

The Role of Public and Private Mitigation for Homeland Security Policy
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1. Overview

Our research focused on two themes:

- Understanding the incentives required to induce private mitigating activities that are complementary to public activities to protect the general public and supporting infrastructure against terrorist activities and natural hazards and
- Adapting existing strategies for benefits transfer to meet the needs for evaluation of homeland security policies.

During Year 3, we met our primary goal—to develop the conceptual basis for and to implement a stated choice survey involving complementary private mitigating behaviors that could be related to homeland security. Intermediate outputs related to meeting this objective include working papers on the conceptual framework and another on modifying the household production framework to allow for uncertainty. Other outputs include developing complementary databases and the results from four focus groups, the survey pretest, and the final stated-choice survey.

The conceptual paper, “A Conceptual Framework for Modeling Economic Resilience,” reviews a number of structural models that have been and could be used to model the role for the resilience of an economy or more generally the interactions of economic, political, and social institutions in response to shocks. In particular, we began the research necessary to consider the feasibility of incorporating models of individual choices that could be treated as private mitigating behaviors and in the aggregate enhance resilience of an overall economy into computable general equilibrium (CGE) models. Although significant research is required to begin the process of including these choices, the ultimate goal would be to use these types of frameworks to estimate net benefits from Department of Homeland Security (DHS) policies. The paper includes guidance on data collection to inform the model.

Our work focuses on developing the methods and data to estimate the welfare impacts of policies related to natural or terrorist events. The conceptual paper complements work done by Dr. Adam Rose on CGE modeling of resilience. The scenarios for the stated-choice survey were selected to provide data that could be used to evaluate bioterrorism as part of the CREATE case study (the foodborne illness scenario) and the REAL ID program that DHS is currently evaluating. As with the airline security survey, we designed the survey and questions to provide data to directly estimate welfare changes and to provide data for benefits transfer exercises, which will be an important part of the DHS strategy for benefits estimation.

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2. Research Accomplishments

The ASU/RTI project is part of the economics program at CREATE. Year 3 projects cover basic research providing theoretical support for resilience, model development, and primary data collection on potential DHS policies. The research activities during Year 3 of the ASU/RTI project had five objectives:

- To develop a conceptual framework that allows the estimation of the factors influencing households' willingness to undertake private mitigating activities that would complement public projects developing public mitigation and protection.
- To develop and complete a stated choice survey that would evaluate aspects of the conceptual framework describing how policy incentives might induce complementary mitigation.
- To extend the empirical analysis of the stated choice survey developed in Year 2 of the research activity. Our specific goal was to expand the econometric analysis of the stated choices among plans to protect against attacks of commercial aircraft from shoulder-mounted missiles.
- To initiate the process of adapting benefits transfer methods to the needs of DHS policy analysis.
- To investigate the feasibility of using the results from empirical models of private mitigation as part of what was labeled as "choice-based resilience" in our proposal to consider private mitigation and resilience in modeling economy-wide responses to shocks as part of the INC project.

During project Year 3, we completed two of our goals, made significant progress on a third, and have initiated a scoping analysis and some initial research on the remaining objectives. Below we detail the results under each goal and describe likely outputs from these activities.

Conceptual Analysis

With supplementary support from RTI International, we completed a working paper that a) reviews the literature adapting the concept of resilience as it has been used in ecology to describe the ability of economic systems to absorb shocks; b) outlines a conceptual framework for measuring resilience through choice-based surveys that offers a structure for describing the interrelationship between complementary private and public mitigation; and c) develops a new conceptual model for the revelation properties of a household production model, assuming perfect substitution between a private good and a public good in the presence of different types of uncertainty.

The working paper provides a conceptual basis for our new choice-based stated-preference survey (also known as a conjoint survey), which we completed at the close of Year 3. In addition, the paper describes an extension of the household production analysis. Subsequent research has also investigated the effects of the characterization of the uncertainty for the revealed preference estimates of willingness to pay for the public good. In this context, the public good is intended to represent some dimension of homeland security at a general level, and the private good, the private services available as some form of mitigation that substitutes for public protection.

Finally, the conceptual analysis was developed to demonstrate how private adjustment can be related, in a Nash framework, to the ways other economic agents' mitigation affects the level of the public good. The analysis also considers the influence of heterogeneity in individual marginal willingness to pay for safety on individuals' incentives to contribute to the public good.

Our current plan is to develop papers for submission to peer-reviewed journals from this research. One will describe the extensions to the household production framework developed by Drs. Strong and Smith; we expect that separate analysis will focus on using the envelop condition to link heterogeneity in values and the structure of the production of safety to an individual's willingness to undertake private mitigation by Drs. Smith and Strong; and finally it should be possible to use the choice-based model of private mitigation together with the new stated preference analysis by Drs. Smith, Mansfield, and Strong.

Stated Choice Analysis of Private Mitigation

The activities associated with developing the stated preference survey were the primary focus of the research during this year. They required a) the development of background materials for and analysis of the results from four focus groups; b) the design, formulation, and analysis of a Web-based pretest of the survey to address issues raised in the focus groups; and c) the design, formulation, and implementation of a final web-based survey of 1,606 respondents. Below we discuss each stage of this research.

Focus Groups

Four focus groups were undertaken during this funding period. Two were conducted in Phoenix, Arizona, in November 2006. An extended vignette was used to describe the temporal evolution of a pandemic. The “story” emphasized the potential interactions between public action and the opportunities for private mitigation. We adapted a scenario developed by Dr. Ingelsby at Johns Hopkins University’s Center for Civilian Biodefense Studies 1 to create an evolving sequence of information and included a set of short tasks for the focus group participants.

On the whole, the strategy was not successful. The participants did not find the pandemic scenario credible. They did not consider private mitigation options offered to be necessary and, in some cases, notably on the possibility of acquiring private medication to avoid the effects of the pandemic, found them to be implausible. When considering the overall problem, participants in the focus group tended to focus on what public officials “should” do and did not consider that they had a responsibility to protect themselves and thus the potential to undertake personal action.

The second set of focus groups were conducted at the end of May 2007 in New York City. These two groups were once again split by median household income in the New York City area (one group below \$50,000 and the other above). The objective of these focus groups was to consider the feasibility of presenting different types of threats within a comparative risk framework. Risk was described in terms of both the likelihood and the attributes of the events at risk. The use of quantitative measures for risk and descriptions of attributes was structured to allow participants to compare features of private and public sources for risk. The analysis was organized using foodborne pathogens as the source of risk. This strategy exploited the opportunities provided by the events in the news and also provided the possibility of linking to other dimensions of the INC project.

In addition, we investigated the plausibility of offering different designs for implementing the REAL ID program as a stated choice question. The analysis of the REAL ID program falls under the benefits transfer objective and fits with the survey conducted in Year 2 to evaluate plans for airline security. Both the airline security and REAL ID surveys are meant to evaluate the feasibility of “rapid response benefit measurement”—the ability to quickly design and field surveys to collect information for benefits analysis of DHS policies.

Both stated choice questions did not fare well in the focus group. Respondents had difficulty describing “typical” attributes of uncertain events. They indicated little concern about foodborne illness and were unwilling to undertake private mitigation.

¹ “Anthrax: A Possible Case History,” by Thomas V. Inglesby, M.D. Senior Fellow, Johns Hopkins Center for Civilian Biodefense Studies, Assistant Professor, Infectious Diseases. The First National Symposium on Medical and Public Health Response to Bioterrorism, Feb. 16-17, 1999. MSNBC, February 16, 1999.

The REAL ID program seemed salient to the New York City residents. The events of the 9/11 attack remained a significant influence on their expectations. Nonetheless, they were unwilling to consider the mitigation alternatives we offered.

Pretest Design, Implementation, and Results

As a result of the experiences with the four focus groups and the difficulty of extracting more precise insights from further focus groups, we designed a pretest survey. The questionnaire used modified versions of the foodborne illness and REAL ID questions. The pretest was conducted in July 2007 using the Knowledge Networks Web panel.

In the New York City focus group, participants selected only the status quo option for the foodborne illness question, meaning they never indicated a willingness to pay for any of the programs we suggested. For the pretest, we introduced an alternative form for the conjoint question. Respondents were told that a decision had been made to introduce a mitigation policy for foodborne illness. The program had a defined cost in terms of a tax increase, and the decision involved selecting among a set of different mitigation options. The set included both subsidized private mitigation plans and a public option. Each question offered respondents a choice between two mitigation plans that could be provided with the same specific annual tax. Each person received two such questions with variation in the attributes and plans presented, while the preset tax amount varied across respondents.

The three plans were:

- A private kit to test food for foodborne bacteria and thereby screen for the source of illness. The plan would reduce the risk of contracting a foodborne illness but not the severity of the illness if the respondent got sick. The test required an added cost (in addition to the annual tax) and added time for food preparation.
- A medicine that reduced the severity of illness but not the risk of contracting the illness. The medicine also involved an added cost but did *not* require added time for food preparation.
- An expansion in the number of Food and Drug Administration (FDA) food inspectors. Like the home test kit, this option reduced the risk of contracting a foodborne illness but not the severity of the illness if the respondent got sick. Unlike the private mitigation options, there was no additional cost beyond the new tax.

After respondents selected the plan they preferred (referred to as the “forced” choice conjoint question), respondents were asked to vote on their preferred plan, including their willingness to pay the required tax necessary to finance the plan.

The pretest also evaluated the REAL ID question. The attributes of the REAL ID plans included annual tax cost, cost of renewing the license, length of time until licenses had to be renewed, waiting time at the Department of Motor Vehicles to get the new license, and the ability to renew the license on line.

Our analysis of the foodborne illness pretest was used to design the final survey. In particular: Respondents appeared to be willing to accept the forced-choice format; however, to jointly interpret the responses to the forced-choice and follow-up vote in economic terms we must maintain strong assumptions about the respondents’ choice process that cannot be tested. One set of assumptions would treat the forced choice as constrained trade-offs with the subsequent vote revealing information about the implicit value of the constraint, akin to an envelop condition. A second would ignore choices that are made by respondents who would not vote for a plan on the grounds they are “corner solutions.” This strategy avoids assumptions required to link the trade-off among attributes in a forced choice to the vote.

To evaluate the importance of these assumptions, we developed a full-choice version of the foodborne illness question. In the full-choice version, the respondents answered a single question that asked them to select among two different plans and the current situation. Selecting the current situation is the equivalent of not voting for the preferred plan in the forced-choice follow-up question. The sample was randomly split between the forced and full-choice versions of the foodborne illness questions. This format should allow testing of various envelop conditions.

Some respondents appeared to have difficulty understanding the risk of contracting the illness. To address this issue, we introduced a risk tutorial comparable to what Johnson et al. (2007)² and Alberini et al. (2004)³ have used to explain risk in surveys assessing policies designed to reduce the risk of serious side effects from medication and mortality risk.

Some respondents appeared to have difficulty understanding the baseline conditions and exactly how the attributes of each plan related to those conditions. In the final survey, we reworded the plan descriptions, emphasizing baseline conditions. We described how each plan influenced the baseline conditions, altered the presentation of the questions and text in the survey, and structured the variation in design attributes for plans so there were clear distinctions between the plans. For example, the medicine could not alter the risk of contracting the illness, but did influence severity. The added FDA inspector and home test kits influenced risk but not severity of the illness. The added FDA inspector and medicine did not influence time for food preparation. These design features helped distinguish how plans altered baseline conditions.

The pretest also included one question to evaluate the REAL ID program. Based on the pretest, the REAL ID question required less revision. Two versions of the information provided to respondents about the advantages of the REAL ID program were randomly assigned to respondents. One emphasized a more complete description of the benefits of the program, and the second omitted this itemization.

Final Survey

The final survey with the Knowledge Networks panel was completed by mid-September 2007. A total of 1,606 completed interviews were collected. We negotiated with Knowledge Networks to obtain detailed information about the panel respondents who refused the invitation to complete the questions, those who refused to enter the panel, and the history of those who dropped after a few surveys. These details on panel participation and nonparticipation will be used in a variety of sample selection or nonresponse analyses. To obtain these detailed data, Knowledge Networks requires an analysis plan. We began developing the sample selection analysis plan but were not able to complete it before the end of the project year.

The results suggest that respondents were able to understand the attributes of each proposed plan and made choices that are consistent with a priori expectations. Because the survey data were not available until mid-September, these results should be regarded as an initial plausibility check for the survey. More detailed analyses, including QA/QC of the code, robustness of the results to the treatment of respondents, as well as the selection analysis, will be needed before specific findings can be presented with confidence.

At this stage, it seems reasonable to conclude that the detailed survey development, including the sequence of multiple focus groups, the added effort to conduct the pretest, and the analysis of available

² Johnson, F.R., S. Ozdemir, C.A. Mansfield, S. Hass, D. Miller, C.A. Siegel, and B.E. Sands. 2007. "Crohn's Disease Patients' Benefit-Risk Preferences: Serious Adverse Event Risks versus Treatment Efficacy." *Gastroenterology* 133(3):769-779.

³ Alberini, Anna, Maureen Cropper, Alan Krupnick, and Nathalie Simon. 2004. "Does the Value of Statistical Life Vary with Age and Health? Evidence from the U.S. and Canada." *Journal of Environmental Economics and Management* 48(1):769-792.

data from each stage and the associated revisions lead to a successful outcome. A rich database is available for analysis. It appears to yield trade-offs consistent with the predictions from the conceptual analysis. The results from the final survey exceeded our expectations based on the outcome of the earlier focus group sessions. As a result, it reinforces the need to continue survey development until it is reasonable to believe respondents are interpreting the survey questions as intended.

Extended Analysis of First Stated Choice Survey

The stated choice survey conducted early in 2006 had two separate components: choices about plans to protect the fleet of commercial aircraft against shoulder-mounted missiles and choices concerning plans to enhance infrastructure or to provide more training to respond to natural and terrorist disasters.

During Year 3, we continued robustness testing of the models for the airline security stated choice question, but in contrast to expectations, we have not completed a draft of a paper reporting the findings. The results have been presented at several meetings. The time required for the new survey activities and other delays prevented completion of the discussion papers. We expect drafts should be available before the close of the calendar year.

In addition, we initiated analysis of the second choice question on infrastructure and developed an incomplete draft of the discussion paper summarizing the results. We expect to finalize revisions in this paper before the end of the calendar year.

3. Applied Relevance

Adapting Benefits Transfer Methods to DHS Needs

Two sets of activities undertaken during the project year are related to this task. The first involves developing the background research on the REAL ID program to be used for the stated choice question. The information includes a summary of drivers' license provisions in all states to allow the results from the survey to be matched to actual conditions in each state.

The second set of activities involved identifying parallel data sets for complementary information to be linked to the foodborne illness choice question. These data include a 2004 supplement to the Current Population Survey (CPS) and the FoodNet program. An application for access to these data as a benchmarking, informational supplement to the foodborne illness component of the stated choice survey was being prepared at the close of the project year.

In addition to these specific activities, Drs. Smith and Mansfield continue to evaluate conventional benefits estimates and transfer methods for possible application to homeland security issues.

Linking Findings from Analysis of Choice Models to General Equilibrium Analyses

Our progress on this objective has been limited to two activities. The first involves background research to develop questions on food expenditures included in the conjoint survey to assist in calibrating the link between stated choices and other market consumption choices. The second involves refinement of the logic of choice-based resilience developed in the initial RTI-supported conceptual paper to include consideration of Nash equilibrium in private contributions to public mitigation as well as preferences heterogeneity.