}\rho_s\right)\right]$$

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Thus, we have

$$\frac{\partial v_2}{\partial s_1} = -\frac{\rho_r D \left(\gamma'(v_e) \frac{\partial r_i}{\partial s_j} - \frac{\partial r_i}{\partial v_j} \rho_s \right)}{|J|}$$

This derivative is negative so long as:

$$\gamma'(v_e) \frac{\partial r_2}{\partial s_1} \quad < \quad \frac{\partial r_2}{\partial v_1} \rho_s$$
$$\Leftrightarrow$$
$$\gamma'(v_e) \quad < \quad \frac{\rho_r \rho_s B_v}{\rho_{rs} B}$$

The interpretation here is simple: So long as the "crowding" effect on a target is not "too" large, victims will tend to flock away from targets that have lower relative protection. When crowding effects are large, on the other hand, hardening a target will induce more victims to enter the risky activities, so much so that some of them may choose to spend time at the unhardened target (realizing that, in equilibrium, terrorists will be spending less effort to attack it).

A.5 Proof of Proposition 3.5

The proposition follows immediately from the textual analysis, and the proof is therefore omitted.

A.6 Proof of Proposition 3.6

The unconstrained liability problem can be solved in two stages. Victim behavior only depends on β. Target behavior depends on both. So we proceed by fixing β optimally, and fixing α optimally given β.

Recall that the social optimum for $\hat{v}$ is characterized by:

$$G - G_0 - \gamma\left(\frac{\hat{v}}{2}\right) - \rho(\hat{s}, \hat{r})D = \left(\rho_r \frac{d\hat{r}}{d\hat{v}}\right)(\hat{v}D + L)$$

whereas the market clearing condition for victims is:

$$G - G_0 - \gamma\left(\frac{v}{2}\right) - \rho(s_i, r_i)D = -\rho(s_i, r_i)D\beta$$

Evaluating both expressions at the social optimum and substituting allows us to solve for β by setting the RHS of the two above expressions equal to one another:

$$\beta^* = \frac{-\left(\rho_r \frac{d\hat{r}}{d\hat{v}}\right)(\hat{v}D + L)}{\rho(s_i, r_i)D}$$

Given this value of β, we consider the target's optimal choice, similarly comparing it to the social optimum, so that (after substitution):

$$\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)\left((1 - (N-1)\,\alpha)\,L + \beta v_1 D\right) + \rho(r_i, s_i)\beta D \frac{dv_i}{ds_i} + \sum_{j \neq i}\left(\rho_r \frac{dr_j}{ds_i}\right)\alpha L$$

$$= \left(\rho_s + \rho_r \sum_j \frac{dr_i}{ds_j}\right)(\hat{v}D + L)$$

Solving the above expression for α yields:

$$\alpha^* = \frac{-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)(L + \beta v_1 D) - \rho(r_i, s_i)\beta D \frac{dv_i}{ds_i} + \left(\rho_s + \rho_r \sum_j \frac{dr_i}{ds_j}\right)(\hat{v}D + L)}{\left[-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)((N-1)\,L) + \sum_{j \neq i}\left(\rho_r \frac{dr_j}{ds_i}\right)L\right]}$$

QED.

A.7 Proof of Proposition 3.7

Since the constraint on β must be binding, we know that $\beta = 0$. Substituting this value into the target's optimality condition, and comparing to the social optimality condition allows us to solve for α as follows:

$$\alpha = \frac{-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)L + \left(\rho_s + \rho_r \sum_j \frac{dr_i}{ds_j}\right)(\hat{v}D + L)}{-\left(\rho_s + \rho_r \frac{dr_i}{ds_i}\right)((N-1)\,L) + \sum_{j \neq i}\left(\rho_r \frac{dr_j}{ds_i}\right)L} \tag{5.6}$$

It is easily confirmed from the target's FOC that

$$\frac{ds_i}{d\alpha} < 0$$

and thus the target will be a net recipient if and only if its level of protection was inefficiently high in the absence of liability. This condition is tantamount to the inequality condition given in the proposition.

The first expression is straightforward: paying victims in the event of a loss makes them less averse to such a loss. In the second expression, the effect of target transfers on victims depends entirely on how these affect target protection. If target transfers increase the level of protection, they draw more victims in, and vice-versa. QED

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