2015 RESEARCH PLAN

Managing and Financing Extreme Events

Risk Management and Decision Processes Center
The Wharton School, University of Pennsylvania

Key focuses:

- Terrorism insurance in 2015
- The market for flood insurance
- Implementable long-term strategies for managing climate risks
- A virtual reality tool for testing risk communication strategies
- Quantifying exposure to tropical cyclones: A focus on inland losses
- Addressing small and medium enterprise disaster risk
- Effective leadership and governance practices in catastrophic risk management
**Topic 1: Terrorism Insurance in 2015**

The Terrorism Risk Insurance Act (TRIA), a public-private partnership, was enacted in 2002 and has been renewed several times. The Risk Center has produced over 20 studies on terrorism risk insurance since 2002 and has been actively involved in all phases of the 2005 and 2007 renewals (quantitative analyses publicly available, briefings, congressional testimonies, industry conferences, etc.).

We propose to continue our work on terrorism insurance in 2015, building on our recent report, *TRIA after 2014*. Specifically, we will conduct analyses as to how the new risk sharing design under pending renewal legislation will impact on the distribution of losses in the aftermath of an attack. Our analysis will examine how losses are affected by the following factors: the nature of the attack (e.g., CBRN or not), its location, and the market share of insurers in these locations. The key factors affecting the insurers' losses will be their deductible, the quantity of coverage they are actually providing in this location, the industry retention under a revised design of TRIA, and the ex post recoupment process.

The Risk Center will continue to serve as a neutral party and promote a dialog with key stakeholders in the public and private sectors to develop a long-term sustainable solution to the issue of terrorism insurance coverage.

In its research, the Risk Center will take into account the ways that other OECD countries have addressed the terrorism risk coverage challenge. For instance the British program, PoolRe, just finalized a new agreement with the British Treasury. An upcoming Risk Center Issue Brief will provide perspective on how TRIA relates to other programs internationally, all of which have been renewed in recent years.
Topic 2: The Market for Flood Insurance

Flooding is the natural hazard that accounts for the most lives lost and the highest amount of property damage in recent decades in the United States and other parts of the world. Hurricanes Katrina, Ike and Sandy have led to historical flood losses.

The Biggert-Waters Act (BW12) signed by the President in July 2012 was designed to provide more accurate information on flood risk by improving the quality of flood maps across the nation. It also phases in risk-based premiums for policyholders with second homes or homes subject to repetitive flooding. The Homeowner Flood Insurance Affordability Act (HFIAA14) passed in March 2014 limits the pace at which risk-based premiums will be implemented and suggests measures to assist those households that may require special treatment due to affordability issues.

The Risk Center has a particular interest in the role that communities and individuals can play in improving resilience to future flood disasters. We also are interested in the role that the private sector could play in providing insurance coverage to supplement the NFIP and plan on working closely with corporate partners interested in this topic.

The research for 2015 will focus on three complementary studies:

1) We will continue our work on NFIP insurance claims data (having access to 35 years of NFIP data nationwide), focusing on understanding the key drivers of flood loss reduction in order to learn how to more effectively price flood insurance so that it more accurately reflects risk.

2) The NFIP’s Community Rating System (CRS) is well positioned to encourage community floodplain management activities. While only 1,100 of the 21,000 NFIP communities (5%) are active in the CRS program, those communities represent two-thirds of all 5.5 million NFIP insurance policies currently in place. We plan on undertaking an analysis of the factors that influence CRS participation with special attention given to the role of flood insurance rebates as an economic incentive for a community to join the CRS and undertake more effective floodplain management activities.

3) Affordability of flood insurance will continue to be an important concern when the NFIP is up for renewal again in 2017. We will analyze options for addressing issues of affordability while still preserving the concept of risk-based pricing of insurance. We will also pursue our ongoing exploration of means-tested government vouchers coupled with loans for investing in loss reduction measures along with other measures such as higher deductibles and community-based activities as a way to reduce future flood losses and hence insurance premiums.
**Topic 3: Implementable Long-Term Strategies for Managing Climate Risks**

This research project complements other extreme events management research to develop a framework for designing long-term strategies for climate risks that stand a good chance of being implemented. The framework builds on a large body of research that recognizes the roles of intuitive thinking and deliberative thinking in making choices under risk and uncertainty.

*Intuitive thinking* operates automatically and quickly, and is often guided by emotional reactions that have been acquired by personal experience with events and their consequences. *Deliberative thinking* allocates attention to intentional mental activities, undertakes trade-offs implicit in benefit-cost analysis, and recognizes relevant interdependencies as well as the need for coordination in coping with extreme events such as future climate risks.

Future climate risks are subject to considerable uncertainty over short periods of time and can severely affect global supply chain configurations due to growing interdependencies — factors that can have important impact on the insurability of such risks. In the absence of considerable past experience with the effects of climate change, long-term strategies with short-term incentives are thus necessary to ensure protection. We will examine two illustrative examples:

1) **Reducing future disaster losses by investing in adaptation measures.** This risk management strategy will take the form of financial incentives to reduce climate-related disaster losses. More specifically, insurance premium reductions will reflect lower claims payments; long-term loans will spread the upfront costs of these measures over the life of the property. The risk associated with future losses will be communicated so that individuals recognize the importance of undertaking these measures today rather than procrastinating.

2) **Reducing carbon emissions by encouraging adoption of solar energy.** We will develop risk management strategies that utilize messages highlighting the short- and long-term benefits of installing solar panels, coupled with short-term economic incentives. The incentives would take the form of lower electricity payments combined with long-term loans to cover the upfront costs of investing in solar panels.
**Topic 4: A Virtual Reality Tool for Testing Risk Communication Strategies**

One of the greatest challenges in risk management is persuading individual homeowners to invest in protection against low-probability, high-consequence events, through the purchase of insurance and investments in mitigation. Unfortunately, little is currently known about the kinds of communication strategies that are likely to be most effective in different hazard contexts and across different media.

In 2014 we neared completion of a prototype software package named HAZSIM—hazard simulation—that provides a flexible platform for the pre-launch lab testing of communication strategies implemented via television, the web, radio, and/or mobile phones. The method departs from more traditional means for testing communication strategies by allowing participants to be exposed to messages in settings where they control media usage and duration.

In a typical application, respondents are taken to a virtual living room where they have the opportunity to turn on a television, a radio, surf the web on a laptop, or leave the room to talk to other decision makers about a specific focal risk or threat. HAZSIM is designed as a general programming platform that can be rapidly adapted to the study of a wide range of risks and hazards.

The 2015 work will involve completion and distribution of the software as well as an initial field test. This application will study how residents of Miami Beach, Florida respond to different strategies for communicating the natural disaster risks. For instance, in recent years, low-lying areas of Miami Beach have been plagued by increasing incidents of flooding that have begun to accompany high tide cycles, however, adaptive responses by the city and residents have been slow. What makes the problem challenging is that residents often receive mixed signals about the future risks posed by flooding (e.g., from environmental groups and NOAA versus politicians and real estate developers), thus precluding a clear consensus approach for remediation and long-term adaptation.

When completed, HAZSIM will provide insurers and researchers alike a unique vehicle for allowing the testing of a wide-ranging set of practical questions related to protection against disasters, including the effectiveness of different means of communicating long-term risk via television ads and web information, and how their effectiveness may be affected by source conflicts — such as when scientific reports suggest an imminent risk but neighbors express little apparent concern.
**Topic 5: Quantifying Exposure to Tropical Cyclones: A Focus on Inland Losses**

Inland flooding from TCs, which often receives less media coverage than coastal storms, is responsible for significant and somewhat underappreciated economic damage as well as numerous fatalities. Inland losses caused by Hurricane Irene (2011) and Hurricane Isaac (2012) are recent examples. These hurricanes are not isolated cases, but are representative of a much larger set of events with significant impacts. Despite their large socio-economic repercussions, little attention has been given to improving knowledge of the nature of heavy rainfall and inland flooding associated with TCs.

The results of this work will provide a regional perspective on the extent, magnitude and temporal variability of TC floods, together with a modeling framework that will allow for an appropriate assessment of the link between this natural hazard and the associated economic impacts. These results will be of paramount importance in better characterizing and quantifying TC flood magnitude, spatial extent, and impacts. For example, our results will provide the foundation for TC flood risk assessment across all impacted areas, not just coastal landfall locations.

Our central methodology will employ new quantification methods of the spatial structure of tropical cyclone-related flood magnitudes at the regional scale developed by researchers at Princeton University and the University of Iowa. The initial phase of this research has focused on an integrated empirical analysis of inland flood losses from Hurricane Ivan in 2004, as well as extending the methodology to four major flood events impacting the Delaware River Basin. We will focus on the assessment of the areas that are more severely affected by North Atlantic TC floods east of the Rocky Mountains, and model the relation among impacts, hazards, exposure and vulnerabilities for TCs over the timeframe of 2000-2012, during which 100 TCs passed at least 500 km from the U.S. coast. Analyses will use USGS discharge data from a hazard perspective, as well as a unique access to the entire portfolio of the NFIP that underwrites the vast majority of residential flood insurance policies throughout the U.S. We identify specific event claim/loss and related policy information from this dataset. The combination of the hazard and loss data elements allows for a detailed characterization of homeowners’ flood claims at a given inland location.

The main outcomes of the proposed research are: (1) at a fairly granular level, the identification of the areas at greater risk of inland flooding from North Atlantic TCs; (2) the characterization of the extent and magnitude of these events; (3) the development of statistical models relating flood magnitude to direct economic losses controlling for the associated exposure and vulnerability aspects over the period 2000-2012; and (4) the use of the resulting empirical relationships to perform sensitivity analysis examining the potential impacts of pre-2000 TCs under the current level of exposure and vulnerability.
**Topic 6: Addressing Small and Medium Enterprise Disaster Risk**

Small and medium enterprises (SMEs) are crucial to the American economy, accounting for half of private sector employment and 45 percent of GDP. But small and medium firms, while often quite vulnerable to disasters, are less prepared than larger firms to cope with catastrophic risks.

To date, there have been few studies on how SMEs financially prepare for and manage disasters. The Wharton Risk Center is continuing its new research program to address this knowledge gap. Our goal is to improve the strategies SMEs can employ to more effectively manage extreme events, enhance the insurance and credit products offered to these firms, increase take-up rates, and improve government programs targeted at SMEs. In 2015 we will focus on two complementary activities:

1) A partnership with the **Federal Reserve Bank of New York** to assess how Hurricane Sandy affected SMEs as a specific case study. In the fall of 2013, over 1,000 SMEs were surveyed in New Jersey, New York and Connecticut. The firms were asked about their financial preparation in advance of Sandy and their losses and economic recovery from the hurricane. Among the initial findings: about one-third of these firms were negatively affected, the most frequent losses were from customer relocation and utilities disruptions, and many firms were insured but not typically for the types of losses they incurred during an event like Sandy. These firms often relied on personal resources or increasing debt to finance recovery. In 2015 we will be providing a more complete picture through a detailed analysis of the data. We will produce a research paper and Issue Brief of our key findings.

2) A new partnership with the **Small Business Administration (SBA)** to evaluate their post-disaster loan program. The SBA program is intended to facilitate SME and household recovery by addressing credit market gaps that emerge following disasters and provide low interest loans to qualifying victims of the disaster. The program has never been systematically studied so little is known about its use and effectiveness. As a first step, we intend to profile the program by identifying the characteristics of firms that use it, average/median amount of loan they received, and the rejection rate. While widely available across the nation, it is not clear what percentage of applicants receive such low-interest loans to complement insurance claim payments. We also want to evaluate the SBA’s role as a public policy mechanism and provide recommendations for its improvement. By combining these data with data from insurers on property and business interruption claims payments, we should be able to provide additional insights regarding the economic consequences of disasters for SMEs.
Topic 7: Effective Leadership and Governance Practices in Catastrophe Risk Management

This topic focuses on the ways that large corporations and senior government officials are dealing with catastrophic risk.

The ongoing Travelers-Wharton Partnership for Research on Risk Management and Leadership explores practices by firms that are particularly effective in detecting and preparing for exceptionally adverse events prior to their occurrence. The research project is intended to help identify and understand effective company governance and executive practices in the private sector, and develop benchmarks for firms and governments for taking steps to reduce the likelihood and consequences of future catastrophic risks and improve their crisis management strategy for responding to large-scale disasters.

1) Focus on S&P 500 firms. In the past three years we have completed interviews with leaders in one hundred S&P 500 companies, analyzed their 10Ks and stock prices. We have also analyzed a number of case studies on good catastrophe risk management practices published in the literature. The project has provided us with insights on how executives and the board of directors have defined highly adverse risks facing their companies, how they have dealt with them and how they are preparing for future ones, and how companies can learn from others’ experiences to improve their own practices in anticipating and responding to extreme events.

An interim report was distributed about a year ago. In 2015 we will complete a book that discusses the research findings from the study. It will provide policy and business criteria and guidelines for large companies worldwide that face a broad set of risks that have catastrophic potential. The book will also contain case studies that complement the interviews, reports, and public data that we have analyzed. Several leading publishers have already expressed interest in the book.

In Phase II of this initiative, well underway, we will work directly with Standard & Poor’s to evaluate risk management and governance practices for the entire S&P 500, using data given to us by Standard & Poor’s. We expect the details of this project to be finalized by the end of 2015.

2) Leadership in government. This study, conducted with a mandate from the Chilean President Sebastian Piñera, examines Chile’s recovery from the severe earthquake that struck the country in 2010. Howard Kunreuther, Erwann Michel-Kerjan and Michael Useem interviewed key interested parties, including the very senior leadership in government, as to how they mobilized the country to rebuild and recover quickly and the critical role that insurance and reinsurance has played. The findings will appear in the book Leadership Dispatches to be published by Stanford University Press early 2015.
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About the Wharton Risk Center

Established in 1984, the Wharton Risk Management and Decision Processes Center develops and promotes effective corporate and public policies for low-probability events with potentially catastrophic consequences through the integration of risk assessment, and risk perception with risk management and risk financing strategies. Natural disasters (floods, hurricanes, earthquakes), technological hazards, and national and international security issues (e.g., terrorism risk insurance markets, protection of critical infrastructure, global security) are among the extreme events that are the focus of the Center’s research. The Risk Center has become today one of the largest nexus of expertise on these issues worldwide and its neutrality allows it to undertake large-scale projects in conjunction with other researchers, organizations in the public and private sectors as well as international institutions. For instance, it has been the academic partner of the World Economic Forum on its Global Risks Report since it inception in 2005.

Building on the disciplines of economics, decision sciences, finance, insurance, marketing and psychology, the Center supports and undertakes applied research on catastrophe risk markets to better understand how individuals and organizations make choices under conditions of risk and uncertainty. Risk Center research also investigates the effectiveness of strategies such as risk communication, information sharing, incentive systems, insurance, regulation and public-private collaborations at a national and international scale. From these findings, the Risk Center’s research team – over 70 faculty, fellows and students – is able to design new approaches to enable individuals, organizations and countries to make better decisions regarding risk under various regulatory and market conditions.

The Center is also concerned with training leading decision makers; its faculty take part in several Wharton executive education programs. The Center actively engages multiple viewpoints, including top-level representatives from industry, government, international organizations, interest groups and academics through its research and policy publications, and through sponsored seminars, roundtables and forums.

More information is available at http://www.wharton.upenn.edu/riskcenter.