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# Risk Management REVIEW



## Wharton Risk Center Celebrates Its 30th Anniversary

The Wharton Risk Center is celebrating its 30<sup>th</sup> anniversary this year. We are marking the occasion with a symposium on “The Future of Risk Management” where leading researchers and practitioners will provide their perspectives on the challenges and opportunities for developing strategies for dealing with extreme events, and where we will recognize the important contributions to risk management made by some of those who have worked closely with us: The Hon. Michael Chertoff (Secretary, U.S. Department of Homeland Security, 2005-2009), Prof. Klaus Schwab (Founder and Executive Chairman, World Economic Forum), and the Travelers Companies, Inc.

The impetus for research on catastrophic risk management was the chemical spill in Bhopal, India on December 3, 1984 that caused a change in the thinking of managers at Rohm and Haas, where Edward Bowman and Howard Kunreuther were conducting a study on managerial decision making with respect to environmental risks. Close interaction with the company led to the establishment of the Wharton Risk Management and Decision Processes Center in 1985, with Howard Kunreuther and Paul Kleindorfer serving as co-directors and Jack Mulroney, President of

Rohm and Haas serving as the Center's first Advisory Committee chairperson.

The Center's mission from the outset has been to study the behavior of individuals, firms and government with respect to low-probability, high-consequence events and to prescribe effective strategies for reducing losses from disasters and aiding the recovery process.

A systematic exploration of the challenges and opportunities in modeling catastrophic risks began as a joint research project with the Wharton Financial Institutions Center in 1996 that brought together the three leading risk modeling companies with insurers, reinsurers and researchers concerned with the role that mitigation and risk transfer instruments could play. This project expanded to become the “Managing and Financing Extreme Events” project that continues to this day. After the attacks of September 11, 2001, research was extended to include national security issues with a focus on public-private partnerships as embodied in the Terrorism Risk Insurance Act (TRIA) passed in 2002 and its recent extensions.

The terrorist attacks also stimulated a large body of research at the Wharton Risk Center and at

many other institutions and organizations on the interdependencies of risks and the challenges firms have in investing in protective measures, knowing that they may be adversely affected by others who have not taken steps to reduce these risks.

The Risk Center is also pursuing research on risk communication and long-term strategies to address climate change and promote flood resilience. These and other projects have been spurred by Robert Meyer, co-director with Howard since 2006 following Paul Kleindorfer's retirement ([in memoriam](#)), Erwann Michel-Kerjan, who joined the Center in 2002 and is now its executive director, and other faculty and post-docs associated with the Center.

The field of risk management and decision making has become even more relevant today in the U.S. and internationally. The Risk Center is well placed to advance knowledge for proposing strategies for dealing with a more interdependent, uncertain and volatile world. To our corporate sponsors, research partners and colleagues in the public and private sectors: thank you. We look forward to working with you and others over the next 30 years.

## Returning Insurance to Its 19th Century Roots

As we celebrate the Wharton Risk Center's 30th anniversary, we are at the same time envisioning the future of risk management. In this spirit I would like to make the case that the insurance industry return to its 19th century roots by requiring those at risk to undertake cost-effective loss reduction measures as a condition for insurance coverage. Back to the future!

This is the way that factory mutuals operated when they were founded in the mid-1800s and some insurers still do today when marketing commercial policies. Firms were given an insurance policy only after they were inspected and shown to be safe. Insurance premiums reflected the best estimates of the risk; improvements were rewarded with lower premiums reflecting the expected reduction in future claims. Firms that did not continue to keep their factories operating safely were warned that their insurance policy would be canceled unless they took corrective action.

Insurance could play a similar role with respect to providing coverage to the residential sector where today, limited attention is given to encouraging homeowners to invest in loss reduction measures. To move in this direction, premiums should reflect risk, and risk information should be communicated in a transparent manner so decision makers have accurate signals as to the nature of the hazards they face. Those at risk should also be made aware of the reduction in premiums they will receive if they take steps to reduce losses from future disasters.

Public-private partnerships are necessary for dealing with insurance against some extreme events. Low-income individuals currently residing in hazard-prone areas are likely to demand financial assistance if their premiums are currently subsidized and the increase in the cost of their insurance raises issues of affordability. Even in situations where insurers are allowed to charge risk-based premiums, they may still feel that some hazards are uninsurable without public sector involvement if catastrophic losses would cause their surplus to be reduced to an unacceptable level and perhaps lead to insolvency.

The National Flood Insurance Program (NFIP) offers an opportunity to creatively address these issues with regard to flood hazards. The Federal Emergency Management Agency (FEMA)'s Technical Mapping Advisory Council has already begun focusing on ways to design flood maps that reflect risk, and several reports by the National Research Council [see next page] are addressing ways the flood insurance program can be modified in advance of its renewal in 2017. More specifically:

- Updated flood maps will allow insurers to more accurately assess the hazard. If private insurers can charge risk-based rates, they would have an economic incentive to market flood coverage.
- The public sector could provide financial assistance to low-income homeowners to address issues of affordability and encourage them to undertake cost-effective mitigation measures to reduce their risk. One way to do this is through a means-tested voucher program tied to low-interest loans to defray the cost of mitigation measures that will reduce the price of insurance. Well-enforced building codes and seals of approval would provide an additional rationale for undertaking these loss-reduction measures.
- A multi-year insurance policy tied to the property would prevent policyholders from canceling their policies, as many do today when they have not made a claim for several years. Property owners would be provided with stable annual premiums over this period and would know that they were protected against water damage from floods and hurricanes.
- Reinsurance and risk-transfer instruments marketed by the private sector could cover a significant portion of the catastrophic losses from future floods. Some type of federal reinsurance would provide insurers with protection against extreme losses.

The broader challenge we face is developing long-term strategies that provide short-term rewards so that change is politically viable. There is a growing interest by policy makers and other stakeholders in ways that insurance can encourage individuals, firms, communities and countries to undertake protective measures before the next disaster occurs.

Insurance has an opportunity to play this role in the residential sector by going back to its basic principles that were adopted almost 200 years ago from the commercial side of the house: encourage or require investments in loss reduction measures today while providing claims payments should one suffer a severe loss.

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## Wharton Risk Center's Involvement with the National Academy of Sciences on Reform of the National Flood Insurance Program (NFIP)

Established in 1968, the National Flood Insurance Program (NFIP) offers flood insurance policies to property owners if their community adopts floodplain management ordinances and minimum standards for new construction in flood-prone areas. However, houses built prior to the adoption of floodplain maps have been given subsidized insurance rates. Following Hurricane Katrina and subsequent storms, the NFIP was driven into debt after borrowing billions of dollars from the Treasury to pay loss claims. In July 2012, the U.S. Congress passed the Biggert-Waters Flood Insurance Reform Act, to phase in risk-based premiums that better reflected expected losses from floods. In response to concerns that the elimination of rate subsidies created a financial burden on policyholders, Congress then passed the Homeowner Flood Insurance Affordability Act of 2014 which delayed the move toward risk-based rates and required FEMA to initiate studies on ways to improve the financial balance of the NFIP.

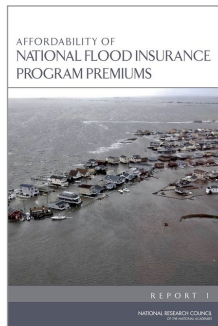
The **National Academy of Sciences/National Research Council** is addressing this task on behalf of FEMA and Congress. **Wharton Risk Center faculty and fellows serve on three NAS committees:**

- Committee on the *Analysis of Costs and Benefits of Reforms to the National Flood Insurance Program* (Howard Kunreuther and Carolyn Kousky)
- Committee on *Risk-Based Methods for Insurance Premiums of Negatively-Elevated Structures in the National Flood Insurance Program* (Erwann Michel-Kerjan)
- Committee on *A Community-Based Flood Insurance Option* (Jeffrey Czajkowski)

The committees published these reports in 2015:

### Affordability of National Flood Insurance Program Premiums: Report I

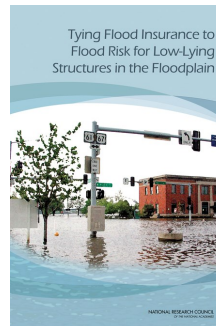
<http://www.nap.edu/catalog/21709/affordability-of-national-flood-insurance-program-premiums-report-1>



*Affordability of National Flood Insurance Program Premiums: Report I* is the first part of a two-part study to provide input to FEMA's affordability framework, explaining the decisions that must be made when designing an assistance program, and describing alternative ways premiums might be made more affordable. This report discusses underlying definitions and the affordability concept as well as providing an overview of the demand for insurance and the history of NFIP premium setting. The report also describes methods for determining when premium increases would make flood insurance unaffordable.

### Tying Flood Insurance to Flood Risk for Low-Lying Structures in the Floodplains

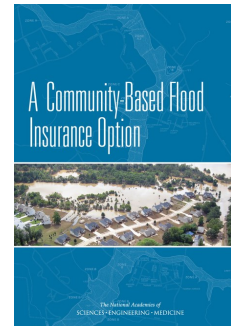
<http://www.nap.edu/catalog/21720/tying-flood-insurance-to-flood-risk-for-low-lying-structures-in-the-floodplain>



*Tying Flood Insurance to Flood Risk for Low-Lying Structures in the Floodplains* studies negatively elevated structures in the NFIP. Low-lying structures (estimated to be about one million, although FEMA lacks elevation data for most) are inundated more frequently, and the depths and durations of inundation are greater than for structures built to the NFIP benchmark. They are likely to be most affected by pricing reforms, calling for transparency in how FEMA prices these policies. This report reviews current and alternative methods for calculating risk-based premiums for these structures.

### A Community-Based Flood Insurance Option

<http://www.nap.edu/catalog/21758/a-community-based-flood-insurance-option>



*A Community-Based Flood Insurance Option* considers the option of a single insurance policy for an entire community which may be more effective and less expensive than administering separate policies for each property within a given community. Community-based insurance is unlikely to provide the solution to the nation's flood insurance problems. Either as a stand-alone option or as part of a suite of policies, community-based flood insurance will need to address specific challenges of increasing take-up rates, reducing administrative costs and enhancing floodplain management.

## Erika and the Boy who Cried Wolf

On August 26<sup>th</sup> of this year, Florida's governor Rick Scott was on edge. In the distant tropical Atlantic, Tropical Storm Erika was approaching the Leeward Islands, and the National Hurricane Center's most reliable forecast models were predicting that in three days it could be bearing down on the highly-populated southeast coast of the state as a fully-blown hurricane. It had been a decade since Florida had experienced a direct hit by such a storm, and Scott, as much as anyone, was keenly aware that a direct hit on an unprepared state could prove disastrous.

But just what action, if any, should be taken, was unclear. In their forecast discussions, the National Hurricane Center cautioned that they were much less certain about the three-day forecast than usual. The reason was that this year's El Niño was producing unusually strong high-level westerly winds that had the potential to weaken the fledgling storm well before it might affect the state.

Scott was thus on the horns of a dilemma. If he ordered a state of emergency and Erika weakened, many would surely accuse him of having cried wolf, something that could cause people to ignore later warnings when storm threats were real. On the other hand, if he did not give the order and the hurricane indeed materialized, the state might not have the time needed to fully prepare for the impact—an outcome that would, at the very least, doom his governorship.

The next day—with impact now two days away—the governor made his decision: he would declare the state of emergency. The Florida National Guard was called up and directed to potential impact areas. News media interrupted normal broadcasts to carry the governor's message and to disseminate the latest on the storm. Supermarket shelves were rapidly

depleted of supplies as residents raced to prepare for the coming storm. Florida would be ready for Erika.

But Erika never arrived. As forecasters had suspected, the winds of El Niño weakened the storm and deflected it south to Hispaniola, and within 12 hours it was nothing more than a mass of comparatively harmless thunderstorms. Rather than bringing disaster, Erika turned out to be something of a positive by bringing welcome rain to a state that had been in the midst of a drought. Erika, in short was a big to-do about nothing.

### **Do false alarms reduce preparedness?**

Did Rick Scott make the right call? There certainly would be ample reason to worry that his caution might have harmed more than helped. When the next storm starts to threaten the state he may be more reluctant to pull the trigger in ordering emergency preparations, recalling the resources that were wasted in preparing for Erika. Residents, for their part, may come to treat states of emergency with greater casualness, believing that the governor issues them indiscriminately whenever the hint of a threat arises.

The academic evidence on just how likely this is, however, turns out to be far more muddled than one might presume. On one hand, there is quite a bit of research showing that cry-wolf (or false-alarm) effects can be quite real in many contexts. Most of us, for example, have learned to ignore car alarms when they go off (other than to wish they would get turned off), and fire alarms are frequently ignored in homes and buildings when they are known to be defective. Even single encounters with false alarms can have deleterious effects; in 2007 a false tsunami warning in Aceh, Indonesia induced such great trauma among residents that they forcibly disabled the system.<sup>1</sup>

Perhaps the best-known experimental work on false alarms was done in the 1980s by the psychologist Shlomo Breznitz, who studied physiological responses to repeated false alarms in labs. In the standard experiment, subjects are instructed to await a mild electric shock that may or may not actually materialize.<sup>2</sup> The emotional response to these warnings turns out to resemble a roller-coaster. When a subject first hears a warning there is a startle response, or a reflexive surge of anxiety. As the seconds pass after the warning, this initial anxiety wanes as respondents adapt to the oncoming threat, only to have it build again in the moments leading up to the expected onset of the event. While repeated false alarms do not change the shape of this anxiety curve, they do decrease its amplitude; unreliable warnings trigger lower levels of anxiety than reliable ones.

However, attempts in the field to see if false alarms have similar dulling effects for warnings that have life-or-death consequences have proven equivocal. Consider the case of air-traffic controllers. In the 1990s the FAA installed computerized systems designed to warn air-traffic controllers of impending mid-air collisions. Computer systems track plane altitudes and trajectories, and if two (or more) planes look to be headed to the same general location an audible alarm goes off, giving the controller one minute to reroute the aircraft. These alarms, however, are prone to false-positive warnings: almost half the time when an alert sounds there is no need to take any action. In 2009, Christopher Wickens and colleagues studied air-traffic controllers' responses to 495 conflict alerts, and, fortunately for fliers, found little evidence of cry-wolf effects: repeated exposure to false alarms did little to degrade the speed with which air-traffic controllers responded to these alerts.<sup>3</sup>

Likewise, researchers have also had difficulty finding evidence for cry-wolf effects in hurricane evacuation decisions. For example, in the summer of 1996, residents of North Carolina were subject to two hurricane land-falls in quick succession, both of which triggered evacuation orders: Bertha in late July and Fran in mid-September. Whereas Bertha proved to be something of a false alarm, Fran was a more serious threat. In a post-storm survey of coastal residents, Kirstin Dow and Susan Cutter found that the false-alarm of Bertha did little to impede evacuation rates for Fran (which were much higher), and only 2 percent of respondents indicated that they would be less inclined to evacuate in the future because the actual impact of the storms proved less than feared.<sup>4</sup>

So are cry-wolf effects a myth? Well, the answer is both “no” and “yes.” There is unambiguous evidence that cry-wolf effects are quite real for hazards such as electric shocks and fires, where warnings are unreliable forecasts of an oncoming event. In situations where pre-event signals have a high rate of false positives, warnings of an event that does not then materialize would, in time, be less effective in triggering protective responses.

On the other hand, cry-wolf effects are less salient for warnings that are issued *after* a hazard has been observed, and where the false alarm lies simply in the mis-prediction of the severity of impact. This helps explain why cry-wolf effects have been hard to find for hurricane evacuations; unlike broken fire alarms, they are rare, and are issued only after a storm has been observed and is tangibly moving toward the coast. In that sense, there has been no false alarm.

While those who evacuate may return to find that the water did not rise as high as feared, residents are just as likely to feel relief that their homes were spared by a very real threat than annoyance that they left

**Cry-wolf effects are less salient for warnings that are issued after a hazard has actually been observed.**

unnecessarily. Moreover, the rarity of storm evacuations implies that when the next one arises past inconveniences are likely to be distant memories that pale next to the immediate—and very real—threat posed by an approaching storm.

**The case for crying wolf**

So, did Rick Scott make the right call in ordering a state of emergency knowing that the odds that Erika would strike were not that high? Most of the available evidence suggests his decision was indeed the right one. While alarm desensitization is a very real phenomenon, there is little evidence that it operates when three critical conditions hold: 1) the warning’s events are infrequent; 2) the phenomenon that is the source of the threat is observable; and 3) the consequences of a maximum adverse impact are large.

How infrequent is infrequent? As illustrated above in the case of North Carolina’s experience with Hurricane Bertha, the interval can be surprisingly short—just long enough for memories of the last false alarm to fade. And people’s memories for weather events are notoriously poor; when autumn passes into winter and worries turn from heat waves to deep freezes, few recall the meteorological details of hurricanes that were near-misses. Meteorologists, in essence, get a Mulligan for past bad forecasts. People are more than willing to believe that the forecasts of the next “big one” will, this time, be on target.

But even in cases where warnings that turn out to be false alarms are in close temporal proximity, there is not likely to be desensitization as long as

there is a tangible attribution as to *why* the event did not materialize. As noted above, people tend not to encode as false alarms storms whose impacts were not as great as warned—they did, after all, occur. This effect is amplified when the event has significant impacts in other places, which become the focus of salient news coverage. As an example, when Hurricane Andrew ravaged southern Miami-Dade County in 1992 neighboring Broward County experienced only limited effects. But few in Ft. Lauderdale are likely to recall Andrew as a false alarm. The more likely emotion was thankfulness for having averted catastrophe.

And, finally, while Aesop’s famous fable may indeed urge caution before warning too often, when the consequences can be severe the old English idiom, “better safe than sorry” appears better to capture most people’s views. Someday—hopefully later rather than sooner—a major hurricane *will* strike southeast Florida, and the state of emergency it will trigger will be a real one. While there is always the chance that some may take it more lightly because of their experience with Erika, this seems unlikely. If anything, Erika may prove to have provided a useful dress rehearsal for when the “big one” finally does arrive.

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## We Must Build Measurable Resilience into Our Communities

### 10 Years after Katrina

As part of a series of initiatives marking the 10th anniversary of Hurricane Katrina, I joined the Mayor of New Orleans and other business and civic leaders at the end of August to publicly discuss lessons learned from Hurricane Katrina and exchange ideas about the future of disaster preparedness and resilience more broadly.

Katrina remains the most destructive natural disaster in recent U.S. history — more than 1,800 deaths, \$125 billion in economic losses, and enduring social and political impacts. When the levee system failed, water from the Mississippi River flooded a large portion of the city. Because many dwellings behind the barrier were built below sea level, it took days for the water to recede, causing permanent destruction. An ill-prepared government was very slow to react, which added to the tragedy. A year later, New Orleans had lost half of its population who moved to other cities—and it has never totally regained it.

Three questions are central: What have we learned from Katrina? What new scientific knowledge has developed? And how do we encourage investment to make our communities more resilient?

One lesson from Katrina was taken on board very quickly: it is not enough for researchers to predict extreme weather events. They must also better communicate about risks, and plans must be in place to act upon them. While comparisons are difficult, the contrast with Hurricane Sandy, which struck New York in 2012, is clear. The state and federal governments (and the media) took the warnings from forecasters seriously and prepositioned emergency response. No head of state wants to be remembered for another Katrina.

### New Knowledge and Innovations

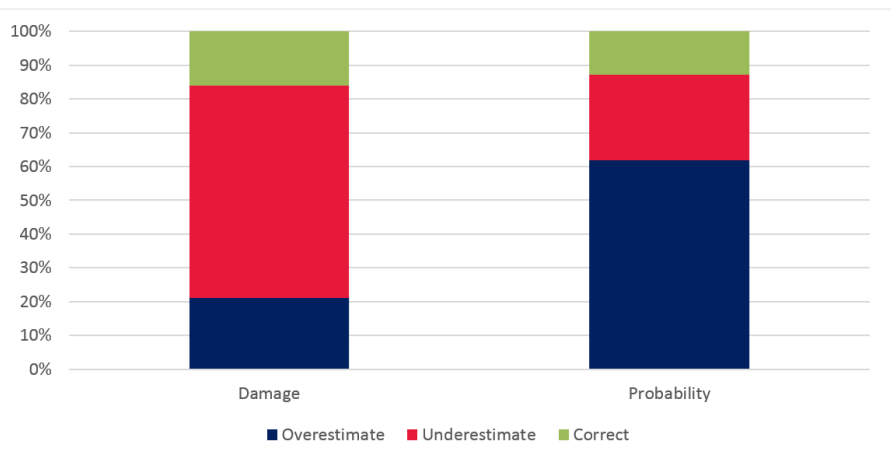
Predicting catastrophes is not an easy task, but we are getting better at it. New storm models better predict wind speed at points in space; storm-surge models are also improving. Climate predictions increasingly focus on regional impacts which are much more relevant to local conditions than are global models.

There are still important knowledge gaps that science must address. Take flooding, which has affected more people than any other hazard. Modernizing our flood maps is one massive but essential undertaking currently under way; but exposure analysis of all buildings, critical infrastructures, and other assets in flood-prone areas is also key. This requires granular (hence costly) elevation data for each asset, of the type traditionally gathered by a surveyor on site. While this is not economically practical on a large scale, new remote-sensing techniques, such as laser and radar-based measurements collected from aircraft, drones or satellites, now makes this feasible. As this technology continues to develop and elevation results are used for safety and commercial purposes, it will become less costly.

Social science, too, has made advances in understanding individual and collective behaviors in the face of disaster risks. But while there is a large body of literature on risk perception, almost all studies have focused on the misperception of the **probability** of a risk. Prior studies did not seek to understand how people perceive the **loss** they will suffer from a disaster.

To fill this gap, we conducted a detailed survey six months after Hurricane Sandy of more than 1,000 homeowners who lived in flood-prone areas in NYC. Based on the survey data, we learned how individuals' risk perceptions compare to experts' risk assessments by examining the degree to which people living in these areas over- or underestimated the likelihood of being flooded and the resulting damage. (Actual damage estimates are taken from our companion paper in *Science* in which we determine the expected storm surge loss at a block-level in New York City.)

We found that while many individuals **overestimated the probability**, most people **underestimated the potential damage**. A large majority of the residents in this flood-prone area (63 percent of them) underestimated the average damage a flood would cause to their house (see Figure 1).



Sources: Botzen, Kunreuther and Michel-Kerjan, *Judgment and Decision Making* (2015).

**Figure 1.** Percentage of respondents who correctly, under-, or over-estimate the flood probability and flood damage (25% error margin)

We also performed a series of analyses to better understand how the perception of damage is influenced by other factors. We found that a **high level of worry about flood**, a **higher income**, and **past experience with devastating floods** result in **higher** expected damage, while **low levels of education** and **high trust in local government's** capability to handle flood for the community lead to **lower** expected flood damage.

Unfortunately, a low level of education is typical in low-income areas, both in OECD and developing countries. The take-away is that many people tend to believe a flood will not be that bad. Thus, improving flood risk awareness is key to enhancing exposed communities' resilience.

### Measuring Resilience

My third point is about encouraging investment to make communities more resilient and here, an apt mantra holds: what gets measured gets managed.

A holistic 5C – 'five capitals' – metric is essential. *Physical* capital includes the indirect products of economic activity, such as infrastructure. *Financial* capital assesses financial protection and diversity of income sources. *Human* capital measures the education, skills and health of people. *Social* capital accounts for social relationships, leadership and governance structure. *Natural* capital includes land productivity, water and biological resources, and actions to sustain those.

Research across many disciplines can gather data in these 5Cs, to provide a baseline, measure progress and to test policies. An agreed upon set of metrics enables a specific community to be given a resilience

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score. These can then be compared with those of others, and tracked.

Our team at Wharton is now piloting this approach in Mexico as part of the global flood resilience program supported by **Zurich**, working with the **Red Cross**, **IASA** in Austria and the international NGO **Practical Action** (see page 8). Research is also being conducted in Peru, Indonesia and Nepal. The **U.S. National Academy of Sciences** is helping us extend the idea through its Resilient America Roundtable.

In collaboration with the **Rockefeller Foundation**, with which the Risk Center is also interacting, a growing number of cities are now appointing chief resilience officers — similar roles to chief risk officers in companies—and the 5C measurement tool should help here as well. In another sign that the lessons of Katrina are being heeded, New Orleans appointed a chief resilience officer last year to advise the Mayor.

### Resilience as a Competitive Advantage and Investment Opportunity

Making resilience synonymous with higher competitiveness of cities, regions and even countries will be the next step. Insurers, which have over \$30 trillion of assets under management, should have a vested interest in reconsidering resilience-related market opportunities as part of their overall investment strategy. After all, making a city more resilient will also make it more insurable.

Measuring resilience, implementing the right incentives and developing new market opportunities are likely to be one of the most exciting challenges of the coming ten years.

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## Update on Community Flood Resilience Work — Partnership with the Zurich Alliance

The Zurich flood resilience alliance partners leading the work in Mexico conducted a field visit in the state of Tabasco in July 2015. The team developed a flood prevent survey intended to collect information regarding community members' perceptions of flood risk and the actions they have taken to reduce their exposure prior to the annual flood season.

Partnering with members of the Mexican Red Cross in Tabasco, roughly 45 pilot surveys were implemented in three Tabasco communities: El Piñal, Boca De San Antonio, and Güiro Arrancado (see Figure 1). The team implemented the pre-event survey at the end of August to 221 households across nine different Tabasco communities, before the seasonal flooding in these communities has begun. Work has started on analyzing the data from the surveys and will continue throughout the fall of 2015.

Following the seasonal flooding, the team will survey households in the affected communities via a post-event survey. This assessment will be linked to the pre-event survey to create continuity and facilitate more in-depth analyses. The post-event survey is also intended to assess damages and losses in the community. This survey will most likely be implemented in early 2016.

Our Zurich alliance resilience framework is gaining visibility and support around the world. The team has met receptive audiences when presenting these concepts at conferences and to groups of public and private decision makers in flood vulnerable communities. The alliance has the opportunity to more fully test the framework as a guide for intervention with its implementing partners. The resilience framework can permeate the process from how NGOs engage with vulnerable communities through initial measurement, intervention planning, learning, and monitoring progress. Some operational pragmatism is needed in this regard that captures the essence of the resilience framework and its many components but is adaptable to the demanding and action-oriented work of NGOs.



**Figure 1.** Area of July 2015 field visit in Tabasco, Mexico

The team also spent two days in Mexico City on these initiatives:

### Case study on risk reduction.

The alliance partners in Mexico are developing a case study to determine what factors motivate individual households to reduce flood risk. We are using data collected from the community baselines resilience framework in addition to hazard and exposure geospatial data to assess whether different strengths across a community help explain why some households have prepared more than others for flood. This case study is scheduled for completion in the coming months.

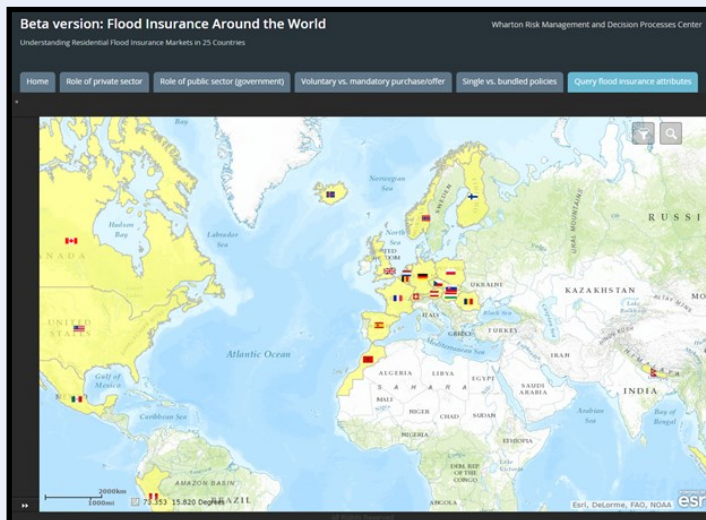
### Community mapping.

Wharton's expertise in geospatial analysis will be utilized to map communities by various hazard, exposure, and vulnerability metrics. Wharton has collected and cataloged an extensive amount of geospatial data from the Mexican geographic and statistics agency, INEGI, including high-resolution lidar elevation data, and socio-economic data collected in the 2010 Mexican census. This data will allow for a more detailed risk assessment of the communities in light of ongoing and proposed interventions and risk reduction activities. Leveraging existing Zurich expertise in hazard risk assessment is a critical component of this effort. Similarly, key lessons and output from IFRC/Mexican Red Cross vulnerability and capacity assessments (VCAs) as well as existing community tracking statistics collected are significant to this work.



*Visiting these communities helped ground team members from Wharton in the cultural context as well as observe progress of community interventions. As part of the resilience initiative, micro-project are being implemented in the Tabasco communities. Here, the team is visiting the Beehive Alternative Livelihoods Project in Güiro Arrancado with the Mexican Red Cross and Zurich Mexico.*

## Interactive Flood Insurance E-Platform



Recognizing the growing interest in improving resilience to flood risk and the role that insurance can play, countries around the world are considering national flood insurance solutions. Insurers are fully involved in these discussions, either because they cover the risk, partner with the national government in various capacities, or because they are contemplating market opportunities.

To complement these discussions, the Wharton Risk Center has been developing an interactive flood insurance market e-platform as part of the Zurich alliance to analyze residential flood insurance markets around the world. Currently, there are five interactive maps describing national flood insurance markets in 25 countries:

1. Role of private sector: categorizes the role of private insurance companies as administrators, primary insurers, or reinsurers
2. Role of public sector (government): categorizes the role of national governments as guarantors, primary insurers, regulators, and/or reinsurers
3. Purchase requirement: voluntary (for residents to purchase) vs. mandatory
4. Single vs. bundled policies: describes whether flood insurance is offered as singular policy or bundled with other types of residential coverage
5. Flood insurance attributes: users can query and search specific flood insurance attributes derived from the above listed maps

We intend that these interactive maps are used by decision makers in the public and private sectors, international organizations, academia and civil society. We hope that all interested parties will provide feedback and additional information, so that we can add more detail to this international comparison. To that end, we invite you to browse and query these maps at: <http://riskcenter.wharton.upenn.edu/flood-insurance-around-the-world/>.

## Flood Resilience Alliance Wins Two International Awards

The secretariat of the **UN's Framework Convention on Climate Change (UNFCCC)** has recognized the Zurich multi-year flood resilience alliance as an outstanding example of efforts to address climate change and its impacts. The program received the award in December 2014 in the category of Financing for Climate Friendly Investments, underscoring the alliance's collaboration across sectors and the partnership's innovative approach to help communities better deal with floods and its aim to influence policy decisions that enhance flood risk management frameworks.

The project also received the **Convergences Special Climate Prize** in Paris in September, 2015. This award was introduced five years ago to provide recognition to a partnership that takes a new approach to multi-sector collaboration. The alliance received the prize not only for its innovative partnership model but also for taking a new approach to the issue of flooding.

The alliance is led by the **Zurich Insurance Group** with funding from the **Zurich Foundation**, in collaboration with the **Wharton Risk Management Center**, the **International Institute for Applied Systems Analysis (IIASA)**, the **International Federation of the Red Cross and Red Crescent Societies** and the international development organization **Practical Action**.



*The Zurich flood resilience alliance received the UN Momentum for Change Award on December 10 at a ceremony in Lima, Peru. Linda Freiner of Zurich (third from left) and Simon Trace of Practical Action (second from left) represented the alliance.*

## South Florida Freshwater Flooding and Groundwater Levels

*Coastal south Florida is vulnerable to salt water intrusion*

Many urbanized coastal areas are facing potentially large economic costs associated with sea level rise (SLR) and related impacts. Chief on the list of concerns are inundated shorelines and increased coastal flooding due to storm surge, but a more veiled threat may be looming underground (Lemonick, 2012).

In some low-lying coastal areas, sea level rise can cause saltwater intrusion and contamination of groundwater (including drinking water) resources in near-surface aquifers (Rotzoll and Fletcher, 2013; Nicholls and Cazenave, 2010; USGS, 2010). This is particularly true in south Florida, where the low topography and extremely porous limestone aquifer make the region highly susceptible to salt water intrusion. This porous limestone also makes the region more prone to flooding as a result of SLR and makes standard SLR adaptation strategies such as sea wall construction ineffective, since rising seas easily percolate upwards behind coastal barriers.

SLR adaptation strategies developed in south Florida suggest that groundwater must be maintained at higher levels and, therefore, closer to the surface in order to prevent the increased risk of salt water intrusion into drinking water supplies. However, the trade-off associated with higher groundwater levels is the increased risk of inland flooding, especially during the annual wet seasons or extreme rain events. As noted by the South Florida Water Management District, “existing levels in surface waters and groundwater affect the ability of drainage systems to receive or store new rainfall. Water cannot flow into primary canals if they are full or if the flow has become blocked. Additionally, if the underground water table is already high, water cannot soak into the

saturated ground. After a heavy rain, water in streets, swales, yards, and low-lying areas is expected and normal.” (SFWMD, 2015).

With colleagues from the South Florida Water, Sustainability and Climate\* research effort, we are examining the relationship between the rate of flood insurance claims and groundwater levels in urbanized areas of Miami-Dade County, the most populous and most flood-impacted county of south Florida’s lower east coast. The study area for this analysis is 16 watersheds within Miami-Dade County. A total of 328 census tracts were spatially joined to these 16 watersheds containing over 1.7 million people and 602,000 housing units.

Using claims data during the timeframe of 1996 to 2010 from the U.S. National Flood Insurance Program (NFIP) to which we have unique access, we conduct a regression analysis of the number of flood claims incurred per watershed per month most importantly as a function of the associated groundwater levels. The regression results have established a statistically significant relationship between groundwater levels and the number of flood claims incurred in our Miami-Dade watersheds.

A total of 43,551 NFIP flood claims were incurred in these watersheds from 1996 to 2010, an average of 241 claims per month in the study area (approximately 15 flood claims per watershed per month). Total damage (building and contents) from these claims is \$327.3 million in 2010 dollars, an average of \$7,515 per claim. The average monthly flood loss in a typical urbanized watershed can be as high as \$8 million under current groundwater level conditions and is likely to increase over time.

This information is expected to be useful in urban planning and water

resource forums in south Florida where new strategies for managing the region’s water resources are being sought. This analysis is particularly relevant to applications of hydro-economic optimization models which provide a solution-oriented framework for integrated analyses of complex water resources systems, and for assessing potential economic impacts of management decisions and resource development options on different system sectors.

\*The South Florida Water, Sustainability, and Climate Project is supported by the National Science Foundation’s Water, Sustainability, and Climate Program with joint support from the United States Department of Agriculture.

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## Environmental Justice Implications of Flood Risk: A Case Study in Miami, Florida

The adverse effects of flooding are unevenly distributed, and socially vulnerable individuals suffer disproportionately from flood events. Socially vulnerable groups include those of low income, racial/ethnic minorities, unemployed, elderly and infirm. Environmental justice (EJ) is broadly defined as equitable environmental quality for everyone, with particular consideration that socially vulnerable groups are not inequitably exposed to environmental hazards. Most case studies have examined social inequities associated with anthropogenic hazards such as air pollution and toxic waste. However, the disproportionate impacts of Hurricane Katrina on African-American and low-income residents of New Orleans, Louisiana, led to an expansion of the EJ framework to include implications of floods and flood risks.

EJ research on flood risks focuses on whether socially vulnerable groups are inequitably exposed to flood hazards because they lack the resources of more affluent and resilient persons to mitigate and recover from flood impacts. The same concepts that can be used to assess affordability concerns of the National Flood Insurance Program (NFIP), an ongoing research endeavor at the Wharton Risk Center, can be applied to investigate the EJ implications of flood risk mitigation via the NFIP.

Recently published research at the Wharton Risk Center assessed inequitable exposure to coastal and inland flood risks for racial/ethnic minorities and other socially vulnerable groups in the Miami Metropolitan Statistical Area (MSA), Florida. Models that estimated exposure to flood risks included control variables for water-related amenities—proximity to public beach access sites and density of vacation homes—giving a more accurate assessment of the EJ implications of exposure to coastal and inland flood risk.

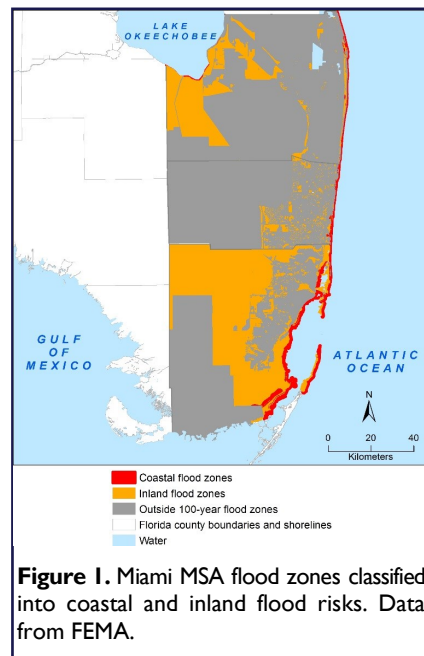
Figure 1 shows the Miami MSA flood zones classified by coastal (FEMA V zones) and inland (FEMA A zones) 100-year flood zones. Figure 2 shows 2010 census tracts classified according to flood risk. All tracts that intersected coastal flood zones were classified as at risk to coastal flooding; tracts that intersected inland flood zones (that were not already classified at risk to coastal flooding) were classified as exposed to inland flood risks. The remaining tracts were treated as outside 100-year flood zones. Social vulnerability was characterized with two indices, *economic insecurity* and *instability*, calculated from several census and American Community Survey (ACS) variables.

Models show that non-Hispanic African-Americans and Hispanic communities were disproportionately exposed to inland flood risks. This is an EJ concern because non-Hispanic African-Americans and Hispanics have strong positive relationships with both social vulnerability indices, so they probably lack resources to mitigate and recover from flood risks. Additionally, areas of inland flood risk lack water-related amenities (vacation homes and proximity to public beaches) so these neighborhoods are not distinguished by these desirable traits.

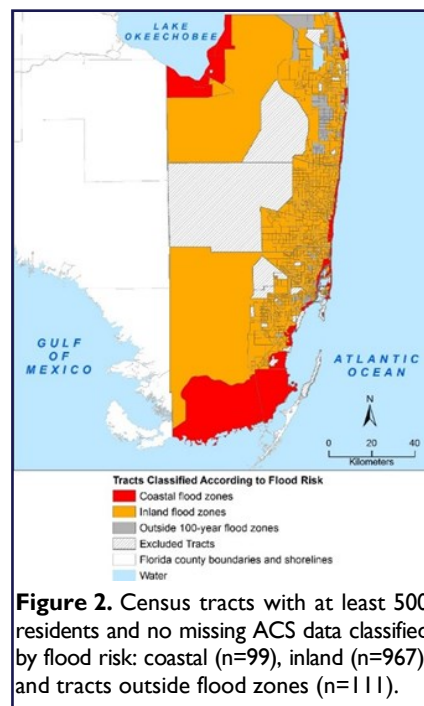
The NFIP has recently determined that properties that are newly mapped into 100-year flood zones must buy flood insurance (if they have a federally backed mortgage). Future research at the Wharton Risk Center will look at newly mapped areas to detect potential inequities and affordability concerns by describing the social vulnerability of those affected residents. Research such as this increases understanding of both EJ and affordability concerns of natural hazards policies in the United States.

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**Figure 1.** Miami MSA flood zones classified into coastal and inland flood risks. Data from FEMA.



**Figure 2.** Census tracts with at least 500 residents and no missing ACS data classified by flood risk: coastal (n=99), inland (n=967), and tracts outside flood zones (n=111).



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## What Drives Households to Buy Flood Insurance?

Insurance has long been regarded as an important risk transfer tool for ex ante management of weather disasters such as floods. In the U.S., the National Flood Insurance program (NFIP) established in 1968 provides flood insurance to homeowners in communities that adopt minimum floodplain management standards.

The passage of Flood Disaster Protection Act of 1973 established mandatory purchase requirements for homeowners with a federally backed mortgage residing in Special Flood Hazard Areas (SFHAs). However, take-up rates remain very low. For example, a survey of homeowners in flood-prone areas of New York City revealed that 80 percent of Hurricane Sandy victims did not have flood insurance (Botzen, Kunreuther and Michel-Kerjan, 2015). There is thus a dire need to determine how to increase the market penetration of flood insurance. In order to do so we need to first understand what drives individuals to purchase flood insurance, and tailor awareness campaigns accordingly.

Previous research has shown that factors that influence individuals' decisions to purchase flood insurance include economic variables such as household income and the price of insurance, risk-related variables such as recent floods and proportion of floodplain area in a county, and demographic variables such as education and age. However, to the best of our knowledge, race has never been tested as an explanatory variable affecting flood insurance demand. This is surprising because studies have demonstrated that minority groups often differ in terms of world view, socioeconomic status, family organization, and trust in political institutions. In the aftermath of Hurricane Katrina, Spence et al. (2007) found differences in information-seeking on the basis of race. Thus, we can expect race to have an impact on the decision to purchase flood insurance.

We studied the drivers of flood insurance purchases in the state of Georgia (USA) which had nearly \$24 billion in flood insurance coverage in

force as of 2014. Georgia is ideal for this study since it has a fairly high percentage of minorities compared to the national average (31 percent African-Americans versus 13 percent nationally). Figure 1 shows county-level flood insurance market penetration rates, that is, the proportion of households in a county that purchased flood insurance. As expected, penetration rates are highest in coastal counties where the proportion of land in floodplains is higher.

Of particular interest is the effect of the racial composition of Georgia on the uptake of flood insurance policies. Utilizing data on flood insurance policies-in-force in counties in Georgia, we discovered that race, education and age all have statistically significant impact on flood insurance purchase. In the case of Georgia, we find that, all else equal, a unit increase in the proportion of African-American population increases the NFIP policies per 1,000 population by 1.05 percent.

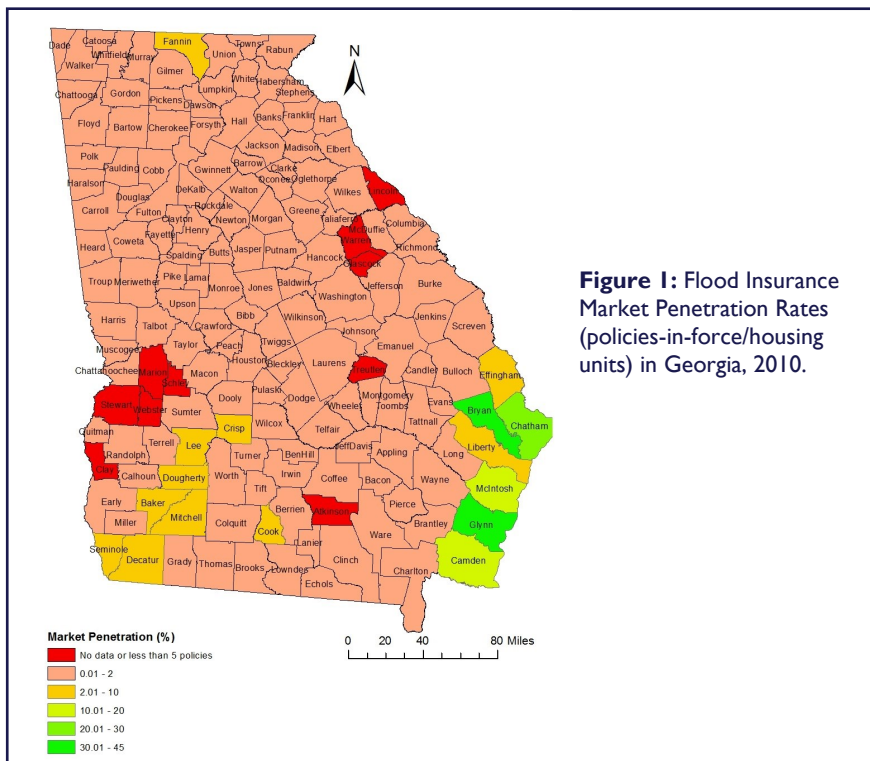
Our findings that take-up of flood insurance differs across racial groups within a community sheds light on the need for more research in communication strategies to reach at-risk populations. When communicating risk, "one size does not fit all."

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**Figure 1: Flood Insurance Market Penetration Rates (policies-in-force/housing units) in Georgia, 2010.**



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## Small Businesses' Vulnerability to Natural Disasters

Natural disasters create many challenges for businesses. Property damage frequently causes the largest value losses, however, business interruptions also contribute notably to losses and delay recovery. Firms poorly equipped to manage a disaster may afterward find themselves in the difficult position of being forced to adopt short-term coping strategies that limit future profitability.

Increased recognition of business interruptions emerged in part as a result of research led by Kathleen Tierney on the 1994 Northridge earthquake near Los Angeles.<sup>1</sup> Customers evacuated or changed their spending habits. The power and water were off. Suppliers couldn't deliver. Employees were managing personal emergencies and couldn't come to work.

Many of these interruptions are relatively short-lived but may create lasting problems for firms. Seventy-five percent of surveyed businesses closed for an average of eight days following the 1989 Loma Prieta earthquake in northern California. Hurricane Andrew in 1992, the costliest hurricane in history at the time, led 90 percent of surveyed firms in southern Miami to close for an average of 64 days. Six years later, research showed that one-third of firms in the area still hadn't fully recovered.<sup>2</sup>

### How does a firm's age and size affect its vulnerability and recovery?

Communities, states and the nation have a vested interest in the well-being of young and small businesses. Research finds that young businesses (less than 5 years old) drive productivity<sup>4</sup> and employment growth.<sup>5</sup> In the U.S., small businesses are often defined as those with fewer than 500 employees. Over 99.7 percent of all U.S. businesses meet this definition and they contribute half of employment and GDP in the U.S.

Using a survey we developed in collaboration with the **Federal Reserve Bank of New York** of over 1,000 businesses in the region affected by Hurricane Sandy, we are exploring the effects of firms' age and size on their disaster vulnerability and recovery.<sup>3</sup>

Initial results from our research indicate that smaller businesses seem to be more vulnerable to disasters than larger ones. Many are located in a single community or region and so every aspect of their business may be affected by a major event. While larger businesses employ dedicated risk officers, managing risk in smaller firms often falls on the owner or top manager for whom preparing for risk competes with day-to-day management.

Young firms seem to have less capacity to manage the financial effects of a disaster and frequently encounter credit constraints. Young firms are also more likely to declare bankruptcy for a variety of reasons related to the challenges of starting a new business. This risk affects their access to credit and may reduce the likelihood that they prepare for low-probability, high-consequence events.

### Finding post-disaster financing

The effects of disasters on debt and investment are particularly important for understanding why disasters can have such lasting effects. Borrowing to cope with losses can help a business address immediate needs, but taking on more debt increases financial risk. Forty percent of negatively affected firms in our survey increased their debt because of Hurricane Sandy.

Negatively affected firms that want to borrow may be unable to do so if lenders doubt their creditworthiness. Disaster-related loan losses can also limit a bank's ability to lend after a severe event. The **Small Business Administration's (SBA) Disaster Loan Program**<sup>6</sup> is intended to address this market gap, but businesses still need a decent credit history and evidence of their ability to repay to be approved.

### Managing disaster risk

A growing body of evidence indicates that investments in risk reduction and preparedness substantially reduce the costs of disasters relative to strategies focusing on post-event recovery. For example, a recent review conducted by the Wharton Risk Center as part of the **Zurich Flood Resilience Alliance** concludes that "for every one dollar spent on flood risk reduction, on average, five dollars is saved through avoided and reduced losses."<sup>7</sup>

Business managers and owners should reframe risk planning as an investment in the firm. Assess your situation: What risks does your current insurance contract cover? Are you in a flood zone? Would your strategy still be effective if conditions differ from your planning scenario?

Public policymakers would do well to institute a voluntary program that encourages disaster preparedness (with "disasters" broadly defined) through assessing and training small businesses. The large network of the SBA's Small Business Development Centers seems well suited to implement such a program. Using chambers of commerce and other private implementers may also be possible.

Participating businesses would receive access to grants or loans from this fund based on means testing: a combination of their preparedness scores, the ability of the business to repay, their presence in socially vulnerable communities and other factors. Such a program might also improve markets when no disaster occurs. This assessment and training could act as a signal to lenders and insurers that improves access to and the terms of financial services for participating businesses.

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- <sup>7</sup> <http://opim.wharton.upenn.edu/risk/library/ZAlliance-decisiontools-IB.pdf>

A portion of this article appears in *BRINK News*: "Small Firms, Big Risk: The Challenge of Natural Disasters and What Can Be Done," (June 1, 2015).



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## Individual Energy Use in a Changing World

Energy use is an increasingly important social and political issue. Throughout the world, the major source of energy is the burning of fossil fuels such as coal, oil, and natural gas. This reliance on fossil fuels has several major drawbacks: fossil fuels are a finite resource, they are pollutants, and they contribute to climate change. One way to address these issues is by changing the way that people use energy. There is much potential to make a significant dent in carbon dioxide emissions by targeting individual energy use, as 38 percent of U.S. emissions are produced by households. Easy-to-implement changes in household energy behavior, such as switching to more energy-efficient appliances, could reduce these emissions by 20 percent (Dietz et al., 2009).

But how can people be encouraged to change their energy behavior? What motivates people to use less energy than they currently do, either through reducing their energy consumption or investing in energy efficient technology, or switching from fossil fuels to renewable sources of energy?

One way to answer this question is to make energy-efficient and renewable energy technologies financially attractive to individuals. As the upfront costs of these technologies—ranging from LED light bulbs to solar panels—continue to decrease, people can expect to see greater returns on their investment and shorter payback periods. Federal tax credits (such as the Solar Investment Tax Credit which provides a 30 percent credit on solar panel installations), provide additional financial incentives for individuals to invest in cleaner energy.

However, while financial considerations are clearly very important, recent social science research, to which the Wharton Risk Center has contributed, has demonstrated the

importance of the role of non-economic sources of value in motivating people to change their energy behavior and choices.

One key lesson that has emerged from this research is that people are more likely to use less energy and invest in energy innovations when these decisions are connected to things that they care about in their everyday life. Three such motivators are (1) how we compare to others, (2) what others think of us, and (3) whether our choices reflect who we are and what we care about. These types of interventions offer inexpensive means of changing people's energy behavior. They also have the benefit of being effective even when financial incentives are not available (e.g., the Solar Investment Tax Credit is set to expire at the end of 2016), when upfront costs deter investment (as people tend to pay more attention to short-term costs than long-term benefits), and when people lack the motivation to learn about the potential financial benefits of changing their energy behavior.

### **How do we compare to others?**

Research has demonstrated that we care about how we compare to others: we do not want to be the worst performer or be left behind. In a landmark study on how to encourage energy conservation, Shultz and colleagues (2007) showed that providing residents with information about how they compared to their neighbors (whether they were better or worse than average) led to decreases in residential energy use, particularly amongst those who were worse than average. The company OPower has used these findings for their business model, in which they provide customers with feedback about how their energy use compares to that of their peers (and compare it to similar customers who are not given this information).

They find a consistent 2.5 percent decrease in energy use when people are provided with feedback about how they stack up against their peers. This drop in energy use is equivalent to an 11 to 20 percent increase in energy prices (Allcott (2011), indicating the effectiveness of using this kind of low-cost intervention to encourage people to reduce their energy use.

Recent findings have also demonstrated the presence of social influence in solar power adoption. For instance, Bollinger and Gilligham (2012) found that for every solar panel installation in a particular ZIP code, the probability that another homeowner in that ZIP code will install solar panels increases by .78 percentage points. The authors identified two likely drivers of this effect: one is that neighbors can provide others with information (“Was it a hassle?” “Who did you use?”). The other is image motivation: people want to keep up with their neighbors who are installing solar panels, and not be left behind.

### **What do others think of us?**

Yoeli and colleagues (2013) showed how concerns about one's reputation can affect participation in a demand-response program, through which utilities can remotely control residents' energy use during peak hours. Their sample contained 15 homeowners' associations in which residents have some level of contact with one another. They put sign-up sheets for the demand-response program in public places, and residents either signed up with their name (observable condition) or with a code tied to their name (anonymous condition).

Residents were three times more likely to sign up for the program when their sign-up was observable than anonymous, indicating that concerns about one's desire to be seen in a positive light by their neighbors can drive energy choices. The utility

would have had to offer a \$174 incentive per household to produce similar sign-up rates.

### **Do our choices reflect who we are?**

We want our choices to align with our values—the things in life that we think are important. One important source of values, particularly in the energy domain, is political ideology. Costa and Kahn (2013) demonstrated that politically liberal households, on average, consume 10 percent less energy than politically conservative households. The authors discuss this as evidence for the voluntary restraint hypothesis: even when there is no financial penalty for “excessive” energy use, politically liberal individuals care about minimizing harm to the environment and adjust their energy use accordingly.

This concern for the environment is often used to promote energy-efficient and renewable energy technologies. Given the political divide over the importance of environmental protection, what are the consequences of using environmental benefits to promote energy innovations?

Howard Kunreuther, Rick Larrick (Duke University), and I (2013) conducted a study in which we gave participants a choice to purchase either an incandescent light bulb or a more expensive energy-efficient compact fluorescent light bulb (CFL). We provided all participants with information about the economic benefits of a CFL (lower electricity bill, longer bulb life), and we only varied whether or not a “Protect the Environment” label was paired with the CFL. When there was no label, liberals and conservatives bought the CFL at the same rate—about 60 percent. But when the environmental label was included, only 30 percent of the more moderate and conservative participants opted for this

bulb, even though everything else about the choice was the same. Choosing the energy-efficient bulb now meant being pro-environmental protection, a value that political moderates and conservatives do not endorse to the same extent that liberals do. Yet when the bulbs were priced the same, almost all participants chose to purchase the more energy efficient CFL, regardless of whether an environmental label accompanied it. This finding indicates the importance of considering how economic and psychological factors interact to affect people’s energy choices.

Taken together, these results show that the approach to understanding individual energy behavior and choice needs to consider non-economic sources of value that matter to people: how we stack up against others, what others think of us, and whether our energy choices and behavior correspond with what we value. The ways in which energy choices are communicated can either bring people to the table or drive them away. Therefore, the messages used to communicate about energy use and energy innovations may be key to determining who changes their energy behavior.

In the coming years, the Wharton Risk Center’s research will seek to integrate how economic and non-economic sources of value affect people’s energy choices and behavior. One example of this is the Risk Center’s work with the **Solar Energy Evolution and Diffusion Studies (SEEDS)**; funded by the **U.S. Department of Energy**, in which we investigate how these factors interact to motivate residential solar adoption. Understanding these interactions will yield deeper and more complete insights as to how to tackle behavior change in the energy domain.

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## What Enabled Chile's Remarkable Recovery from Disaster?

By Alexandra Hamilton, [PPR News](#), June 1, 2015

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Within just a few minutes, buildings collapsed, infrastructure broke, and hundreds of people lost their lives. The earthquake that rocked Chile in 2010, one of the largest in history, measured a magnitude 8.8. The ensuing damage wiped out roughly 18 percent of the country's GDP. Yet the country demonstrated an extraordinary recovery. Chile's stock market showed no significant decrease and its sovereign debt rating never decreased—in fact, both of these measurements improved following the tragic event. The country's resilience is even more remarkable given that a new Chilean president took office just ten days after the quake occurred.

Chile's recovery is all the more astonishing because it is so atypical. Most countries that suffer catastrophes take years or even decades to recover. The United States, for example, is still paying for Hurricane Katrina's damage a decade after the storm hit New Orleans. Similarly, Japan is still struggling to rebuild areas hit by the massive earthquake and tsunami it suffered in 2011.

At a seminar co-hosted by the Penn Program on Regulation and the Wharton Risk Center as part of its Risk Regulation Seminar Series, the authors of the new book, *Leadership Dispatches: Chile's Extraordinary Comeback From Disaster*, detailed the factors they found were responsible for Chile's incredible recovery from the disastrous earthquake. The book's co-authors, the Wharton School's Michael Useem, Howard Kunreuther and Erwann Michel-Kerjan, wrote their book to pinpoint how Chile managed to respond so well to the tragedy, and what lessons other nations should learn from Chile's recovery.

The authors began the discussion by highlighting the tremendous impact of the earthquake and showing how improbable the country's comeback was. Dr. Erwann Michel-Kerjan then framed the central questions: How did Chile do it? And what can others learn from this experience?

Professor Useem outlined four reasons to explain Chile's successful comeback. First and foremost was the leadership of Chilean President Sebastian Piñera who took office less than two weeks after the earthquake occurred. Not a typical politician, Piñera, an economics Ph.D. and successful former businessman, took a hands-on approach to leadership, paying careful attention to details. He also did not shy away from setting difficult yet strategic goals, like ensuring that all children would return to school in roughly two months. This was a daunting task, given that nearly a third of the country's schools had been destroyed.

The second explanation for Chile's incredible recovery centered on the leadership of the cabinet members, the high-level government ministers who played pivotal roles in implementing the nation's recovery strategies. In particular, the authors touted the ministers of housing, health, the interior, and mining for their work in rebuilding the country. Professor Useem noted that two of the ministers (housing and mining) had no prior experience in those fields. Yet Piñera carefully selected them, reasoning that although they could learn about housing construction costs or mine safety procedures, he would not need to teach them how to lead, manage a department, and most importantly, make things happen.

Third, the authors focused on Chile's approach to financing the recovery. Following the quake, Chile increased its taxes temporarily. Together with Chile's largely insured homeowner market, these economic factors allowed Chile not only to avoid large-scale financial ramifications from the earthquake, but were instrumental in seeing the Chilean economy grow at a rate of 6 percent just one year later.

Fourth, the authors credited the country's culture and long-term thinking that helped mitigate some of the quake's initial damage and facilitate the recovery. Chile, which is situated along the Ring of Fire, has experienced quite a few earthquakes in its history and so has developed laws and practices to deal with earthquakes. For instance, it has stringent building codes that are strictly enforced. It also imposes legal responsibility on developers for a building's structural integrity for ten years after its construction. Furthermore, almost all homeowners in Chile have earthquake insurance because banks require it in order to get a loan to buy a house.

As successful as Chile's recovery was, the Wharton authors noted that there were still areas that left room for improvement, in particular, some of Piñera's statements following the earthquake. While reassuring the citizens of Chile that their country would be rebuilt, some of the announcements may have set expectations too high, or assumed for the president and his cabinet too much responsibility for reconstruction. Useem posited that some of Piñera's statements following the earthquake may have led to his largely decreased public approval rating later in his term.

Professor Kunreuther discussed the systematic biases and different modes of thinking in Chile's response to the tragedy. He identified two types of thinking — intuitive and deliberative. Most of us use intuitive thinking every day, relying on simplifying factors like memories of previous experiences to help us make choices. The problem, Kunreuther explained, is that intuitive thinking is less helpful in the face of catastrophic events, where we often have no precedent to guide our decision making. That is when the more effortful deliberative thinking must come into play. A major part of Piñera's success in leading the country's recovery was in fixing the short-term problems, but still thinking deliberately about solutions to long-term problems as well.

In 2014, Chile's ability to learn from its experience in responding to the 2010

quake was tested when it suffered another earthquake, this one with an 8.2 magnitude. The country fared remarkably well, having learned from its previous experience.

Chile's comeback from the 2010 earthquake was enormously successful. Its speedy recovery was a key factor in Chile becoming the first Latin American country to be invited to join the Organisation for Economic Cooperation and Development, a global forum of 34 countries that seeks to improve economic progress.

Unfortunately, many tragedies around the world are not followed by such a strong recovery, and instead, the aftermath of natural disasters can affect countries for years. The lessons from *Leadership Dispatches* are important for other nations and their leaders in how to prepare for and manage disaster.

## LEADERSHIP DISPATCHES



CHILE'S EXTRAORDINARY  
COMEBACK  
FROM DISASTER

MICHAEL USEEM,  
HOWARD KUNREUTHER,  
AND ERWANN MICHEL-KERJAN

Stanford University Press, 2015  
ISBN: 9780804793872

256 pp.

<http://sup.org/book.cgi?id=25059>

**Michael Useem** (center) is the William and Jacalyn Egan Professor of Management at the Wharton School, and Director of the Wharton Center for Leadership and Change Management. **Howard Kunreuther** (right) is the James G. Dinan Professor, Professor of Decision Sciences and Business Economics and Public Policy, and Co-Director of the Wharton Risk Management Center. **Erwann Michel-Kerjan** (left) is the Executive Director of the Wharton Risk Management Center.

The authors were invited by then-Chilean President **Sebastián Piñera** to work on matters of catastrophic risk management. This book was written with the active cooperation of the **Government of Chile**, with **Aldo Boitano**, **Eugenio Guzmán**, **Rodrigo Jordán**, and **Matko Koljatic** of **Vertical S.A.** and **Catholic University, Santiago, Chile**, and in collaboration with the **World Economic Forum**.



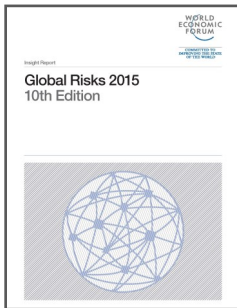
Photo credit: Samer A. Khan

The authors highlight the impact of the earthquake and Chile's improbable recovery at a Risk Regulation seminar.

View the seminar video at <http://bcove.me/o21wdipc>

See also: [Learn Crisis Leadership from World's Best](#). *Wharton Magazine*, Spring, 2015  
[How Smart Leadership Revived Chile after an Historic Disaster](#). *Knowledge@Wharton*, April 15, 2015

## Risk Center Partners with the World Economic Forum on *Global Risks 2015*



The 2015 edition of the *Global Risks* report completes a decade of highlighting the most significant long-term risks worldwide, drawing on the perspectives of experts and global decision-makers. *Global Risks* is an initiative of the [World Economic Forum](http://www.weforum.org). The Wharton Risk Center has been the Forum's academic partner since 2005. Over that time, analysis has

moved from risk identification to thinking through risk interconnections and the potentially cascading effects that result.

Taking this effort one step further, this year's report underscores potential causes as well as solutions to global risks. Not only does it set out a view on 28 global risks in the report's traditional categories (economic, environmental, societal, geopolitical and technological) but it also considers the drivers of those risks in the form of 13 trends.

The report features an assessment by experts on the top global risks in terms of likelihood and potential impact over the coming ten years. This edition finds interstate conflict with regional consequences to be the number one global risk in terms of likelihood, and the fourth most serious risk in terms of impact. It is ranked as more likely than extreme weather events (2), failure of national governance systems (3), state collapse or crisis (4), and high structural unemployment or underemployment (5).

The 2015 report features three examples of risk management and resilience practices related to extreme weather events. Howard Kunreuther, co-director of the Wharton Risk Center and an Academic Advisor for *Global Risks 2015* notes that, "Experts and the general public are now much more concerned with weather-related events than they were ten years ago because of the increasing losses from natural disasters around the world. 'Extreme weather events' is ranked as the second most likely global risk, and the failure of climate change adaptations is in the top five global risks in terms of potential impact. As the 2015 report indicates, there are now efforts underway — such as the Resilient America Roundtable by the National Academy of Sciences — to focus on long-term strategies currently being undertaken by communities to reduce the likelihood of severe catastrophes and to cope with disasters more effectively should they occur."

Erwann Michel-Kerjan, executive director of the Wharton Risk Center and member of the *Global Risks* Advisory Board, reflects on ten years of collaboration with the World Economic Forum: "Modern risk management is now in high demand in presidential offices and boardrooms. The methodology that was developed and continuously improved over the last decade can help many global leaders eager to strengthen resilience of their country or organization. While not a crystal ball, the report provides an essential compass to better navigate the world of risks."



### Top 5 Global Risks (Likelihood)

	2007	2008	2009	2010	2011	2012	2013	2014	2015
1 <sup>st</sup>	Breakdown of critical information Infrastructure	Asset price collapse	Asset price collapse	Asset price collapse	Meteorological catastrophes	Severe income disparity	Severe income disparity	Income disparity	Interstate conflict with regional consequences
2 <sup>nd</sup>	Chronic disease in developed countries	Middle East instability	Slowing Chinese economy (<6%)	Slowing Chinese economy (<6%)	Hydrological catastrophes	Chronic fiscal imbalances	Chronic fiscal imbalances	Extreme weather events	Extreme weather events
3 <sup>rd</sup>	Oil price shock	Failed and failing states	Chronic disease	Chronic disease	Corruption	Rising greenhouse gas emissions	Rising greenhouse gas emissions	Unemployment and under-employment	Failure of national governance
4 <sup>th</sup>	China economic hard landing	Oil and gas price spike	Global governance gaps	Fiscal crises	Biodiversity loss	Cyber attacks	Water supply crises	Climate Change	State collapse or crisis
5 <sup>th</sup>	Asset price collapse	Chronic disease in developed world	Retrenchment from globalization (emerging)	Global governance gaps	Climatological catastrophes	Water supply crises	Mismanagement of population ageing	Cyber attacks	High structural unemployment

<http://www.weforum.org/reports/global-risks-report-2015>

■ Economic
 ■ Environmental
 ■ Geopolitical
 ■ Societal
 ■ Technological

## A decade-long partnership with the World Economic Forum

2015 marks the 10<sup>th</sup> year anniversary of the partnership between the Wharton Risk Center and the World Economic Forum. Our collaboration began in 2004 as one of the Forum's partners on the *Global Risks* report initiative. Our task was to produce a report that would be easy to read and accessible for non-risk specialists and that would help top decision makers around the world more clearly see the risks ahead of us, learn from good practices, and support multi-stakeholder responses.

The success of the report could only be measured over time therefore, it had to be a multi-year commitment, be forward looking and innovative. Over the years, and with risk management becoming much more strategic for heads of state, corporations and civil society, the report has grown to be an important barometer of risks around the globe and across industry sectors. The report, now one of the flagship reports of the World Economic Forum, is distributed widely a few weeks ahead of the annual meeting of the World Economic Forum in Davos and discussed at length with participants there.

Every year the report reveals how a group of nearly 1,000 experts from academia, business, government and not-for-profit organizations perceive 30 to 50 risks (both likelihood and severity in the next ten years) on economic, environmental, geopolitical, societal and technological issues. Combined with a series of workshops and numerous expert inputs, this report also sheds light on interdependencies between risks. The risk interconnections map (see <http://reports.weforum.org/global-risks-2015/#frame/10e05>) we started to explore in 2004 has now helped make better

sense of the cascading effects a crisis on one continent can quickly have on another. While such interdependencies seem obvious today, these were much less so a decade ago. Our efforts in the 2015 and in the forthcoming edition (January 2016) also look at general trends in both the short term (18 months) and longer term. Every report now highlights some good practices on risk management and resilience.

As Klaus Schwab, founder and Chairman of the Forum, states: "The 10<sup>th</sup> edition of the *Global Risks* report is published at a time of profound transformations to our global context. Across every sector of society, decision-makers are struggling to cope with heightened complexity and uncertainty resulting from the highly interconnected nature of the world and the increasing speed of change."

Wharton's partnership with the Forum is broader than the *Global Risks* initiative. Our team has participated in a number of sessions at the annual meeting in Davos and at regional meetings. Risk Center faculty were among the founding members of the Forum's Global Agenda Council (GAC) on Mitigation of Natural Disasters launched in Dubai in 2008, co-chaired by Howard Kunreuther and Michael Useem. Their book, *Learning from Catastrophes: Strategies For Reaction and Response* (Wharton School Publishing) was the first volume published by any GAC (there are now over 100 such councils; see [www.weforum.org](http://www.weforum.org)).

Throughout our decade of collaboration we've strived to address critical topics of risk trends and long-term thinking, and we look forward to continuing this partnership in the years to come.

## Katrina — a look back

The Risk Center marked the 10th anniversary of Katrina with a focus on resilience.

**Six Lessons From Katrina Loom Even Larger 10 Years Later** (in *Government Executive*, August 17). Donald F. Kettl, Howard Kunreuther, and Ronald J. Daniels, editors of *On Risk and Disaster: Lessons from Hurricane Katrina* (UPenn Press, 2006) note that natural disasters have become more frequent and more costly. We need to pay more attention to who bears the costs of disasters, and how to integrate partnerships involving both government and the private and nonprofit sectors. And we need to understand that natural disasters aren't the only dangers our communities face.

**We must build resilience into our communities** (in *Nature*, August 27). Erwann Michel-Kerjan discusses advances such as new resilience metrics to improve protection against natural disasters. Communication about disasters has also improved, but knowledge gaps remain; exposure analysis of assets in flood-prone areas is key.

**Beyond Katrina: Lessons in creating resilient communities** (August 2015). Zurich North America and the Wharton Risk Center's whitepaper outlines new flood resilience strategies and identifies the need to devote more resources to preventive measures rather than post-event disaster relief, and overcoming current infrastructure vulnerabilities. [http://opim.wharton.upenn.edu/risk/library/whitepaper\\_beyond\\_katrina\\_2015.pdf](http://opim.wharton.upenn.edu/risk/library/whitepaper_beyond_katrina_2015.pdf).



Erwann Michel-Kerjan participated in a series of meetings and a panel discussion that took place in New Orleans on the 10<sup>th</sup> anniversary of Hurricane Katrina. The panel discussed lessons from Katrina and how the storm dramatically changed the paradigm of how businesses, governments and communities manage pre-disaster planning and post-disaster recovery.

Mayor Landrieu noted, "Compelling lessons from August 2005 were illuminated in the panel discussion by leaders from Zurich, the City of New Orleans, and the Bayou District Foundation who were on the front lines of the recovery efforts, along with key insights from The Rockefeller Foundation and Wharton's Risk Management and Decision Processes Center." #Katrina10



Taking part in the panel were (from left to right):

**Mike Foley**, CEO of Zurich North America Commercial  
**Michael Lewis**, best-selling author of *Moneyball*, *The Big Short*, *The Blind Side*  
**Dr. Judith Rodin**, President of The Rockefeller Foundation  
**Mitch Landrieu**, Mayor of New Orleans  
**Gerard W. Barousse Jr.**, Chairman of the Bayou District Foundation  
**Dr. Erwann Michel-Kerjan**, Executive Director, Wharton Risk Center

## Involvement in U.S. Policy Decision Making

Howard Kunreuther was invited by Chairman Barletta and Ranking Member Carson to participate in a U.S. Congress roundtable policy discussion held by the **Subcommittee on Economic Development, Public Buildings, and Emergency Management**. The purpose of the roundtable, “The State of Pennsylvania and FEMA Region III are Leaders in Mitigating Disaster Costs and Losses,” was to examine disaster costs and losses, focus on hazards impacting Pennsylvania and the region, and identify best practices for mitigating and avoiding disaster impacts. The roundtable was held on May 28 at the Federal Emergency Management Agency (FEMA) Region III Offices in Philadelphia, Pennsylvania. Video of the roundtable: <http://transportation.house.gov/calendar/eventsingle.aspx?EventID=398970>.



Members of the **Subcommittee on Economic Development, Public Buildings and Emergency Management** held a roundtable discussion in U.S. Congress on March 18, 2015 on “What is Driving the Increasing Costs and Rising Losses from Disasters?” The purpose of the roundtable was to examine and discuss data related to disaster costs, the trends observed over time, and the projections for the future given the policies in place today. Participants included:

The Honorable Joseph L. Nimmich, Deputy Administrator,  
Federal Emergency Management Agency  
Mr. Francis X. McCarthy, Analyst in Emergency  
Management Policy, Congressional Research Service  
Mr. Christopher P. Currie, Director, Homeland Security and  
Justice, Government Accountability Office  
Dr. Erwann O. Michel-Kerjan, Executive Director,  
Wharton Risk Management and Decision Processes Center  
Mr. Eric Nelson, Vice President, Catastrophe Strategy & Analysis,  
Travelers Insurance  
Mr. Stephen Ellis, Vice President, Taxpayers for Common Sense

For more information see <http://transportation.house.gov/news/documentsingle.aspx?DocumentID=398733>.

## Penn Wharton Public Policy Initiative

September 2015 marks the third anniversary of the founding of the Penn Wharton Public Policy Initiative (PPI). Penn Wharton PPI is a hub for research and education, with offices on Penn’s campus and in Washington, DC, that is focused on leveraging the University’s resources to improve federal policymaking on issues impacting business and the economy. The Initiative works with faculty and research centers across the University — including the Wharton Risk Center — to share their expertise with policymakers and their staffers in DC through the publication of nonpartisan, data-driven issue briefs, as well as the convening of meetings and conferences.

Penn Wharton PPI enhances public policy education on campus in many ways. The Initiative hosts lectures by key policy actors. It administers Public Policy Research Scholars, a new undergraduate honors certificate program. And it funds summer internship opportunities at the White House, executive and independent agencies, Hill offices and committees, and other organizations in DC. Over the past two years, Penn Wharton PPI has supported 170 summer internships, making it possible for more Penn students to directly experience the world of federal policymaking.



**PENN WHARTON**  
PUBLIC POLICY INITIATIVE

UNIVERSITY of PENNSYLVANIA

## Howard Kunreuther Receives 2015 Shin Research Excellence Award

Howard Kunreuther received the **2015 Shin Research Excellence Award** from the **Geneva Association** and the **International Insurance Society (IIS)** in recognition of his outstanding work on the role of public-private partnerships in mitigating and managing risks. The commissioned research is refereed by a panel of judges representing insurance experts and industry scholars. The paper is published in the [Geneva Papers on Risk and Insurance, 1018-5895/15: 1-22, 2015](http://www.geneva.ch/pubs/1018-5895/15:1-22.2015).

Prof. Kunreuther presented his talk on “Insuring Against Extreme Events: The Need for Public-Private Partnerships” at the IIS’s 51st annual Global Insurance Forum in New York City, June 14-17. His presentation is viewable at <http://bit.ly/1fLYg>.



Howard Kunreuther and Michael Pritula (McKinsey & Co.) engage in a [discussion](#) on “Managing Extreme Risks.”



The third day of the event took place at UN headquarters. Panelists (from left to right) **Julie Dana (World Bank)**, **Jay Guin (Air-Worldwide)**, **Maryam Golnaragh (Geneva Association)**, **Howard Kunreuther**, and panel moderator, **Ian Branagan (RenRe)** stand to applaud UN Secretary-General BAN Ki-moon, who delivered the keynote address.

## Lloyd’s Science of Risk Prize awarded for “Evaluating Flood Resilience Strategies”

Erwann Michel-Kerjan and his colleagues won one of two first prizes in the **2014 Lloyd’s Science of Risk Prize** program, sponsored by the London insurance market Lloyd’s. The award recognizes “*Evaluating Flood Resilience Strategies for Coastal Megacities*” (published in May 2014 in the journal [Science](http://www.sciencemag.org)), jointly undertaken by **Jeroen Aerts, Wouter Botzen, Hans de Moel (VU University, Amsterdam)**, **Kerry Emanuel (MIT)**, **Erwann Michel-Kerjan (Wharton)** and **Ning Lin (Princeton University)**.

The paper studied four resilience strategies to cope with future storm surges and the likely impact of sea level rise, performing a cost-benefit analysis of resilience strategies to protect large coastal megacities against storm surge today and in the future, and applied their new methodology to New York City. Cost-effectiveness emerges over longer-term horizons because designing and implementing necessary infrastructure projects can take a decade or longer. The implication for New York and other large cities is to put strategies into place immediately. The difficulty in financing such resilience strategies involving large-scale infrastructure projects, including barrier islands, was also considered by the research. None of the strategies are cost-effective under climate scenarios if the full cost is handled by New York City alone.

The Science of Risk Prize program is open to published, peer-reviewed academic research that can contribute to innovation and better understanding of risk in insurance. “The research submitted gave us valuable insights into new and emerging risks and how to assess them, which is the essence of our Science of Risk Prize,” said Lloyd’s director of performance management, Tom Bolt, who presented the awards.



Erwann Michel-Kerjan presents *Evaluating Flood Resilience Strategies for Coastal Megacities* which was awarded the 2014 Lloyd’s Science of Risk Prize. <https://www.lloyds.com/news-and-insight/news-and-features/lloyds-news/lloyds-news-2014/joined-up-thinking>.



The Risk Center welcomes **Dr. Alex Van Zant** as a postdoctoral fellow. His research considers both how individuals engage in strategic behaviors to manage the impressions they form on others, and how those behaviors influence others' decisions under uncertainty. Alex has examined how individuals convey certainty through verbal and nonverbal channels to manage the impressions they form on others, along with how they make decisions about whether to deceive others for economic gain. He has also explored how people are influenced by strategic nonverbal behaviors, their responses to trust violations, and the impact of leaders' justifications for policies on individuals' support for those policies.

At the Risk Center, Alex will research how risk and uncertainty can provide a motive for expert advisors to convey a high degree of certainty in the accuracy of their judgment—even to the point where they engage in deliberate exaggerations. He will also conduct a separate stream of research on how public leaders' use of moral appeals can increase public support for policies and increase individuals' willingness to take action to promote those policies.

Alex received a B.A. from the University of California, Berkeley, where he double-majored in Economics and Psychology. He also holds a Ph.D. in Business Administration from the Haas School of Business at the University of California, Berkeley, where he specialized in Organizational Behavior.

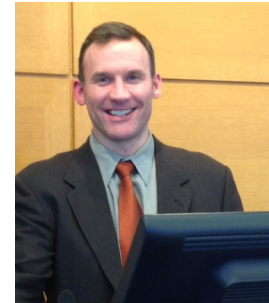
### 2015 Paul R. Kleindorfer Award

Congratulations to **Emma E. Levine**, recipient of the *Paul R. Kleindorfer Scholar Award*. The Operations, Information and Decisions department at the Wharton School established the *Paul R. Kleindorfer Memorial Fund* to honor the memory of Paul Kleindorfer, Emeritus Professor who passed away in August 2012. The award recognizes the OID doctoral student who is making the most outstanding progress towards the completion of his or her dissertation and provides \$4,000 of research support. Emma is also an Ackoff Doctoral Student Fellow of the Risk Center. Her main stream of research examines moral conflicts between honesty and benevolence and how practitioners navigate this conflict when providing performance feedback and delivering difficult prognoses.



Contributions to the Paul R. Kleindorfer Memorial Fund may be sent to Alison Matejczyk, Wharton School, University of Pennsylvania, 344 Vance Hall, 3733 Spruce Street, Philadelphia PA 19104. Please make checks payable to the Trustees of the University of Pennsylvania, with "Kleindorfer Fund" in the memo field.

As part of a special session on Forecasting Natural Disasters, Jeffrey Czajkowski presented "The Economics of Natural Disasters: Moving from Risk Assessment to Risk Reduction" at the **2015 U.S. Frontiers of Engineering Symposium** on September 9-11 in Irvine, California.

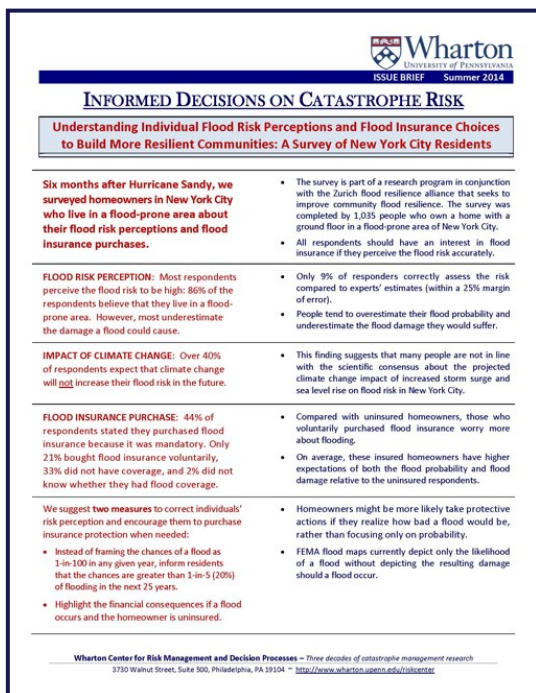


Organized by the **National Academy of Engineering (NAE)** of the **National Academy of Sciences**, the annual symposium brings together 100 of the nation's outstanding young engineers (ages 30-45) from industry, universities, and federal labs to facilitate cross-disciplinary exchange and promote the transfer of new techniques and approaches across fields in order to sustain and build U.S. innovative capacity. Other areas discussed were Cybersecurity and Privacy, Engineering the Search for Earth-like Exoplanets, and Optical and Mechanical Metamaterials. The presentations are available at <http://www.nae-frontiers.org/Symposia/USFOE/USFOE-PastSymposia/2015USFOE.aspx>. An associated paper from his talk is forthcoming in the NAE's quarterly publication of *The Bridge*.

Dr. Czajkowski presented his 2015 joint research effort (with **Kevin Simmons of Austin College** and **James Done of NCAR**) on the role of strong and well-enforced building codes in reducing Florida windstorm losses at the **National Exercise Program Climate Preparedness, Adaptation, and Resilience Seminar** held in Miami, FL on September 21. This FEMA sponsored initiative is aimed at supporting sustained, community-based climate adaptation, preparedness, and resilience planning. The building code research will be further featured at the 2016 **Federal Alliance for Safe Homes (FLASH) Annual Conference – The Next Generation of Resilience** conference January 27-29 in Orlando, FL. A final report has been submitted to the Florida Department of Emergency Management.

## Wharton Risk Center Issue Briefs

The Wharton Risk Center's issue briefs are non-technical 4-page summaries distilling the Center's new research findings and the team's best thinking on how the findings can be applied to the management of catastrophic risks.



The 2014-2015 series includes research on:

- Property Prices in Inundated Areas
- Does Federal Disaster Assistance Reduce the Demand for Insurance Protection?
- New York City Residents' Perceptions of Flood Risk and Insurance Purchase Choices

Issue briefs are available on the Center's website, <http://riskcenter.wharton.upenn.edu/issue-briefs/>. To request hard copies, please contact Carol Heller, [heller@wharton.upenn.edu](mailto:heller@wharton.upenn.edu).

### Seeing Is Believing? Property Prices in Inundated Areas

Our findings suggest that buyers of floodplain properties have a limited awareness about flood hazards, despite the federal requirement for flood insurance for floodplain properties with a federally-backed mortgage. Our results suggest that it is the result of being flooded, rather than knowing there is a potential to be flooded, that affects property prices (“seeing is believing”).

### Does Federal Disaster Assistance Reduce the Demand for Protection?

Federal disaster relief potentially creates moral hazard: receiving or expecting to receive money from the government after a disaster might reduce demand for insurance, resulting in even greater need for government relief when another disaster hits. Overall, we find that federal disaster assistance grants result in decreased demand for insurance. Low-interest disaster loans have no systematic impact on insurance purchases.

### Flood Risk Perceptions and Flood Insurance Choices: A Survey of New York City Residents

Six months after Hurricane Sandy, we surveyed over 1,000 homeowners in New York City who live in a flood-prone area about their flood risk perceptions and flood insurance purchases. Among the findings: most people underestimate the damage a flood could cause. 44 percent of respondents stated they purchased flood insurance because it was mandatory. Only 21 percent bought flood insurance voluntarily, 33 percent did not have coverage, and 2 percent did not know if they had flood coverage.

## Risk Regulation Seminars

### Climate Change Policy

Climate change is already beginning to threaten the food supply. Coastal flooding, driven by rising sea levels, is increasingly frequent and devastating. What is required to achieve climate change policies that will reduce the risks associated with global warming?

The [Penn Program on Regulation](#) brought together a panel of climate change experts to discuss strategies for the [United Nations Framework Convention on Climate Change](#) in Paris. The panelists, [Michael Oppenheimer](#), [David Victor](#) and [Elke Weber](#), along with Howard Kunreuther, were among contributors to the [Intergovernmental Panel on Climate Change](#) (IPCC)'s recent [Fifth Assessment Report](#) that documents climate change and its implications, ethical issues and uncertainties, and lays out the data to support a global target of limiting warming to 2 degrees Celsius.

One concern is that wealthy countries can "reduce" their carbon emissions by outsourcing them, since emissions are attributed to the country of production, rather than the consuming country.

The panelists agreed that outcomes could be improved if negotiating countries abandon emissions targets and the quest for a single, consensus-based treaty, making way instead for smaller scale agreements.



Photo credit: Sameer A. Khan

*Elke Weber describes climate change as a collective action problem; the costs of action will be immediate, while the benefits will be distant and diffuse. Furthermore, unanimity is very difficult to achieve with such a large number of negotiating parties.*

The **Risk Regulation Seminar Series** brings distinguished speakers to address topics of importance to academia, industry and public policymakers. The series is sponsored by the [Penn Program on Regulation](#) and the Wharton Risk Center, <https://www.law.upenn.edu/academics/institutes/regulation/seminars.html>. Seminars are free and open to the public.

March 24, 2015 (see article at left)

#### **Climate Change Policy and the Upcoming Paris COP21 Talks**

SEMINAR RECORDING: <http://bit.ly/1KF7ojo>

<http://www.regblog.org/2015/06/08/hamilton-treaty-climate-change/>

**Howard Kunreuther**, Wharton School, University of Pennsylvania

**Michael Oppenheimer**, Princeton University

**David Victor**, Laboratory on International Law and Regulation, UC San Diego

**Elke Weber**, Center for the Decision Sciences, Columbia University

February 24, 2015 (see page 16)

#### **Leadership Dispatches: Chile's Extraordinary Comeback from Disaster**

SEMINAR RECORDING: <http://bcove.me/o21wdipc>

**Mike Useem**, Wharton Center for Leadership and Change Management

**Howard Kunreuther**, Wharton Risk Center

**Erwann O. Michel-Kerjan**, Wharton Risk Center and Chair, OECD Secretary

General Board on Financial Management of Catastrophes

February 3, 2015

#### **The Risks and Regulatory Challenges of Unconventional Oil and Gas Development.**

Jointly sponsored by the [Kleinman Center for Energy Policy](#).

SEMINAR RECORDING: <http://bcove.me/njnfe0a8>

Insights on how regulators can balance conflicting policy and economic interests that surround hydraulic fracturing and other techniques of energy extraction.

**Adam Finkel**, Penn Program on Regulation, University of Penn Law School

**Bernard Goldstein**, Dean, Univ. of Pittsburgh Graduate School of Public Health

**Mitchell Small**, Carnegie Mellon University

**Hannah Wiseman**, Florida State University College of Law

October 21, 2014

#### **How Do Bank Regulators Determine Capital Adequacy Regulations?**

[https://www.law.upenn.edu/newsevents/calendar.php#event\\_id/48509/view/event](https://www.law.upenn.edu/newsevents/calendar.php#event_id/48509/view/event)

The failure of banking regulators to use cost-benefit analysis in order to determine capital requirements may have contributed to the financial crisis of 2007-2008.

**Eric Posner**, University of Chicago Law School

November 18, 2014

#### **EPA's Climate Action Plan**

<http://www.regblog.org/2014/12/15/walters-experts-debate-clean-power-rule/>

The agreement with China commits the U.S. to a variety of initiatives in setting an ambitious goal to reduce emissions by 26-28 percent of 2005 levels by 2025.

**Cary Coglianese**, Director, Penn Program on Regulation, University of Pennsylvania Law School

**Joel Beauvais**, U.S. EPA

**Dallas Burtraw**, Resources for the Future

**Tomás Carbonell**, Environmental Defense Fund

**Jeffrey R. Holmstead**, Former EPA Assistant Administrator

December 9, 2014 (see page 30)

#### **Cybersecurity and Law Enforcement Back Doors**

SEMINAR RECORDING: <http://bcove.me/ucqm4g2j>

<http://knowledge.wharton.upenn.edu/article/why-electronic-back-doors-could-be-unintentionally-helping-hackers/>

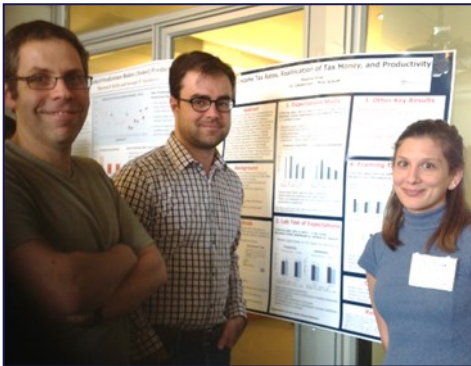
**Matt Blaze**, School of Engineering and Applied Science, University of Pennsylvania

**Jeffrey Vagle**, Center for Technology, Innovation and Competition,

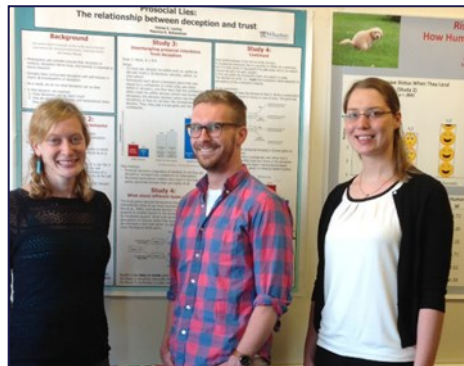
University of Pennsylvania Law School

## Russell Ackoff Doctoral Student Fellowship Awards, 2015

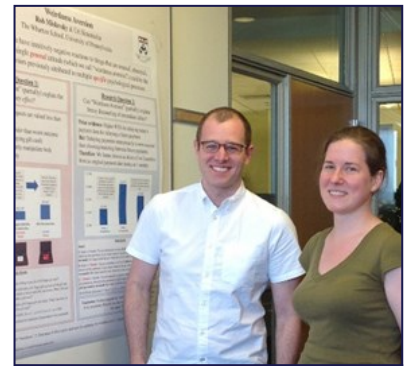
The Wharton Risk Center is pleased to announce the recipients of its 2015 Russell Ackoff Doctoral Student Fellowships. Prof. Emeritus Russell Ackoff's (1919-2009) work was dedicated to furthering understanding of human behavior in organizations. The fellowships are funded by an endowment provided to the Wharton School by the Anheuser-Busch Charitable Trust that also funded a chair held by the late Paul Kleindorfer, former co-director of the Wharton Risk Center. The grants fund data collection, conference fees and other research expenses for studies in human decision making by doctoral students in Wharton and other departments at the University of Pennsylvania. See <http://riskcenter.wharton.upenn.edu/russell-ackoff-doctoral-student-fellowships/>



Prof. Uri Simonsohn (OID),  
Prof. Alex Rees-Jones (OID) and  
Shalena Srna (Marketing)



Emma Edelman Levine (OID),  
Brad Bitterly (OID) and  
Celia Gaertig (OID)



Robert Mislavsky (OID) and  
Theresa Kelly (OID)



Berkeley Dietvorst (OID) and  
Prof. Howard Kunreuther (OID, co-director  
of the Risk Center)

*Recipients of the 2014 Ackoff Doctoral Student Fellowships presented their research at the Risk Center's annual Ackoff luncheon and poster session. Some 50 students and faculty members attended the event which coincided with the announcement of the 2015 award recipients. This year, fellowships were awarded to 32 doctoral students at Penn.*



Andrea Contigiani (Management) and  
Adam Leive (Health Care Mgmt &  
Economics)



An important part of the Ackoff program is getting together with other doctoral students involved in decision research.



Alix Barasch, Nora Becker, Preethi Rao,  
Ana Gazmuri and Prof. Bob Meyer  
(Marketing, co-director of the Risk Center)



Prof. Jon Baron (Psychology) and  
Prof. Maurice Schweitzer (OID)

RECIPIENT	DEPARTMENT	PROPOSAL TITLE
Luis Ballesteros	Management	<a href="#">Lead, Follow, or Abstain: Organizational Decision-making in Highly Uncertain and Dynamic Environments</a>
Alixandra Barasch	Marketing	<a href="#">Gaining or losing focus? How photo-taking affects consumer experiences</a>
T. Bradford Bitterly	OPIM	<a href="#">The Impact of Humor on Interpersonal Perception and Behavior</a>
Emma Boswell	Health Care Mgmt & Economics	<a href="#">India's Market-Based Pharmaceutical Price Control Regulation: Evidence on Firm Response, Product Quality, and Access</a>
Andrew Boysen	Finance	<a href="#">Health Insurance Policy and Entrepreneurship</a>
Devon Brackbill	Annenberg School	<a href="#">Designing Collaboration Networks to Improve Collective Problem Solving</a>
Shulamite Chiu	Health Care Mgmt & Economics	<a href="#">The Effect of Insurance Expansions on Supply-Side Behavior in Dentistry</a>
Amanda Chuan	Applied Economics	<a href="#">Public Announcements of Support and Default Settings</a>
Berkeley Dietvorst	OID	<a href="#">Diminishing Algorithm Aversion</a>
Emma Edelman	OID	<a href="#">Lie unto others as you would have others lie unto you: Community standards of deception</a>
Celia Gaertig	OID	<a href="#">Framing effects in medical decision making</a>
Xuan Gao	Psychology and Marketing	<a href="#">Mental simulation of missing information affects risk attitudes towards future experiences</a>
Ana Gazmuri	Business Economics and Public Policy	<a href="#">Revealed Preferences through School Choice and School-Side Cream-Skimming</a>
Stephen Glaeser	Accounting	<a href="#">Termination Risk and Executive Risk Taking</a>
Zheng Jai Jennie Huang	Business Economics and Public Policy	<a href="#">Peer Effects on Charitable Giving: How Can Social Ties Increase Charitable Giving Through Cognitive Dissonance?</a>
Fujie Jin	OID	<a href="#">Value Creation from Social Media Strategies: Evidence from Large Sample Firm-Level Analysis</a>
Daniel Kim	Finance	<a href="#">Can we explain Bitcoin's price? Trading volume and volatility?</a>
Adam Leive	Health Care Mgmt & Economics	<a href="#">Health Insurance Choices and Retirement Saving: The Relationship Between Health Savings Accounts, 401(k)s, and Insurance Plans</a>
Jiaying Liu	Annenberg School	<a href="#">When Do Boomerang Effects Happen? The role of normative appeals and processing styles on attitude change among people likely to be skeptical about a message</a>
Tong (Joy) Lu	Marketing	<a href="#">The Effects of Reward Distribution Systems within Social Network Structures on Motivation and Performance</a>
Chenyi Ma	School of Social Policy and Practice	<a href="#">Still Vulnerable after All These Years? Housing Recovery in New Jersey Communities after Sandy</a>
Robert Mislavsky	OID	<a href="#">When Are Field Experiments Unethical?</a>
Preethi Rao	Health Care Mgmt & Economics	<a href="#">Hospital Response to reimbursement change: Evidence from California Medicaid</a>
Sydney Scott	Psychology and Marketing	<a href="#">Preferences for Natural when Preventing versus Curing</a>
Holli Seitz	Annenberg School	<a href="#">Effects of Mammography Narratives On Risk Perceptions and Screening Intentions</a>
Jackie Silverman	Marketing	<a href="#">Shh, it's a secret, but pass it on: The impact of secrecy on sharing behavior</a>
Shalena Srna	Marketing	<a href="#">Influence of Formal Dress on Purchase Behavior</a>
Evan Weingarten	Marketing	<a href="#">Purchase Processes Under Informational Uncertainty: The Case of Webrooming and Showrooming</a>
Shinjae Won	Management	<a href="#">Exploring Tenure as a Signal for Loyalty and Competence in the Market for Senior Managers</a>
Andy Wu	Business Economics and Public Policy	<a href="#">Angel Investments by Venture Capital Partners</a>
Jingwen Zhang	Annenberg School	<a href="#">Developing an Online Social Network Physical Activity Intervention for Young African American Women to Reduce Risks for Chronic Diseases</a>

## RECENT PUBLICATIONS more at <http://riskcenter.wharton.upenn.edu/publications/>

Atanasov, Pavel & Howard Kunreuther.

[Cautious Defection: Group Representatives Cooperate and Risk Less than Individuals.](#)

*Journal of Behavioral Decision Making*, 10.1002/bdm.1880.

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[Seeing is Believing? Evidence from Property Prices in Inundated Areas.](#)

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Atreya, Ajita, Susana Ferreira & Erwann Michel-Kerjan.

[What Drives Households to Buy Flood Insurance? Evidence from Georgia.](#)

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Barasch, Alixandra, & Jonah Berger. [Broadcasting and Narrowcasting: How Audience Size Affects What People Share.](#)

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[Divergence between Individual Perceptions and Objective Indicators of Tail Risks: Evidence from Floodplain Residents in New York City.](#) *Judgment and Decision Making*, 10(4): 365-385.

Brooks, Alison Wood, Francesca Gino, & Maurice E.

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*Management Science* (2015).

Collier, Benjamin. [Small Firms, Big Risk: The Challenge of Natural Disasters and What Can Be Done.](#)

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Dietvorst, Berkeley F., Joseph P. Simmons, & Cade Massey, [Algorithm Aversion: People Erroneously Avoid Algorithms After Seeing Them Err.](#) *Journal of Experimental Psychology: General*, <http://psycnet.apa.org/psycarticles/2014-48748-001.pdf>

Doherty, Neil A., Christian Laux, & Alexander Muermann.

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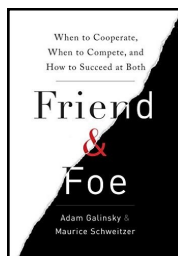
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Kettl, Donald F., Howard Kunreuther & Ronald J. Daniels.

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[Demand for Fixed-Price Multi-Year Contracts: Experimental Evidence from Insurance Decisions.](#)

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Kunreuther, Howard C. & Mark V. Pauly.

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Levine, Emma E. & Maurice Schweitzer.

[The Affective and Interpersonal Consequences of Obesity.](#) *Organizational Behavior and Human Decision Processes*, 27, 66-84. 2015.

Mello, Susan & Robert Hornick. [Media Coverage of Pediatric Environmental Health Risks and its Effects on Mothers' Protective Behaviors.](#) *Risk Analysis*, DOI: 10.1111/risa.12467

Meyer, Robert.

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Michel-Kerjan, Erwann. [We must build resilience into our communities.](#) *Nature*, 524: 389 (August 26, 2015).

Michel-Kerjan, Erwann. [Effective risk response needs a prepared mindset.](#) *Nature*, 517:413 (January 22, 2015).

Michel-Kerjan, Erwann, Jeffrey Czajkowski & Howard Kunreuther. [Could Flood Insurance be Privatized in the United States? A Primer.](#) *The Geneva Papers on Risk and Insurance*, 40: 179–208. 2015.

Montgomery, Marilyn, & Jayajit Chakraborty.

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Useem, Michael, Howard Kunreuther & Erwann Michel-Kerjan.

[Leadership Dispatches: Business Lessons from a President Taking Charge.](#)

*The European Business Review* July-August 2015.

Xiao, Erte, & Howard Kunreuther.

[Punishment and Cooperation in Stochastic Social Dilemmas.](#) *Journal of Conflict Resolution*, DOI: 10.1177/0022002714564426.

## RISK CENTER IN THE MEDIA more at <http://riskcenter.wharton.upenn.edu/faculty-news/>

September 10, 2015, *Knowledge@Wharton*, [Europe's Migrant Crisis: Balancing the Risks with Long-term Gains](#). Robert Meyer, Risk Center co-director, discusses the challenges the migrant crisis poses for receiving countries and how they could address them.

August 26, 2015, *The New Republic*, [Is Your City Ready for the Next Katrina?](#) Article quotes Howard Kunreuther on why people don't prepare.

July 2, 2015, *Knowledge@Wharton*, [Will Rising Heat in the Climate Change Debate Propel Action?](#) Wharton's Erwann Michel-Kerjan and Eric Orts and Fr. James Martin discuss recent calls for action on climate change. (audio)

June 25, 2015, *World Risk and Insurance News*, [How to finance and protect against extreme events](#). Video interview with Howard Kunreuther in connection with his award-winning research. Highlights include the need for public-private partnerships for financing extreme events, cyber risk and terrorism insurance, and multiyear insurance policies to stabilize insurance for extreme events.

June 16, 2015, *Marketplace*, [Fixing the TSA will take time, expert says](#). Michael Useem explains that changing the culture of a large organization such as the TSA can take six months to a couple years.

June 9, 2015, *Wall Street Journal*, [With CEOs, Two Heads Aren't Better Than One](#). Professor Michael Useem comments on companies having co-chief executives.

May 20, 2015, *The Washington Post*, [It's bad business not to donate to Nepal](#).

Op-ed by Luis Ballesteros and Michael Useem: The limited business assistance to Nepal reflects the limited company footprint there at the moment, but that absence will likely constitute a big strategic mistake for the future.

April 27, 2015, *Philadelphia Inquirer*, [From Nepal quake, lessons for the U.S.](#) Op-ed by Michael Useem, Howard Kunreuther and Erwann Michel-Kerjan. Just a week before Nepal's event, about 50 earthquake specialists had gathered in its capital city, Kathmandu, to recommend ways for the country to prepare for another "big one" like the 8.2 earthquake that had leveled the city in 1934.

April 27, 2015, *Wharton Magazine*, [Learn Crisis Leadership from World's Best](#). Michael Useem, Howard Kunreuther and Erwann Michel-Kerjan describe how Chile's leaders made and executed their decisions to enable Chile's extraordinary comeback from the earthquake of February 27, 2010.

April 26, 2015, *Financial Times*, [Scientists begin to get ahead of the weather](#). Interview with Erwann Michel-Kerjan, executive director of the Risk Management Center.

March 5, 2015, *USA Today*, [An earthquake of a snowstorm](#).

Op-ed by Erwann Michel-Kerjan, Howard Kunreuther and Michael Useem: What happened in Chile in 2010 could teach us a thing or two about coping with this winter.

March 3, 2015, *Globe and Mail.com*, [How Chile bounced back from its big quake](#). Video interview with Michael Useem, co-author of Leadership Dispatches: Chile's Extraordinary Comeback from Disaster, discusses leadership lessons gleaned from the study.

February 25, 2015, *The Washington Post*, [Neuroscience is coming to the law. Can we keep politics out of it?](#)

Op-ed by Francis Shen and Dena Gromet: Our new research shows that Americans know very little about neurolaw, and that Republicans and independents may diverge from Democrats in their support for neuroscience based legal reforms.

February 12, 2015, *The Washington Post*, [Want to get conservatives to save energy? Stop the environmentalist preaching](#).

Article cites research by Wharton Risk Center Fellow, Dena Gromet and colleagues in the *Proceedings of the National Academy of Sciences*, regarding how liberals and conservatives felt about energy-efficient compact fluorescent lightbulbs (CFLs), and how that varied by whether they were marketed with "green" messaging.

January 20, 2015, *Scientific American*, [Attempts to Predict Terrorist Attacks Hit Limits](#).

Erwann Michel-Kerjan, executive director of the Wharton Risk Center: "You cannot reliably track terrorism risk without access to classified information."

December 9, 2014, *BusinessWeek*, [The Unexpected Threat to Super Bowl XLIX](#).

By Howard Kunreuther and Erwann Michel-Kerjan: Congress needs to make a decision on renewing a piece of legislation that you possibly never have heard of: TRIA—the Terrorism Risk Insurance Act.

October 26, 2014, *POLITICO*, [All Ebola is Local](#).

Stephen Flynn weighs in on the Ebola outbreak as the latest example of our national anti-resilience.

October 20, 2014, *Businessweek.com*, [How Climate Change Is Fueling the Miami Real Estate Boom](#).

Robert Meyer explains why, paradoxically, hope that buyers and sellers remain collectively naïve, or at least act as if they are, about the risks of sea level rise.

October 17, 2014, *NBC News.com*, [Why Do So Few California Homeowners Have Earthquake Insurance?](#)

Erwann Michel-Kerjan suggests alternative pricing structures—lower deductible paired with a 90-10 rule—that might incentivize California homeowners to buy earthquake insurance and invest in risk reduction measures.

### **An Integrated Approach for Responding to Hazards from Tropical Cyclones**

Working with partners at **Princeton University**, **MIT**, and **NOAA**, the Wharton Risk Center is participating in **National Science Foundation** funded research that will establish a new integrated framework to assess and manage the risk of landfalling tropical cyclones risk. The Risk Center will carry out policy analysis for the National Flood Insurance Program (NFIP), designing a means-tested voucher program intended to address affordability issues related to the price of risk-based flood insurance premiums. We will investigate the feasibility of this program as well as the accuracy of the current and new (soon-to-be released) FEMA flood maps, to gauge the sensitivity of the voucher program to projected flood risk and the consequences in coastal resiliency if NFIP policy were made based on inaccurate flood maps.

### **Critical Infrastructure Resilience Institute MEASURING AND REWARDING RESILIENCE**

Funded by the **Department of Homeland Security**, this new **Center for Excellence** project will focus for the Risk Center on identifying and overcoming the barriers that are hindering more effective public-private partnerships, with a focus on the insurance sector, in generating incentives for advancing regional lifeline infrastructure resilience. Our plan is to be able to provide a tangible market analysis in that regard so some of the currently substantial federal government exposure to providing catastrophic funding for disaster losses can be transferred to the private sector. Reducing the public sector's exposure by cost-effective risk reduction measures will allow DHS to more effectively allocate limited budget to the remaining risks. The Risk Center is collaborating with the **Center for Resilience Studies at Northeastern University** led by Stephen Flynn with Sean Burke.

### **Center for Risk and Economic Analysis of Terrorism Events (CREATE)**

With support from CREATE at USC, the Risk Center is building on our ongoing research on flood risk management and insurance in the United States conducted in close collaboration with the top management of FEMA at the U.S. Department of Homeland Security. Floods are the one natural disaster where the federal government currently plays a major role in designing and implementing strategies for mapping the risk, reducing future losses by supporting risk prevention, and aiding financial recovery through the National Flood Insurance Program (NFIP).

### **Cybersecurity and the Risks of Law Enforcement Back Doors**

Cyberattacks are among the most threatening of emerging risks. Law enforcement agencies want to require software, networking, and other technology companies to build their products' encryption and other security systems so that companies could "unlock" the data for law enforcement. However, security engineers, cryptographers and computer scientists are in almost universal agreement that a "back door" increases the attack surface of the system. A second problem is that many of these devices and systems are built by small companies that do not have the know-how to imperviously secure them.

Cybersecurity experts Jeffrey Vagle (center), Executive Director of the Center for Technology, Innovation & Competition at the University of Pennsylvania Law School, and Matthew Blaze (right), Associate Professor of Computer and Information Science at Penn's School of Engineering and Applied Science, agree that "back doors," however well-intentioned, could raise security risks. The discussion, moderated by Howard Kunreuther, was part of the [Risk Regulation Seminar Series](#) co-sponsored by the Penn Program on Regulation and the Wharton Risk Center. See the full article at: <http://knowledge.wharton.upenn.edu/article/why-electronic-back-doors-could-be-unintentionally-helping-hackers/>. View the seminar recording at: <http://bcove.me/ucqm4g2j>.



### **Catastrophic Risk: How Corporate America Copes with Disruption**

Findings from the study on Effective Leadership Practices in Catastrophe Risk Management in the S&P 500, supported by a partnership with Travelers, are the subject of a book underway by Howard Kunreuther, Erwann Michel-Kerjan, and Michael Useem. Leaders in the S&P 500 shared how their enterprises are coping with and learning from a range of disruptions and recent crises — their own and others' — and how their operations are now preparing for future calamities in the U.S. and abroad. We identify a range of emerging practices that should be of value for all, including community leaders and governments worldwide.

***Research Sponsors and Corporate Associates are a vital part  
of the Wharton Risk Center's operations.***

In addition to providing crucial support for the Risk Center's operations, **Corporate Associates** participate in roundtable discussions and offer insight into the value, direction and timing of research projects. **Research Sponsors** provide funding for specific research initiatives of mutual interest and regularly interact with Risk Center directors, faculty and fellows to discuss these initiatives. Associates and Sponsors attend our workshops and conferences at no cost. These meetings offer an opportunity to consult with experts and policy makers from research institutions, industry and government agencies from the U.S. and abroad.

The Risk Center is inviting interested organizations to become **Strategic Partners**. With a multi-year commitment, Strategic Partners play a key role in the Center's future research, which can enable these companies to impact the future of their industry. Strategic Partners also benefit from greater visibility and customized relationships across the Wharton School through membership in the Wharton Partnership, Wharton's primary vehicle for fostering industry-academic collaboration.

*Corporate Associate, Research Sponsorship, and Strategic Partnership contributions to the  
Risk Management and Decision Processes Center of the Wharton School are tax-deductible.*

***We thank our Corporate Associates, Research Sponsors and  
Strategic Partners in 2015 for their support and involvement.***

**American Insurance Association**

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**Lloyd's**

**Marsh & McLennan**

**Munich Re**

**Property Casualty Insurers Association  
of America**

**State Farm Fire & Casualty Company**

**TransRe**

**Travelers Companies, Inc.\***

**WeatherPredict Consulting, Inc.  
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\* Strategic Partners

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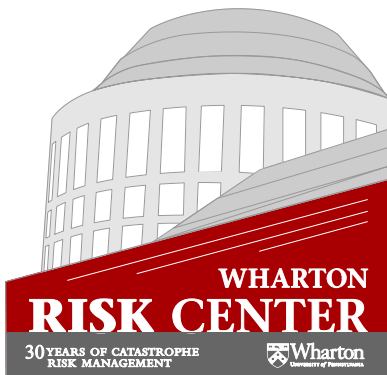
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Or visit our website at <http://riskcenter.wharton.upenn.edu/corporate-associates/>

## WHARTON RISK MANAGEMENT AND DECISION PROCESSES CENTER

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Robert Meyer, Co-Director  
Erwann Michel-Kerjan, Executive Director  
John-Paul Lacovara, Business Administrator  
Carol Heller, Communications Manager  
Maria Puciata, Administrative Assistant

*Over the past three decades, the Risk Management and Decision Processes Center at the Wharton School has been at the forefront of basic and applied research to promote effective corporate and public policies for low-probability events with potentially catastrophic consequences. The Wharton Risk Center has focused on natural and technological hazards through the integration of risk assessment and risk perception with risk management strategies. After the attacks of September 11, 2001, research activities were extended to include national security issues (e.g., terrorism risk insurance, protection of critical infrastructure).*

*Building on the disciplines of economics, finance, insurance, marketing, psychology and decision sciences, the Center's research program is oriented around descriptive and prescriptive analyses. Descriptive research focuses on how individuals and organizations interact and make decisions regarding the management of risk under existing institutional arrangements. Prescriptive analyses propose ways that individuals and organizations, both private and governmental, can make better decisions regarding risk. The Center supports and undertakes field and experimental studies of risk and uncertainty to better understand the linkage between descriptive and prescriptive approaches under various regulatory and market conditions.*

*In the past several years, the Center has significantly increased its size to now include 70 faculty, research fellows, students and visiting scholars to undertake large-scale initiatives in the United States and around the world..*

*Providing expertise and a neutral environment for discussion, the Center is also concerned with training decision makers and promoting a dialogue among industry, government, interest groups and academics through its research and policy publications and through sponsored seminars, roundtables and forums. Our newsletter and issue briefs provide updates of Center activities and publications.*

**Risk Management Review is a publication of the Center for Risk Management and Decision Processes  
Wharton School, University of Pennsylvania**

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