

# Economic Modeling for Homeland Security Analysis

by

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# Overview

- Most DHS Centers have economists affiliated with them
- Most of our research is on *consequences*, or economic impacts of terrorism
- Other areas of application:
  - risk analysis (e.g., identification of targets)
  - risk management (e.g., BCA of mitigation)

# Modeling Advances & Scope

- Begin with standard disaster loss estimation
- Modify it for features unique to terrorism
- Expand it to include:
  - Resilience (inherent & adaptive ability to mute impacts)
  - Behavioral linkages (amplification of risk)
  - Systems linkages (cascading failures)

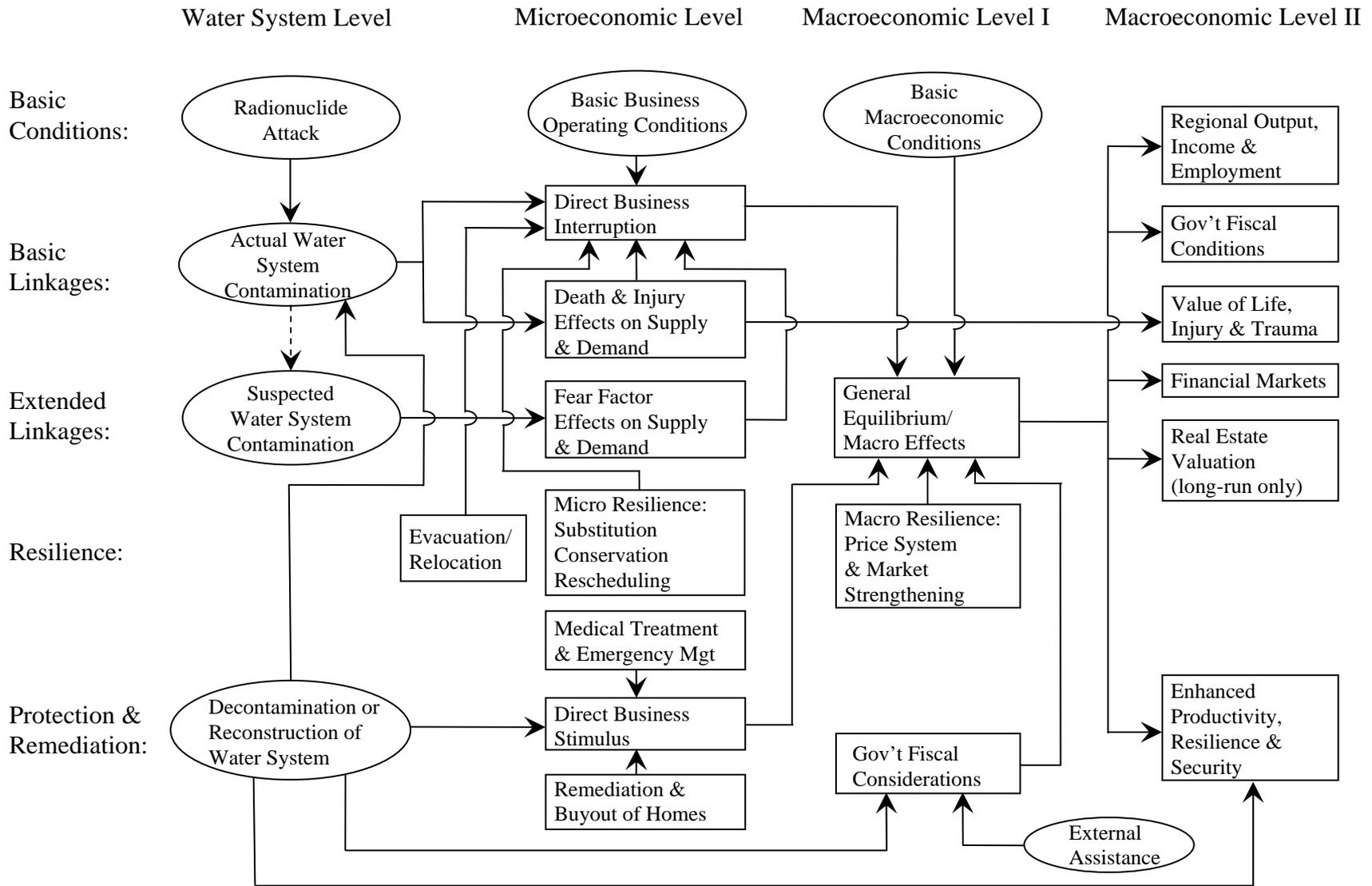


Figure 2. Estimating the Total Economic Impacts of a Radiological Attack on a Municipal Water System



# Modeling Approaches

- Macro
  - Input-Output (multi-regional)
  - Computable General Equilibrium (behavioral response)
  - Econometric (forecasting)
  - Network (systems-economy linkages)
- Micro
  - Agent-Based (behavioral response)
  - Experimental (valuation)
  - Utility/Production Function (terrorist target & capability)

# Economic Model Choice

- Strategic elements in model selection:
  - policy question
  - relevant assumptions (behavior, spatial resolution, role of markets, constraints)
  - data availability



# Spatially Disaggregated Impact Models

**Peter Gordon, Jim Moore, Harry Richardson**

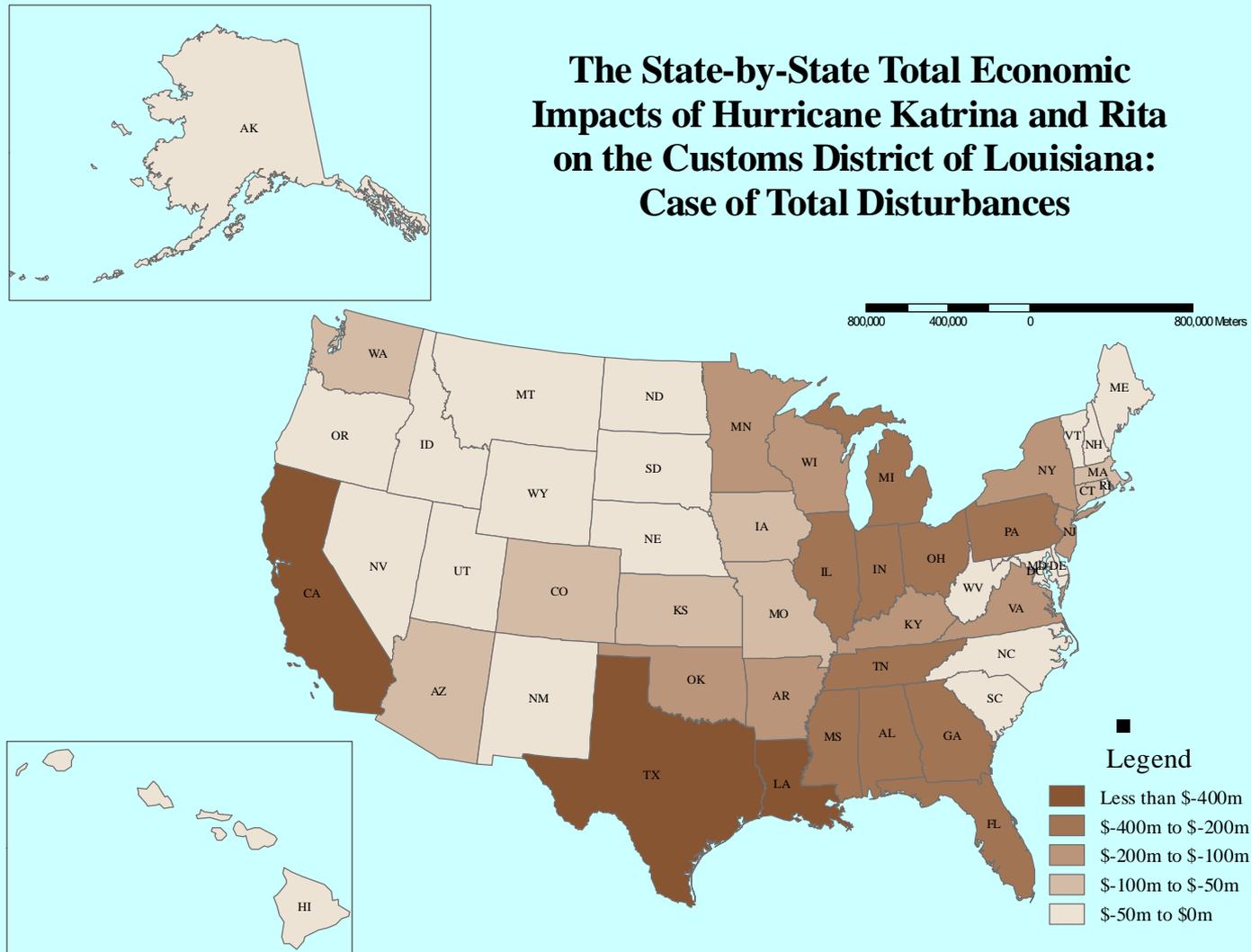
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## Key Research Results

- A Radiological Bomb Attack on the Los Angeles-Long Beach Ports (\$34 billion economic loss, SCPM)
- Conventional Bomb Attack on bridges – Terminal Island (up to \$3.75 billion economic loss per month, SCPM)
- Closure of 3 Ports (LA-LB, NY-NJ and Houston)
  - Application of NIEMO
  - One-Month Economic Loss = \$21 billion, \$14.4 billion, and \$8.4 billion, respectively

## The State-by-State Total Economic Impacts of Hurricane Katrina and Rita on the Customs District of Louisiana: Case of Total Disturbances



**Figure 9.** The State-by-State, Total Economic Impacts of Reductions in Foreign and Domestic Imports and Exports Through the Customs District of Louisiana Following Hurricanes Katrina and Rita: August 1<sup>st</sup> 2005 through March 31<sup>st</sup> 2006.



# Regional Economic Impact Analysis with Computable General Equilibrium Models

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USC



# Economic Resilience

## General Definition:

- *static*: ability of a system to maintain function when shocked
- *dynamic*: speed of a system to recover from shock

## Types of Resilience:

- *inherent*: normal ability during crises to maintain function (input/import substitution, market reallocation)
- *adaptive*: ingenuity during crises (increased substitution possibilities, market strengthening)



# Key Questions

- Is resilience a meaningful concept?
- Is resilience multi-dimensional?
- Can resilience be rigorously defined?
- Can resilience be empirically measured?
- How effective has resilience been to date?
- Can resilience be enhanced or depleted?

# Key Research Results

- A 2-week outage of *electricity* in Los Angeles County would result in losses of \$20.5 billion if resilience is non-existent and \$2.8 billion if resilience is maximized
- A 2-week outage of *water* in Los Angeles County would result in losses of \$20.7 billion if resilience is non-existent and \$2.3 billion if resilience is maximized

# Individual Resilience Options

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Resilience Factor	Water	Electricity
Conservation	1.0	6.1
Adaptive Substitution	1.6	3.9
Inventories/Storage	3.0	—
Alternative Sources	—	28.1
Importance	58.7	28.7
Production Rescheduling	75.5	79.4
Total	91.0	89.6

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# The Role of Public and Private Mitigation for Homeland Security Policy

**V. Kerry Smith**

Arizona State University

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**Carol Mansfield**

RTI International

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## Objectives

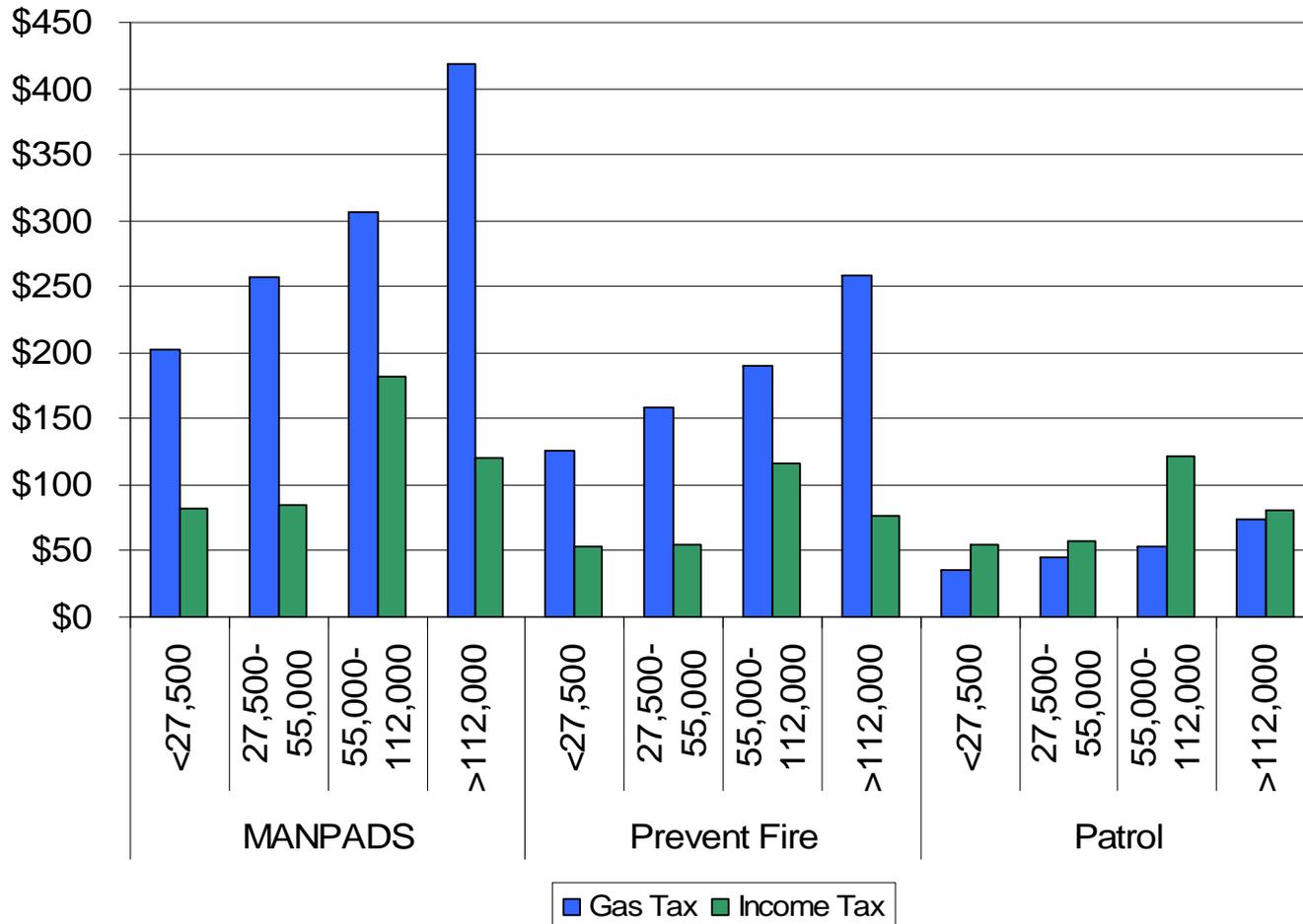
- Evaluate economic adjustment and learning in response to unexpected shocks – example: hurricanes
- Develop framework for rapid response estimation of benefits from protecting significant infrastructure – conjoint study of MANPADS
- Structure a choice based model of economic resiliency consistent with evaluation of policies to promote complementary public and private mitigation
- Measure incentives required to promote private mitigation likely to enhance economic resilience



## Stated Preference Conjoint Survey to Measure WTP for Airline Security

- Conjoint survey exploits relationship between mix and levels of a good's attributes and the economic value of that "good"
- Survey respondents offered a series of choices among "goods" with varying attribute mixes
- If cost is included as a component of each choice, then Willingness to Pay (WTP) can be estimated

# Annual WTP for Airline Missile Defense by Income Category





# The Dynamics of Public Response to a Terrorist Strike: Recommendations for Data Collection, Analysis and Modeling

**William J. Burns**

Cal State University- San Marcos

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## Objectives

- Model the Dynamics Driving Risk Perception and Risk-Related Behaviors in a Community following Disasters *with a Special Emphasis on Terrorism.*
- Develop Empirical and Simulation Models that Facilitate “Behaviorally Realistic” Risk Management in Response to Disasters.
- Provide a Methodological Structure that Allows Voice for Public Concerns Regarding Disasters.

## Technical Approach

- **Currently:** There exists a descriptively rich portrayal of people's perception of risk, trust and policy preferences with respect to disasters.
- **Limitations:** High resolution snapshots still unable to provide insight into dynamic processes driving community preparedness and response
- **Consequences:** Difficult to estimate ripple effects (*social, political, economic*) that might follow
- **Approach:** Longitudinal Growth Curve (captures threat event context) and System Dynamics Modeling (captures system feedbacks and delays)

# Bruce McCarl -- Economic Work within FAZD

## Basic Directions

Studies of economics of select prevention, detection, response and recovery strategies

- Carcass disposal
- Animal ID

Economics of balance between pre- vs post-event actions

Costing of events

- Linking with epidemiological models to cost out prospective events
- Market observation

Policy design

- Incentives for compliance
- Investments

# The Economic Balance Problem

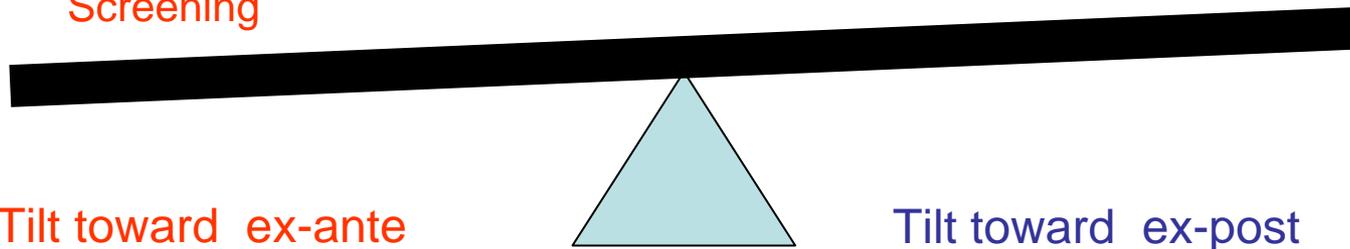
## Balance between pre and post event spending

### Ex-Ante Invest

Anticipation  
Prevention  
Installation  
Screening

### Ex-Post Fix

Detection  
Response  
Recovery



Event is more likely  
Ex-ante Activity has multi benefits  
Ex-ante Activity is more effective  
Ex-ante Activity is cheaper  
Ex-post treatment more costly  
Fast spreading disease  
More valuable target  
Big demand shift -- health

Event is less likely  
Ex-ante Activity is single purpose  
Ex-ante Activity is less effective  
Ex-ante Activity is expensive  
Ex-post treatment less costly  
Slow spreading disease  
Less valuable target  
Little demand shift -- health

# Robert Greenbaum, START-- Examine Indirect Economic Impacts Subsequent to Terrorist Incidents

## “The Effects of Domestic Terrorism on Local Economic Development”

- Robert Greenbaum and Tricia Petras, Ohio State University
- Paper to examine indirect economic impacts on businesses and employees (wages and employment) in US
- START Funding
- Uses Global Terrorism Database (GTD) based upon data originally collected by the Pinkerton Global Intelligence Service

Builds on two papers that also used GTD to examine indirect economic impacts of terrorist incidents in Italy

- “The Economic Impact of Terrorist Incidents on the Italian Hospitality Industry,” Robert Greenbaum and Andy Hultquist, *Urban Affairs Review* (September 2006)
- “The Impact of Terrorism on Italian Employment and Business Activity,” Robert Greenbaum, Laura Dugan, and Gary LaFree, *Urban Studies* (Forthcoming May 2007)



# Localized Violence Impacts Local Businesses Indirectly Too

- Cost of doing business influenced by violence
  - Increased security, insurance costs, interest rates
  - Increase labor costs due to difficulty in attracting workers
  - More difficult to attract frightened customers (may be industry specific)
  - Costs to moving to avoid violence
- Even “smaller” incidents impose costs



# Integrated Network of Centers Project on Econ & Community

- Smith/ Mansfield (CREATE): private-public complementarities in resilience & mitigation
- Epstein (PACER): behavioral epidemiology
- Mohtadi/ Kinsey (NCFPD): supply-chain
- McCarl (FAZD): animal populations & their mgt
- Greenbaum (START): relocation
- Norris et al. (START): community resilience
- Gordon et al. (CREATE): interregional resilience
- Rose (CREATE): modeling framework

# Expanding Our Client Base

- Transportation Security Administration
- Private Sector Office
- National Bioterrorism & Countermeasures Center
- Citizenship & Immigration Services