

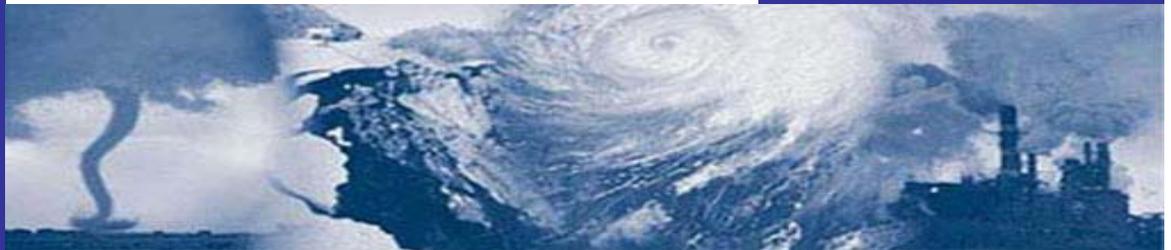
Risk Management REVIEW



RISK MANAGEMENT AND DECISION PROCESSES CENTER

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Roundtable on Enhancing Interdependent Global Supply Chain Effectiveness

As part of an ongoing research initiative with Lockheed Martin, the Wharton Risk Center and the Institute for Strategic Threat Analysis and Responses at the University of Pennsylvania (ISTAR) convened a Roundtable on November 3rd, 2006 aimed to bring together a diverse group of key decision-makers in charge of global supply chain effectiveness (logistics, customs, IT, finance) from several industries. Among these

organizations were ACE-INA, Benchmarking Partners, Council of Foreign Relations, Guardsmark, IBM, Lockheed Martin, Marsh, Navigant Consulting, and the Rand Corporation. Ideas, expertise and best practices were exchanged on three complementary aspects, each of which was the focus of a specific session:

Economic/Security Trade-off in Interdependent Global Supply Chain

A description of interdependent security was presented, specifically how investment (or non-investment) by one actor in the global supply chain can effect supply-chain-wide risks and benefits. A discussion followed on economic/security trade-offs and how supply chains overlap from one industry to another.

The Role of Information sharing: Challenges and Initiatives

Much has been said about the need for strategic information sharing to enhance security and competitiveness. The challenge remains: how to do it? The necessity of understanding what data quality and data integration issues arise in any information sharing platform was addressed. Studying how global information sharing, as well as the use of new technologies such as RFID and smart containers, can help companies to mitigate and manage operational risks and supply chain disruptions.

The Role of Insurance and Financing Institutions

As there is an obvious link between security and financial risk coverage, the community of national security and the world of insurance have a lot to benefit from interacting with each other. Quite surprisingly,



Roundtable organizers Erwann Michel-Kerjan, Howard Kunreuther and Harvey Rubin posing with James Lee Witt of Witt Associates (second from the left), former Director of FEMA.

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Guiding Principles for Mitigating and Insuring Losses from Natural Disasters

Co-Director's Corner



There has been a major change in the magnitude of the damages from natural disasters over the past ten years that is forcing society to rethink the role that the public and private sectors should play in reducing future losses and providing funds for recovery. A look at the data reveals that 10 of the 20 most costly natural disasters have occurred the past five years with all of them due to hurricanes, typhoons or tropical storms.

The four hurricanes in Florida in 2004 (Charley, Frances, Ivan and Jeanne) collectively totaled over \$29 billion in insured losses and Hurricane Katrina is estimated to have cost insurers and reinsurers between \$40-\$55 billion. At the same time victims have complained about receiving substantially less than the actual costs to repair or rebuild their damaged structures from these disasters. Many have turned to the Small Business Administration for low interest loans to repair their damaged property; however, a property owner is only eligible for a loan if he or she can show the financial ability to repay it. Hence low income residents will have to find other sources of disaster assistance.

We need a new approach to financing the costs of natural disasters and encouraging individuals in hazard prone areas to undertake mitigation measures. This is the principal focus of a major research project on "Insuring and Mitigating Risks of Large-scale Natural Disasters" in conjunction with

Georgia State University and the Insurance Information Institute:

To help guide the study the research team has formulated the following two principles---one which focuses on efficient resource allocation (Principle 1) and the other concerned with equity and distributional issues (Principle 2):

Principle 1: Risk-based Premiums

Insurance premiums, to the extent possible, should be based on risk.

Principle 2: Equity and Affordability Issues

Special treatment should be given to low and middle income people residing in hazard-prone areas who cannot afford risk-based premiums

Principle 1 is important because it provides a clear signal of relative damage to those currently residing in areas subject to natural disasters and those who are considering moving into these regions. Risk-based premiums also enable insurers to provide discounts to homeowners and businesses who invest in cost-effective mitigation measures. These discounts reflect the reduced claims should the property be exposed to a future natural disaster. If the premiums are highly subsidized, insurers have no economic incentive to offer these discounts. In fact, they prefer not to offer coverage to these property owners because it is a losing proposition in the long-run.

Principle 2 reflects a concern for residents in high-hazard areas who will be faced with large premium increases if insurers adhere to Principle 1. Today, in many Gulf Coast states premiums in regions subject to hurricane damage are highly subsidized due to rate regulations imposed by State Insurance Commissioners. The three leading modeling firms, AIR

Worldwide, EQECAT and Risk Management Solutions, each of whom provide estimate of the risks to property associated with natural disasters, have recently increased their estimates of the likelihood of future severe hurricane damage, in some cases by as much as 40 percent over 2005, due to a combination of climate change and increased development in coastal areas. If insurers are permitted to reflect these new estimates in the premiums they charge, homeowners residing in hurricane-prone areas will be paying considerably more for coverage than they are today.

To deal with the affordability issue some type of insurance vouchers should be provided by the state or federal government. The system could work as follows: A homeowner in a high hazard prone area would pay an insurance premium that reflects risk and then get reimbursed for a portion of the increased cost over last year as a function of his or her income. In this way insurance could reward individuals for undertaking risk reduction measures rather than preferring not to offer coverage in high hazard-prone areas.

In the coming months the research team will be interacting with key stakeholders to more fully appreciate the economic and political tensions in trying to satisfy both guiding principles. In this spirit we will be exploring a wide variety of policy options that involve the private and public sectors to varying degrees. We will be sharing the preliminary findings of our study on the Wharton Risk Center website in the early part of 2007 and welcome your inputs over the coming year.

Howard Kunreuther

Co-Director's Corner

Mitigation and Herd Behavior: Insights from the Wharton Behavioral Lab

Suppose an acquaintance has just moved to Los Angeles and is wondering whether or not to purchase earthquake insurance. What advice would you offer? While there is no one-size-fits-all answer, most would agree that there *is* a best way to calculate one: through objective cost-benefit analysis. If you were trained in decision analysis you would begin by asking your acquaintance a series of detailed questions such as what the probability is that his or her home will be affected by a quake in a given year, the home's value, and his or her attitudes toward risk. If the risk-adjusted expected monetary benefit of insurance exceeds its costs you would recommend that she purchase it. While such an analysis would be imperfect (your acquaintance, for example, may be unsure about hazard probabilities), it would presumably be superior to any intuitive approach to solving the problem.

Would your acquaintance actually follow such cost-benefit advice were you to give it? Research over the years that has studied how people make mitigation decisions suggest that there is a good chance that the answer will be "no"; the decision will more likely be made using a far more primitive heuristic, simply asking friends and neighbors whether they carry earthquake insurance. The more owning insurance is seen as a social norm, the more your acquaintance will be moved to acquire it—regardless of whether it is actuarially worthwhile or not. In many real-world settings social feedback thus trumps the insights provided by mathematical analysis.

But here is an odd wrinkle: while on the surface such behavior might seem ill-considered, homeowners who ignore private insights into a problem

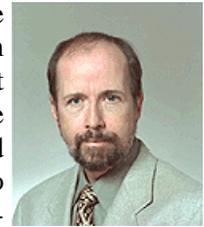
and simply follow the herd are behaving in exactly the manner that economists would say they *should* if they are rational. Specifically, in social judgment domains where private information is imperfect (e.g., one's cost-benefit analysis may be flawed), one will be better off, paradoxically, ignoring the private calculation and basing decision on the observable actions of others, *even though the basis of those decisions is unknown*.

The phenomena that lead to this result are known as *information cascades*, and are best understood through the following textbook example. Imagine that you and a group of colleagues have been invited to play a game whose objective is to guess whether an opaque urn contains a larger proportion of red or blue balls. One by one you and your colleagues are invited to come to the front of the room and take a single draw from the urn, privately observe its outcome (red or blue), then *publicly* announce a best guess about whether the urn contains more red or blue. This sequential process continues until everyone has made a guess, at which time the true proportion of red in the urn is revealed. Everyone who made a correct public prediction receives \$100, and those who make incorrect guesses receive nothing. To help you mentally calculate odds, at the start you are told that the urn contains either 2/3 red balls and 1/3 blue or the reverse—with both being equally likely.

What is the right way to make a guess in this task? Suppose you are first in line and draw a red ball. You do not need to be a statistician to realize that the best guess for the whole urn is "red", and that is what you would announce to the room—albeit with limited confidence. Now suppose that the person behind you in line also draws a red ball. Your public prediction makes

hers easier: because she can deduce from your announcement that you must have also drawn a red ball, she will also announce the prediction "red"—but with greater confidence. Continuing, imagine the third person in line privately observes a blue ball. What prediction should he announce? Because he can deduce from the two previous predictions that the first two draws must have been red, his best guess, of course, remains "red", even though he privately observed blue. This is a critical juncture in the game. Now things get interesting: supposed the fourth person in line again privately observes a blue ball. Unlike the first three, he can no longer uniquely deduce the private information each of the first viewed; he just knows that all three predicted red. As a result, he will also predict red, with all subsequent guessers following suit, *regardless of the true sample distribution of red and blue balls*. We thus have a potential paradox: each prediction is being made in a perfectly rational manner, but each guess may prove to be perfectly wrong.

A curious behavioral aspect of this phenomenon that arises when the game is played with real people is that players fail to appreciate the thin empirical basis on which herd predictions are made—people treat imitative predictions as if they were observational data. As a result, in cases where the group turns out to be wrong (for example, if it turned out in the above example that the urn, in fact, contained a majority of blue balls), the common reaction by players is that the game must have been rigged—



(Continued on page 4)

(“Meyer” Continued from page 3)

-they just find it hard to believe that so many people could be so wrong.

The analogy to our original problem of buying earthquake insurance should be clear. The fact that, say, everyone of your acquaintance’s neighbors carries earthquake insurance *is* information that should be rationally considered when making the purchase decision. The problem, however, is that as decision makers we have a tendency to overestimate its information value; the fact that everyone has earthquake insurance may simply be a consequence of herd behavior that has no original basis in a careful calculation of comparative costs and benefits.

Herd behavior in mitigation: laboratory evidence

Of course, a major factor that might temper erroneous herd behavior in real-world mitigation decisions is that the true effectiveness of decisions can, at least in principle, be observed when a hazard occurs. After a hurricane destroys houses on a beachfront, one is most likely to rebuild in the style of the home that best withstood the storm, not in the previously-most popular style.

To explore whether such feedback indeed tempers erroneous herd behavior, in cooperation with the Wharton Behavioral Labs we have recently been conducting a series of experiments that study the dynamics of group earthquake mitigation behavior. In these experiments small groups of 6-10 participants are invited to play a real-time simulation that tests their ability to make intuitively-correct cost-benefit decisions about investments in earthquake mitigation. In the simulation participants are endowed with an income stream and homes at different locations in a hypothetical country that is prone to periodic earthquakes. As the simulation progresses

they can use their income to purchase fixed improvements that potentially decrease their home’s vulnerability to earthquake damage. Each participant is continuously able to observe the mitigation decisions being made by others. At random times during the simulation earthquakes occur of different magnitudes, and participants are charged for any resulting damage, which is a function of the distance of their home to the epicenter, the strength of the quake, and the amount they have invested in mitigation.

The key manipulation in the experiments was the true effectiveness of the mitigation investments. At the start participants were told that experts were equally divided over whether investments were cost-effective, with there being a 50-50 chance that investments were dollar-for-dollar effective versus completely ineffective. The goal of the experiment was to see whether participants, playing in groups, would learn the optimal levels of investment (either 100% or 0%) over repeated plays of the simulation.

The answer was a decided “no”. Over repeated plays of the simulation there was no significant difference in average investment levels between communities where mitigation was truly cost-effective and those where it was not. There was, however, a significant community norm effect—rather than basing decisions on what they could privately observe about how different levels of investment were affecting earthquake losses, the best predictor of participants’ investment levels was the mean level of investment by the community. Social information was seen as trumping independent calculation.

These simulations, however, might be said to have one major weakness relative to the real world: in natural settings there will likely be expertise present in a population that, if followed, can lead herds in normatively-

correct directions. To test such effects we then ran a variation of our simulation in which we planted expertise in each community of players. This was done by giving one randomly-chosen participant in each group a private message that revealed whether mitigation investments were, in fact, cost effective or not. The other players in the community, however, were not informed which of their colleagues had the expertise; they only knew that one of them had full information.

Did planting expertise in the communities lead to optimal behavior? Sadly, in some cases it actually had the opposite effect. In cases where mitigation was ineffective planting expertise had the desired effect of gradually reducing mean-investment levels to the normatively-correct value of 0. The problem was that in cases where mitigation was effective we observed this same behavior: rather than investments increasing to 100% over time, they gradually reduced to zero.

Interviews with participants after the experiments provided a clear explanation for why this occurred—although it is not one that sounds particularly rational. As it turned out none of the players who were endowed with the knowledge that mitigation was effective initially acted on this knowledge in the normatively-correct manner. While they should have undertaken a 100% investment, most initially invested at much lower levels, preferring to save the money on the chance that they would not experience an earthquake, or that any quake they experienced would be minor. Other players, in turn, seeing that no one in their community

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More Lessons To Be Learned: BP's Texas City Refinery Accident

On March 23, 2005, a catastrophic accident occurred at the 'isomerization' unit of British Petroleum's (BP) Texas City refinery. The US Chemical Safety and Hazard Investigation Board (CSB) undertook investigation of this accident and early in the investigation noted that:

"The March 23 accident occurred during the startup of the refinery's octane-boosting isomerization (ISOM) unit, ...[when vented equipment was overfilled with highly flammable liquid hydrocarbons resulting in] ...a geyser-like release of highly flammable liquid and vapor onto the grounds of the refinery, causing a series of explosions and fires. Fatalities and injuries occurred in and around work trailers that were placed too near the ISOM unit and were not evacuated prior to the startup. Alarms and gauges that should have warned of the overfilling equipment failed to operate properly on the day of the accident."

On August 17, 2005, Carolyn Merritt, Chairman of the CSB announced that:

"The CSB recommends that BP immediately convene an Independent panel of experts to examine the BP's corporate management systems, safety culture and corporate oversight of its refineries. The panel should report its recommendations the BP workforce and the public.

In addition to examining safety culture, we expect the Panel to assess the effectiveness of specific management systems, such as mechanical integrity and near-miss investigation programs.

Part of the vision for this panel comes from the board that investigated the Columbia shuttle disaster, and from other panels that

have investigated major oil and chemical accidents overseas. These include the special panels that investigated the Piper Alpha platform disaster in the North Sea and the Esso Longford gas explosion in Australia"

BP accepted the CSB recommendation of convening an Independent Panel and announced on October 24 2005 that former U.S. Secretary of State James A. Baker III had agreed to chair a panel. The Panel will make a thorough independent assessment that focuses particularly on BP's oversight of the management of safety at the refineries it acquired through mergers and acquisitions and also the various aspects of BP's Corporate culture related to effective management of process safety.

Nature of the Texas City Accident:

Practitioners generally draw a distinction between 1) relatively frequent occupational injuries and illnesses caused by slips, falls, over-exposures, struck-by, etc occurrences which are collected by OSHA as Occupational Injuries and Incidents (OII) and 2) Low Probability-High Consequence (LP-HC) process accidents such as Bhopal, Longford, Toulouse, etc., which result in multiple injuries, illnesses and deaths caused by either explosions, fires or mass poisonings resulting from the unintentional releases of flammable substances, toxic chemicals, or energy.

There is substantial evidence of a lack of correlation between a firm's effective prevention of relatively frequent OII and the effective management of LP-HC process accidents and this lack of correlation has been reviewed and supported by recent Risk Center research (Rosenthal et al 2006 and Elliot et al 2006). The Texas City Refinery accident is another example of this lack of correlation: BP refiner-

ies had an OII rate that was better than the industry average.

The BP Panel report will be released on December 19th of this year and the final CSB accident report should be issued by Spring 2007. Both reports will be valuable and of interest in and of themselves and the author of this note believes that the accident itself as well as the CSB and Panel reports will result in BP creating and operating a more effective process safety management system. As the literature has shown such systems are the key to improved process safety.

Unfortunately, the literature also shows that maintaining an effective process safety management system over time is a very difficult task because on average the likelihood that any U.S. firm will experience any significant reportable process accident, much less a catastrophe of the magnitude that occurred at Texas City is about once in 30 to 40 years. Research has shown that businesses and people tend to focus attention and resources on proximate risks and discount and Low Probability-High Consequence events such as level 5 hurricanes or major process accidents unless they have experienced one relatively recently.

The Risk Center has wrestled with this public policy problem for some time and has put forth proposals for improving and maintaining the effectiveness of systems for managing LP-HC risks. Public discussion of the BP Texas accident after the Panel and CSB reports issue may bring these issues front and center once again.

Irv Rosenthal can be contacted at rosentha@wharton.upenn.edu for questions regarding the above citations and any comments.

2001-2006 : Terrorism Insurance Markets Five Years Later

Before September 2001—and despite terrorist attacks that occurred in the 1990s in several European countries, including Spain, France and the U.K., and the first attack on the World Trade Center in New York City in 1993—terrorism was effectively covered as an unnamed peril by standard all-risk commercial policies in the U.S. The 9/11 attacks, which inflicted \$35 billion in insured losses (at the time, this was the most costly catastrophe in the history of insurance, now the second after Hurricane Katrina) led here to the creation of a new market: terrorism risk insurance.

The Risk Center has done considerable work in this new risk financing area over the past few years. In addition to several published articles, book chapters and white papers, the report *TRIA and Beyond*, written last year with several of our Wharton colleagues, and in conjunction with a large number of organizations, remains an important source of information for anyone interested in this field.

We have continued working on national security and terrorism risk insurance in the past year and will do so in the coming months as TRIA is scheduled to sunset at the end of 2007. With growing interdependencies resulting from the globalization of economic activities, companies operating worldwide must also pay attention to how other countries in which they operate have addressed the question of terrorism loss coverage in order to determine their financial exposure here and abroad.

To address this concern, a Risk Center study undertaken with Burkhard Pedell (University of Stuttgart), and published this month in the *Journal of Applied Corporate Finance*, focuses on three major econo-

mies: the United States, the United Kingdom and Germany. To the best of our knowledge, this study is the first attempt to evaluate prices and take-up rates in other countries so as to be able to make comparisons.

What we have found might be somewhat puzzling for those who think the U.S. is the most likely target for terrorism. Using a sample of 1,623 Marsh clients for the U.S. market and the 1,153 contracts covered by the German monopolistic insurance company Extremus, we show major differences between the two countries. After taking into account differences in the size of the firms and in the definitions of insurance price, the price of comparable coverage in Germany appears to be at least 30%—and, by some estimates, as much as four times—higher than in the U.S. We also conclude that insurance prices in the U.K. are likely to be several times higher there than in the U.S. (based on the reinsurance prices of Pool Re today). Is it possible, five years after 9/11, that the U.S. market for terrorism insurance under TRIA is now drastically underpriced?

Our study also challenges the standard definition of “terrorism insurance price”: depending on whether one considers the ratio of premiums to total insured value (TIV) (which is today used in most studies) or the ratio of premium to limit (the real quantity of terrorism insurance purchased), results can vary widely. Indeed, a company can have a large total insured value of \$20 billion but cover only a small portion of its assets against terrorism (e.g., \$200 million). If that company pays \$200,000 in premium, what should be the right measure of price: \$200,000/\$20 billion or \$200,000/\$200 million? We provide a comparison of these two

measures for a large number of firms in the U.S. and Germany. Using TIV can grossly underestimate the true cost of terrorism risk coverage.

Where do we go from here? In the coming months, there will be a national debate as to whether TRIA should be renewed again and, if so, whether its coverage should be changed. When TRIA was renewed at the end of December 2005, Congress charged the President’s Working Group on Financial Markets (PWG) with issuing a report that would “analyze and report on terrorism risk coverage conditions *and solutions*.” Surprisingly, the PWG report published on September 30, 2006 does not address in any way what might be the key features of a long-term solution. Based on work during the past five years here and abroad on national security and financial protection against megaterrorism, I recommend that the new Congress or the White House study this question in much more detail and begin to search for real solutions.

A robust risk financing mechanism to protect the nation against the economic consequences of terrorism should not be viewed as an “insurance problem”. Rather it is a vital element of any policy to ensure national security and economic growth.

Feel free to contact me for any additional information at erwannmk@wharton.upenn.edu.

Erwann Michel-Kerjan



Near-Miss Project: Role of Human Behavior in Chemical Process Safety and Reliability – a Quantitative Approach

Recently, the Chemical Safety Board's report on BP's Texas refinery accident reminded us one more time the importance of recognition and resolution of weak signals for prevention of accidents. The Risk Center's Near-Miss project, which is focused on this very subject, started in 2000 and led to the development of an eight step near-miss system design. The foundation of the eight step system was the empirical data collected from various manufacturing sites of large chemical companies. More recently, through collaboration with Dr. Warren Seider and Anjana Meel of the Chemical Engineering Department of the University of Pennsylvania, a more quantitative study of chemical facility system reliability has been undertaken.

The methods for plant-wide, dynamic risk assessment have been developed to predict: (1) the frequencies of occurrence of abnormal events in plant units, (2) the propagation of abnormal events through their safety systems, and (3) their subsequent consequences utilizing accident precursor data, helping to achieve inherently safer operations. Furthermore, the National Response Center (for hazardous release reporting) (NRC) database is exploited to model the rate of occurrence of incidents and equipment and human failure probabilities in various chemical and petrochemical companies using Bayesian theory.

There is very little work in the literature that attempts to model the interaction between management, operator and the physical

system in a way to quantitatively assess the outcome of various scenarios, hence the impact of different management decisions. In 1996 Elizabeth Pate-Cornell developed a "System-Action-Management" framework as an analytical structure that expands quantitative risk analysis techniques to incorporate the effects of management and organizational factors on human action and error. Modifying her concept of hierarchical levels of system interactions, through inclusion of additional connections between different layers, a new model was developed to more accurately represent chemical plant environment.

This framework can then be used to model accident probabilities. Different scenarios were developed to demonstrate the model's effectiveness in identifying the impacts of various factors (such as training, maintenance problems, operator's (in)capabilities, control system failures) on accidents using hypothetical situations and what

are perceived to be "realistic" values for different parameters. The next improvement will include identifying closer correlations between the variables used in the model and industry practices.

Also, a Game Theoretic decision model has been developed for a given plant to determine the advantages and disadvantages of having a Near-miss Management System (NMMS) with different sophistication levels. The utility of this model has been demonstrated by assuming various scenarios for a plant environment and through calculation of the tradeoffs for "management" and "operator" components determining each one's preferred NMMS. Again, this study will be developed further by indexing to the industry practices.

For details on the Near-Miss project, contact Ulku Oktem at oktem@wharton.upenn.edu.

The Wharton Risk Management and Decision Processes Center announces the appointment of Dr. Erwann Michel-Kerjan as Managing Director of the Center.

Erwann has been with the Risk Center since Fall 2002, and has significantly contributed, through his research, to developing new Center activities in the field of economics of national security, protection of critical infrastructures and financing of extreme events (e.g., terrorism and natural disaster insurance). He has published many articles on these issues and two books, the new one (see page 8) now available in bookstores. Erwann brings an international perspective as well, which has helped reach a broader group of decision makers here and abroad.

As Managing Director, Erwann will oversee the day to day operations of the Risk Center. He will also be responsible for developing new areas of research and partnerships.

"Since its creation in 1984, the Center has undertaken pioneer research from which results are used extensively today by the business community and policymakers. Building on this 20-year history, I would like to see the Wharton Risk Center reinforcing its leading position by increasing our workforce to respond to the challenges posed by the new era of large-scale risks many companies and countries have entered," says Erwann Michel-Kerjan.

(“Meyer” continued from page 4)

had invested at a high level, reached the erroneous conclusion that the informed player—whoever he or she might be—must believe that mitigation is not effective. This, in turn, reduced their own levels of investment. And this reduction in community investment, paradoxically, served to strengthen the informed players’ willingness to gamble by not investing—causing even further reductions in investment over multiple plays. Once again, social information was seen as trumping objective.

Conclusions

In some ways, of course, these findings should be quite familiar to students of real-world mitigation behavior, where “friends and neighbors” effects have been observed for years. The value of the experiments is to show that these effects are far more powerful than may have previously been believed—implying that mitigation errors that arise from “group think” may be far more difficult to correct than one might hope. The reason, in part, is that herd behavior has a rational economic basis: in most settings the collective opinion of groups *is* the best predictor of what we should do as individuals. Where we err, however, is putting too much confidence in the precision of this predictor; we tend to confuse the size of the herd with the quality of the underlying evidence—a connection which need not exist at all.

Over the next several months we will be revisiting the herd problem through experiments designed to see what it takes to break-through the “group think” effect. The findings will be reported in later issues.

Robert Meyer

The Impacts of Third Party Certifiers on the Safety of the Food Supply

Economic Research Services (ERS) of the U. S. Department of Agriculture (USDA) and the Wharton Risk Center have signed a cooperative agreement to conduct a study of third party certification for the U. S. food supply. One of the big unknowns about the food supply chain is the impact that third party certifiers (TPCs)—firms specializing in third party certifications—are having on food safety. This project will begin filling this research void.

The project will be two pronged. The first will describe the market for certification and characterize what certification means. The second will be an empirical study that will show whether food safety is increased by third-party certification.

The first task will be accomplished through interviews with the certifiers and insurers. As the market for certification appears to be dominated by a small number of firms, a relatively small number of interviews should be sufficient for us to characterize the market for certification and the costs of certification.

The certifiers will be asked to describe the market for certification - what and how much. We’ll exam-

ine the consistency between the TPCs’ standards and how these standards differ from baseline Federal food safety standards and whether the TPC standards have changed over time. We’ll determine if all certifiers agree on the safety problems that deserve attention and on which products, if any, certifiers certify to different standards. We will ask the TPCs for their assessment of the extent of certification—the share of various markets that are certified. On the other side of the certification, we’ll ascertain how difficult it is for food suppliers and manufacturers to have products certified. Costs of certification incurred by food suppliers and manufacturers could include purchase of equipment, worker training, and ongoing product monitoring and testing. In addition, we will inquire about TPC vigilance: frequency of audits as well as the depth of information collection during audits. Additionally, we will ask certifiers to describe their clients. The limited evidence available to us suggests that only large firms are certified. Why is there no return for small firms? Is certification a fixed cost, so only large firms

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New Book on Protecting Critical Infrastructure

Seeds of Disaster, Roots of Response. How Private Action Can Reduce Public Vulnerability, co-edited by Erwann Michel-Kerjan of the Risk Center, along with Phillip Auerwald and Todd M. La Porte of George Mason University and Lewis Branscomb of Harvard’s Kennedy School of Government, was released by Cambridge University Press on September 11, 2006. More information is available online at www.seedsofdisaster.com.

The book shows the necessity of deeply rooted interaction between private and public institutions and the accountability and leadership that are required in order to go from words to action. One of the highlights of the book is an entire section on “Creating Markets” in which the U.S. terrorism insurance market is analyzed in detail.

Using Ecosystem Services to Reduce Disaster Losses

Communities in the upper and middle portions of the Charles River watershed in Massachusetts are protected from floods, not by levees and a dam, but by wetlands. In the 1970s, the U.S. Army Corps of Engineers opted to protect nature's natural floodwater storage system rather than undertake a structural approach to flood control (Chandler and Doyle 1978). Villages in India located behind coastal mangroves suffered less damage during the devastating December 2004 tsunami in the Indian Ocean than those on the coasts where mangroves had been destroyed (Danielsen, Sorensen, Olwig et al. 2005). The majority of drinking water consumed by residents of New York City is safe from pathogens, in part due to the protection of the Catskill and Delaware watersheds. The storm surge that hit New Orleans following Hurricane Katrina would likely have been smaller had not over 1 million acres (an area about 1.5 times the size of Rhode Island) of Louisiana's original coastal wetlands been lost (van Heerden 2005).

These cases exemplify the concept of "ecosystem services," or the benefits people receive from the environment. These benefits can include commodities, like timber and food, in addition to a broad array of services, such as pollination, water purification, and recreation. A subset of ecosystem services reduces the expected damages from certain natural disasters, either by lowering the probability of an event occurring, such as slope stabilization preventing landslides, or by reducing the impact when one does occur, such as the ability of wetlands to buffer storm surge. Risk managers and scholars have often failed to give serious attention to the possibility of using natural capital –

the environment – to help stem the rising losses from natural disasters. Yet many ecosystem services, such as flood mitigation, storm surge attenuation, water purification, slope stabilization, and carbon sequestration serve to reduce human vulnerability to a variety of hazards: floods, hurricanes, waterborne disease outbreaks, landslides, and climate change.

Adding provision of ecosystem services to the arsenal of policy approaches for bringing down disaster losses is prudent given that such an approach has the potential to be cost-effective, provide valuable co-benefits, and for some services, minimize the potential for human and technical error. Several policy experiments in providing ecosystem services are testament to this potential: investments in wetlands for flood control and watersheds for water purification have proven cost effective (Heal 1998; Appleton 2002; National Research Council 2005; Postel and B. H. Thompson 2005). The use of wetlands in Napa, CA and Reno, NV for flood control have shown that these restoration activities generate a wide range of co-benefits such as recreation, economic development, and habitat for wildlife. Finally, whether it is the failure of levees or the outbreak of *Cryptosporidium* in Milwaukee that was attributed to human error in operating a treatment plant (Edsall and Charlton 1997), it is clear that structural solutions to reduce risk are prone to human error in ways natural systems are not.

Most risk-reducing ecosystem services are public goods, whether at a local or regional scale, such as storm surge attenuation, or at a global scale, such as carbon sequestration. The level of these public goods is often determined by the land-use decisions of many private actors. Thus, there is reason to believe the amount of ecosystem services provided is suboptimal,

since provision of public goods is hindered by free-riding and individual landowners are not likely to consider the social costs of their actions. Furthermore, coordination across a landscape may be needed as "a single decision to drain and till a farm field, fill a wetland or build a parking lot has little measurable impact on flooding. But when combined with thousands of similar decisions over decades the impact can be devastating" (Faber 1996).

Three strategies for overcoming these challenges to providing ecosystem services present themselves. First, government could purchase critical land for providing ecosystem services and protect it. This was done along the Charles and Napa Rivers as mentioned earlier. Often, however, this is costly, politically infeasible, or full protection is not necessary as other land uses are compatible with the provision of ecosystem services. A second possibility is that government could regulate land-use. The Watershed Protection Act in Massachusetts, for example, regulates land use activities in critical areas of the watershed that supplies Boston with its drinking water. Regulation of this type is often politically impossible, however.

A third option that is receiving increased attention is the possibility for beneficiaries of ecosystem services to make payments to landowners for certain land-use activities that would increase the level of a particular ecosystem service (Wunder 2005). Termed PES (payments for ecosystem services), this approach could be used to incentivize particular actions that would reduce the expected damages from a natural disaster, such as maintaining forest cover on steep slopes. While the "buyer" or entity

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however, this interaction is not as much developed as one might expect. Challenges and business opportunities for the insurance industry in dealing with extreme events were presented. Discussion of the linkage of information sharing and its impact on risk reduction with specific incentive/reward financial mechanisms (lower insurance premiums, government subsidies for specific technologies, preferential treatment by customs and border control agents, and other financial benefits) followed.

The final segment of the Roundtable covered opportunities for collaborative Research. The networking that has started among the attendees, who rarely interact, will provide the basis for new joint projects that will address the formidable challenges we foresee in the Global Supply Chain for the years to come.

A highlight of the meeting was the luncheon talk by James Lee Witt, former Director of FEMA, who provided perspectives from the public sector in addressing Emergency Response from the Federal standpoint. Another highlight was the final panel with the discussion by Pedro Ramos, Managing Director of the City of Philadelphia, of the Emergency Preparedness Review Committee's work in the past 12 months to better prepare Philadelphia's response capabilities to deal with disasters. Eight primary strategic themes were created and over 50 recommendations to strengthen the program were developed by the Committee that was co-chaired by Mr. Ramos and the University of Pennsylvania's Istar Director Harvey Rubin. Included on the panel with Mr. Ramos were Steve Flynn from the Council of Foreign Relations and Bill Kinane of Guardsmark.

("Third Party Certifiers" continued from page 8)

can spread the cost across a large output?

From the interviews, we expect to characterize the drivers for changing standards (these could be competition among certifiers or catching up to new government standards or advances in technology).

The second task of this project will be to use existing USDA Food Safety and Inspection Services (FSIS) databases to determine if certification raises the safety of food products. Certification will be correlated with an indicator of safety (*Salmonella* levels). FSIS has conducted *Salmonella* tests for the meat and poultry slaughter and processing plants and, separately, has surveyed plants regarding their food safety practices. The data bases can be combined, allowing researchers to associate certification with *Salmonella* counts. The extent to which facility size, age, number of employees, value of sales, and number of regulatory inspected plants in the parent firm show different *Salmonella* counts will be part of the analysis as it is important to account for these factors.

This Co-op agreement furthers the relationship between ERS and the Risk Center that has included a jointly sponsored December 8, 2005 Roundtable on "Food Safety, Insurance, and Third-Party Certifiers." Fred Kuchler of ERS and Peter Schmeidler (pschmeid@wharton.upenn.edu) of the Risk Center will be heading the TPC project and would appreciate input from readers interested in this area.

("Using Ecosystem Services to Reduce Disaster Losses"

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making the payment could be the government – in a sense entering into a contract for private provision of a public good – it need not be. Vittel, the bottled water company, for instance, pays farmers near its source water to adopt certain land-use practices that preserve water quality (Déprés, Grolleau and Mzoughi 2005).

Another example of private payments for risk reducing ecosystem services comes from the Panama Canal. Deforestation in Panama has made the supply of water to the canal erratic, increased the amount of sediment clogging the channel, and also increased the runoff of nutrients stimulating blooms of weeds. Costly dredging is required to control these latter two problems. To finance reforestation, Forest Re, a forest insurance company, has proposed that insurance and reinsurance companies underwrite a bond to finance tree planting. Companies that currently hold insurance against the closure of the canal would buy the bond in exchange for a reduced premium (The Economist 2005).

Optimal strategies for providing ecosystem services are still being debated by social scientists and ecologists are still studying the exact processes by which some services are produced. Still, there is enough evidence from experience on the ground to suggest that academics and practitioners interested in minimizing disaster losses may want to consider ecosystem services as one more tool for mitigating damages or reducing the chance that a disaster does occur.

For questions regarding the above citations and any comments on this article, please contact Carolyn Kousky at carolyn_kousky@ksgphd.harvard.edu.

The Corporate Associates program is a vital part of the Risk Center's operation. Corporate Associates sit on the Center's Advisory Committee, participate in roundtable discussions and offer information and insight into the value, direction and timing of research projects.

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The Wharton Risk Center wishes to thank Elizabeth Miles for her years of service as Chair of our Advisory Committee. Even though you have retired as Chair, we look forward to having your continued input into our activities for many years to come. You did such a wonderful job that we are not going to replace you.



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Since its creation more than 20 years ago, the mission of the Wharton Risk Management and Decision Processes Center has been to carry out a program of basic and applied research to promote effective corporate and public policies for low-probability events with potentially catastrophic consequences. The Risk Center has focused on natural and technological hazards through the integration of risk assessment and risk perception with risk management strategies. After 9/11, research activities have extended to include national security issues (e.g., terrorism risk insurance, protection of critical infrastructure).

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