



### Project 13c: Portfolio Allocation (Bier)

This work applies game theory and risk analysis to explore the optimal allocation of defensive investment to particular targets, taking potential adversary responses into account.

**Modeling Area:** Risk Analysis

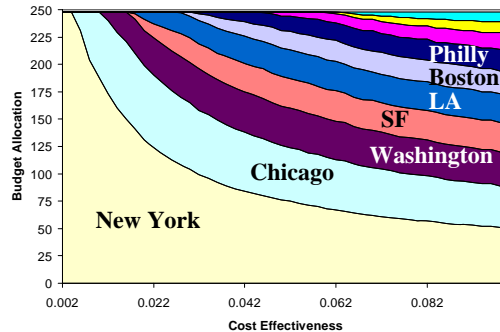
**Application Area:** Infrastructure Security,  
Risk-based Resource Allocation

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**Institution:** University of Wisconsin-Madison

**Student Research Assistants:**

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The optimal percent of defensive investment to allocate to less attractive targets increases as investment becomes more cost effective

#### Brief Description:

This work studies the optimal allocation of defensive resources to targets. The approach applies risk analysis and game theory to recommend an optimal allocation given the cost-effectiveness of defensive investments, and the extent of uncertainty about attacker goals.

#### Objectives:

The goal of this research is to explore how the optimal portfolio allocation for terrorism defense among more and less important targets depends on factors such as the cost-effectiveness of defensive investments, and the uncertainty about attacker goals and motivations.

#### Major Products and Customers:

- Qualitative guidance about portfolio allocation that could be used by state or federal agencies (for example, in the Urban Area Security Initiative)
- Insight into which factors have the largest effect on the optimal portfolio allocation, which could be used to guide further research efforts (e.g., to develop better information on the cost-effectiveness of security investment)

#### Interfaces to other CREATE Projects:

This project builds on theoretical models developed by CREATE in the past, will use data from the project on critical infrastructure protection, and will contribute to the case study on resource allocation. It also relates to basic methodological work being undertaken in other projects (e.g., development of software for portfolio allocation, modeling of terrorist decision processes).

#### Interfaces to non-CREATE Projects:

Preliminary discussions with personnel from the Wisconsin Office of Justice Assistance could eventually lead to a student internship or project applying this work at the state level.

#### Technical Approach:

CREATE-developed game-theoretic models of defense take into account the fact that terrorists are intelligent and adaptive, and can observe our defenses and adapt their strategies accordingly, but that defenders are uncertain about attacker goals and motivations. We are applying this

model to a realistic case study involving optimal allocation of defensive resources among cities, as a way to gauge the realism of the results.

We are beginning with estimates of the terrorism risk by city, produced by Rand using a model of terrorism risk originally developed by Risk Management Solutions. We eventually plan to apply the same technical approach to estimates of infrastructure density being developed by CREATE, for comparison purposes.

**Major Milestones and Dates:**

Basic analytical and computational tools have been developed, and extended to the case of multiple targets. Sensitivity analysis has revealed the fact that the cost effectiveness of defensive investment appears to be the most influential input parameters. Methods for extending the basic model to address overarching defenses (like border security or all-hazards protection) have been identified; a proposal has been submitted to the National Science Foundation to pursue that idea in greater depth.

1. Apply the model to data on infrastructure density – December 2006.
2. Revise and document computer code to be more user friendly – December 2006.
3. Extend to case of differing cost effectiveness of defensive investments – December 2006.
4. Write up results of Rand and infrastructure data for a refereed journal – March 2007.
5. Write up results on overarching defenses for a refereed journal – May 2007.