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## Climate Risk Management and Institutional Learning

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## Abstract

Insurance companies are a prominent mechanism for risk transfers. Many initiatives are looking toward private–public partnerships and new risk-management instruments to provide a cushion for climate change-related effects. For this aspiration to be fulfilled, insurers and institutions within which they operate need to learn about emergent risks and develop workable strategies. We explore three factors shaping the evolution of insurance practices: quantitative models of catastrophic loss, experience of catastrophic loss, and outcomes of litigated cases. We use the available evidence to assess the importance of each of these factors in how the industry is evolving and, hence, what actual risk reductions and transfers are more likely in the future.

**Key Words:** climate change, insurance, risk management, climate change litigation, insurance modeling and learning

**JEL Classification Numbers:** Q54, K23, G22

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# Climate Risk Management and Institutional Learning

Hadi Dowlatabadi and Christina Cook\*

## Introduction

The management of risk involves identification, characterization, and quantification of risk occurrence probability and consequences, as well as the development of strategies to reduce event probabilities or ameliorate adverse consequences once they have occurred. Concerns about global climate change date back to the 1970s and represent the risk-identification stage. The characterization and quantification of the risk of climate change has involved many bodies, the most prominent being the Intergovernmental Panel on Climate Change. The development of measures to mitigate the risk of climate change has been undertaken by the countries that are signatories to the United Nations Framework Convention on Climate Change (UNFCCC). Measures for risk management have been specified under article 4.8 of the UNFCCC and are the subject of increasing international attention as the magnitude of climate change effects and inadequacy of current mitigation efforts grow more evident.

Trends in extreme weather losses over the past three decades are unmistakable (Lott and Ross 2006), and while the debate over the relative roles of climate change and human factors in explaining them rages on (Changnon et al. 2000; Pielkea et al. 2005), there remains a need to manage these risks more effectively. In the two decades of debate since the clarion call of concern about climate change, advocates of climate mitigation have focused on climate-related losses, starting with Cline (1992) and now Stern (2006), while others have tried to develop the risk context as it is being modified by climate change (e.g., Casman and Dowlatabadi 2002; Pielke and Sarewitz 2002; Rieter et al. 2003). The former have identified myriad pathways by which climate change can affect underlying processes of natural and human activities. The latter have tried to identify and rank climate risks within the myriad risks facing natural and human-mediated systems. We have learned that systematic risk mitigation in general is rare and many

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currently unaddressed risks, including climate change-related risks, may be addressed effectively and with favorable results. For example, developments in flood-prone areas and spatial correlation of residential insurance underwriting are not being discouraged and building standards designed to limit wind damage are not being enforced. Therefore, the largest benefit of the new awareness of the risks from climate change may be the adoption of systematic risk management in arranging human activities, from supply chain logistics to urban planning. Although often ignored, this is an important ancillary benefit of the climate-change debate. The focus of this paper, however, is not risk management in general but the process of learning by which the insurance industry's risk management strategies are evolving with respect to climate change.

Insurance long has been used in risk management and now is recognized as a key element in public-private initiatives for spreading risks temporally, geographically, and among diverse social and commercial communities (Mills 2005). Many insurance initiatives are looking toward public-private partnerships and new risk-management instruments to provide a cushion for climate change-related effects (Mills et al. 2005). For such initiatives to be successful, insurers and institutions within which they operate need to learn about emergent risks and develop workable strategies. We propose that there are three main modes of learning that are shaping the evolution of insurance: quantitative models of catastrophic loss, experience of catastrophic loss, and outcomes of litigated cases. This paper is devoted to a description of the industry and these modes of learning.

In 2004, the global insurance industry had revenues in excess of US\$3 trillion, approximately 60 percent of which was in life insurance (Lorenzo and Lauff 2004).<sup>1</sup> The remaining 40 percent includes property, crop, business interruption, and liability insurance. Note that the unprecedented scale of insured losses due to Hurricane Katrina (US\$61 billion) is less than five percent of the premiums collected for the relevant insurance policies.

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<sup>1</sup> The pattern of underwriting varies across Europe, Asia, and North America.

## The Industry

An insurance company has two complimentary core businesses: asset management and insurance coverage.<sup>2</sup> Insurance companies are important to society because they provide underwriting services and indemnify insured losses. For insurance companies, insurance premiums are a source of capital that they can invest in profitable ventures. Even if insurance underwriting were to pay out as much as it collected, the insurer still would have held its clients' money for the duration of the contract at an interest rate determined through competition among insurance companies. This is a better deal than borrowing the capital directly. As a result, the rate of interest on capital is a driver of insurance companies seeking clients. Profit maximization leads to fewer high-risk underwritings when the cost of borrowing is low. On the other hand, when interest rates are high, the insurance industry likely will accept clients that would otherwise not be considered insurable. In response to significant correlated losses, feedbacks have emerged between the insurance industry and capital markets. First, rating agencies have put large insurers on notice for possible ratings downgrades (Mills et al. 2005). Second, to limit exposure to natural catastrophe risk, over the last decade insurers have begun the development of financial instruments to be sold into the capital markets (Catovsky 2005). Such financial instruments include catastrophe bonds and weather derivatives.

The insurance industry is considered an exemplar of the science of risk management involving large numbers of uncorrelated losses (e.g., life, car, fire). However, the relatively large losses sustained by national insurance companies due to geographically concentrated weather events in Florida and Mississippi hint at an industry that has yet to assess and manage successfully risks from correlated, catastrophic, and infrequent events. We think the challenge lies in how to develop accurate estimates of hazards and vulnerability when relying on sparse data stretching back into the distant past. In addition, risk assessment and management is compromised further by evolving land-use factors, including siting patterns, building technologies, occupancy patterns, and interdependencies.

## Event-based Learning

Humans long have been transferring and spreading risks. Early forms of insurance were developed nearly 4,000 years ago (Kunreuther 1998). Catastrophic events have been a major

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<sup>2</sup> In the United Kingdom, this is reflected explicitly in a unified regulatory structure, where the Financial Services Authority oversees all financial institutions from banks to insurance companies.

driver of insurance provision (e.g., the formation of fire service in Rome in AD 6 [Carlson 2005]), which remained largely a tool of private risk management until the mid-18<sup>th</sup> century, when private fire companies grew competitive and inefficient in coverage (Carlson 2005). Hence, a public approach to risk management emerged as fire services were municipalized (Carlson 2005). Today, the public fire service is augmented with private fire insurance in a hybrid management of the risk from fires. Public–private risk-sharing arrangements and insurer regulations are also the norm in property theft (private insurance and public policing) and auto-accident insurance (private insurance and public safety infrastructures and regulations). Theoretically, it is easy to show that correlated or concentrated underwritings are not a good idea. In practice, some insurers have failed to manage their underwritings accordingly, and recent extreme events have meted harsh lessons about the inadvisability of this practice. They also have highlighted the fact that some risks may be uninsurable by private institutions.<sup>3</sup>

Contrary to popular belief, it is not the magnitude of loss from extreme events that determines the performance and stability of insurance companies but the health of their assets. In August 1992, Hurricane Andrew had a dramatic effect on the insurance industry, causing US\$22 billion (in 2004 dollars) of insured damage. This payout drove 11 insurance providers to file for bankruptcy (Catovsky 2005). By contrast, although the insured losses from the 2005 hurricane season were nearly three times the losses from Andrew, exceeding US\$61 billion (in 2005 dollars), only one insurance firm was forced into insolvency. This outcome has been attributed to improved asset management not better assessment of risks from extreme weather. In 1992, industry assets were performing poorly, whereas in 2005, assets were highly profitable and largely unaffected by contemporaneous hurricanes.

Over the past half century, the share of insured losses has grown as the damage due to extreme weather events has increased. Hurricane Andrew was the first large-scale event to alert the industry to geographically correlated risks. However, responses, such as refusing to underwrite residential policies, were dampened by the regulatory strictures imposed by the state of Florida. The events of the 2004 and 2005 hurricane seasons were painful reminders of the risks of geographically correlated underwriting, as once again insurers suffered major losses. In May 2006, just weeks before the 2006 hurricane season, Allstate refused to renew coverage or issue new policies in 14 coastal counties of Texas, as well as in New York City, Long Island, and

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<sup>3</sup> An uninsurable asset is one that faces such a risk that the premiums needed to underwrite the risk are too costly for the owner of the asset (see Kunreuther 1998).

Westchester County in New York (Adams 2006). The company reasoned that their leadership position in homeowner underwriting had created too much correlated risk exposure on the East Coast of the United States. They also noted that the more northerly latitudes on the Atlantic coast were “due” for a large hurricane event—the last such disaster having been in 1938.

Other examples of event-based learning can be found in fire insurance (the Great London Fire of 1666) (Carlson 2005), earthquake coverage (the 1906 San Francisco earthquake and fire) (Guatterri et al. 2005), and flood-damage insurance (Hurricane Betsy in 1965 precipitated the development of the National Flood Insurance Program in the United States) (Federal Emergency Management Agency 2002).

### **Model-based Learning**

Probabilistic risk analysis has been a major part of the engineer’s toolkit for half a century. It was first adopted in insurance for estimation of risks from earthquakes (Cornell 1968). Weather-related risk-assessment modeling is more recent. Models that estimate the maximum storm on coastal areas and account for storm power decays after landfall (Kaplan and Demaria 1995) are used as inputs to deductible and premium calculations for property insurance in affected areas.

Increasingly, probabilistic models are being used to estimate the risks from extreme events. The state governments of Florida (for hurricanes) and California (for earthquakes) have developed a process of model approval and certification. Models are then used to set rates and structure the coverage (i.e., deductibles, caps, and premiums) offered to potential clients (Grossi et al. 2005).

An important part of any insurance contract is the “deductible” portion of the payout in the event of a loss. Frequent, smaller loss claims can accumulate into large sums over time. An important means of keeping insurance affordable, and underwriting less costly, is to structure the deductible and premium rate schedules to encourage clients to accept a high deductible to save insurers the costs associated with trivial claims. To that end, insurers have begun to mandate percentage deductibles rather than fixed-value deductibles (Mills et al. 2005). Models have been extremely helpful in generating damage probability surfaces for the quality of construction in building. As a result, rate structures have been refined and homeowners have begun to engage in mitigation, such as the installation of storm shutters.

Despite these advances, three factors have led to a relatively slow adoption of models in the rate-setting process. First, rates used to be based on claims from historic events and model-



based rate calculations have sought much higher insurance rates, which is not well received by state regulators, for whom affordability is a major concern. Second, the models have been successful in differentiating different risk groups and this too is not well received because it often identifies higher risk clients with lower incomes. As a result, regulators often impose pooling between different risk groups to make insurance more affordable (Wharton Risk Center 2007). Third, the models frequently are proprietary in nature and their probabilistic property loss curves exhibit a wide range of values, which compounds the issue of appropriate rate setting (Grossi 2005).

Further evidence of model-based learning is found in MetLife's decision, as part of their homeowner policy renewals, to demand home inspections and to insist that homeowners within five miles of saltwater invest in expensive impact mitigation measures before their policies are renewed.<sup>4</sup> To mitigate risk, the government should: a) limit development in coastal areas; b) specify building codes that minimize risk from flood and wind damage, and c) enforce these codes. In the absence of such measures, companies such as MetLife have taken it upon themselves to specify building codes and building inspection as a prerequisite for coverage in high-risk areas.

In Europe, the European Union and industry-funded efforts (e.g., MICE, PRUDENCE, and STARDEX) have provided a range of downscaled daily data for climate-change predictions at the local level (Robinet 2006). The heat wave of August 2003 took at least 14,000 lives in France. Given the Philadelphia and Chicago experiences in North America, this should have been an avoidable tragedy.<sup>5</sup>

Insurers are using the downscaled data (often extreme plausible data points) to elicit support from the European Union, national, and local governments for measures that will increase the coping capacity of cities in the event of future heat waves. The most successful mitigation measures for coping with heat waves rely on greater awareness of the conditions of the elderly, available transportation, prearranged relief stations, and higher local social capital.

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<sup>4</sup> In 1968, the U.S. federal government created the National Flood Insurance Program in response to increasing flood losses and disaster-relief costs, as well as a recognition that private insurance companies could not profitably provide such coverage at an affordable price, primarily because of the catastrophic nature of flooding and the inability to develop an actuarial rate structure that could reflect adequately the risk to which flooding properties were exposed (see FEMA 2002).

<sup>5</sup> See Pirard (2005).

These measures increase adaptive capacity and also confer benefits far exceeding their proximate goal of avoiding loss of life in future heat waves.

### Learning through Litigation

Insurance is provided through contracts in which the risks and conditions for payment are defined as clearly as possible. However, catastrophic weather events can wreak damage that is not easily attributable to a specific causal factor. This would not matter if insurance policies covered any and all risks. However, the notion of what risks are insurable has evolved through experience of large losses. Thus, hazards that are proven to be too risky for private insurance have devolved to public instruments (e.g., flood protection in the United States).

Extreme weather events may cause damages via a number of mechanisms, only a subset of which would be covered by the insurer. In such cases, the parties to an insurance contract often seek clarification from the courts. In May 2006, the U.S. District Court for the Southern District of Mississippi heard a case on this point arising out of damage caused by Hurricane Katrina on the Gulf Coast.<sup>6</sup> The court held that coverage available under the plaintiff's State Farm policy is restricted to damage caused by wind. Damage attributable to flooding is not covered by the policy.<sup>7</sup> This is in accordance with "the general rules that have governed claims for property damage caused by a hurricane" (Maniloff 2006). The court then called for fact finding by experts to determine whether wind or flooding caused the damage. Since it is likely that some of the damage was caused by both wind and flooding, the adjustment process will not be straightforward.

Most interestingly the court determined that: "To the extent that plaintiffs can prove their allegations that the hurricane winds (or objects driven by those winds) and rains entering the insured premises through openings caused by the hurricane winds proximately caused damage to their insured property, those losses will be covered under the policy, and *this will be the case even if flood damage, which is not covered, subsequently or simultaneously occurred.*"<sup>8</sup>

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<sup>6</sup> *John Tuepker and Claire Tuepker v. State Farm Fire and Casualty Company*. 2006, Case No. 1:05CV559-LTS-JMR.

<sup>7</sup> See note 4 above on flood insurance.

<sup>8</sup> *John Tuepker and Claire Tuepker v. State Farm Fire and Casualty Company*. 2006, Case No. 1:05CV559-LTS-JMR, emphasis added. For further discussion on the wind/water controversy see Wharton Risk Center (2007), chapter 3.

It has been noted that this determination is likely to be challenged by insurers as contrary to existing Mississippi law (Maniloff 2006). Regardless of the final outcome, this case highlights the challenges of determining the proximate cause of loss.<sup>9</sup> The problem of proximity, an area of confusion and disagreement in the law, is likely to loom large in all litigation arising from damage caused by climate change-related risks.<sup>10</sup>

Learning by litigation is not new: asbestos, tobacco, and breast implants are among the best known liability cases of the twentieth century. Climate change may represent the next frontier of liability litigation.<sup>11</sup> Several legal actions in the United States regarding climate change already have commenced. There have been public law actions aimed at the decisions or omissions of public bodies, such as *Friends of the Earth, Inc. v. Watson* (An action pursuant to the National Environmental Policy Act against the U.S. export credit agencies for funding fossil fuel projects, where the court denied the defendant's motion for summary judgment.) and *Massachusetts v. EPA* (An action by 12 U.S. states, several cities and many environmental nongovernmental organizations against the U.S. Environmental Protection Agency [EPA] for failure to regulate greenhouse gas emissions under the Clean Air Act. The U.S. Supreme Court ruled that the EPA does have the authority to regulate greenhouse gases). To date, civil law actions have included *Conn. v. Am. Elec. Power Co.* (The first civil action brought by eight U.S. states, New York City and nongovernmental organizations against the five biggest U.S. power companies, arguing that emissions from the defendants' power plants are a public nuisance, which was dismissed for lack of jurisdiction.) and *California v. General Motors* (An action brought by the attorney general of California in September 2006 seeking compensation for environmental damage caused by increased greenhouse gas levels from vehicles produced by the named auto companies, which are a public nuisance that costs California billions of dollars to fight pollution and erosion.).<sup>12</sup>

Although the plaintiffs in climate-change litigation have just begun to experience success, doubters should recall the trajectory of tobacco litigation. There were three major waves of tobacco litigation in the United States. Cases in the first wave (1954–1973) and second wave

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<sup>9</sup> An insurer will only cover damage that is shown to have been proximately caused by the risk insured against.

<sup>10</sup> Kunreuther and Michel-Kerjan (forthcoming) suggest this provides strong reasoning for comprehensive disaster insurance.

<sup>11</sup> For academic discussions of climate change litigation, see Healy et al. (2004) and Grossman (2003).

<sup>12</sup> Other aspects of the litigation are discussed in Kunreuther and Michel-Kerjan (forthcoming).

(1983–1993) floundered on the tobacco industry’s vigorous defense strategies, specifically that cigarettes are not harmful and smokers had assumed risks and were therefore negligent (Daynard 2001). Success in the third wave (1994–) of tobacco litigation has been attributed to several factors, including the decision by state attorneys general to take up the litigation, thus obviating the blameworthy defendant; the certification of class action suits, thus allowing nationwide consortiums of well-financed plaintiffs’ attorneys to combat the deep pockets of the tobacco industry; abundant evidence of industry wrong-doing (supplied by investigative reporters); and political pressures on the U.S. Food and Drug Administration, including the movement to regulate nicotine as a drug (Daynard 2001). If climate-change litigation follows a similar trajectory, we may be at the beginning of a wave of success.

In much of this paper we have focused on underwriting homeowner risks due to climate change. Of course, the industry also offers many other types of insurance coverage, including drought, crop, life, and business interruption, and director and officer liability. Director and officer liability insurance has been among the less defined forms of exposure. However, it may be one of the most potent weapons in the efforts of nongovernmental organizations to bring about a greater sense of urgency and action on climate change in large energy and utility companies (Mills 2005). The insurance industry was asked at a recent workshop about their preparation for this eventuality and whether modeling would be a useful approach to inform them of their potential exposure and any needed revision to the price and terms of coverage. A prominent insurance association representative said that the industry could only learn the true extent of its exposure for director and officer liability in a court case.<sup>13</sup> While this may be true in part, the authors believe that the industry’s reluctance to examine its exposure in this area demonstrates a lack of preparedness.

Mass tort litigation has become a major means of policymaking in the United States, often referred to as “regulation by litigation” (Viscusi 2002). Regulation by litigation has generated suits against entire industries for unforeseeable events and massive loss liabilities (Cummins 2002). Insurance is a risk-management tool that functions by transferring risk. Regulation by litigation can undermine contractual risk shifting and contribute “to chronic effects that undermine the optimal functioning of liability insurance markets” (Abraham 2002). At the point of sale, insurers increase premiums and deductibles, decrease policy limits, and add

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<sup>13</sup> Personal communication with author, May 8, 2006.

policy exclusions. At the point of claim, policyholders and courts often are able to shift the risk of unforeseen occurrences to insurers by reading into insurance contracts coverage that was never intended and for which no premium was collected (Cummins 2002). However, the fact that many mass tort litigations are settled out of court means that the terms of settlement often are private and cannot be used to estimate the true pace and cost of “learning” from litigation.

## Institutional Setting

The insurance industry operates within a complex social and institutional framework. Caught between profitable lines of actuarial risks and uncertain catastrophic risks, the industry is being forced to underwrite and cross-subsidize risk without full knowledge of the extent of exposure (e.g., the industry was forced to continue to provide residential coverage in Florida after Hurricane Andrew). Catastrophic events lead to institutional failures and opportunities to rewrite the rules of engagement affecting three aspects of risk management: 1) what is insurable in the private sector; 2) how much more risk mitigation will be carried out by public institutions; and 3) other provisions for covering privately uninsured or uninsurable losses. Integrated risk-assessment models can be used to develop a more systematic approach to this evolving picture, especially where both human factors defining exposure and the nature of hazards are evolving.

However, events, not models, have been leading the evolution of the industry. Over the past half century, major catastrophic events have led to a number of responses at various levels of government and industry:

- In some states, the industry has restricted coverage in some markets (e.g., Allstate in vulnerable regions) and has declined to renew policies it considers too risky (coastal areas that are at great risk for hurricane damage). In Florida, the state has usurped the private-sector role by forming a publicly funded insurance company of last resort, the Citizens Property Insurance Corporation of Florida.<sup>14</sup>

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<sup>14</sup> See Wharton Risk Center (2007), chapter 3. See also, [http://www.citizensfla.com/about/depoinfo.cfm?show=pdf&subject=faqs&link=/shared/depop/documents/DepopFAQ\\_Consumer022107.pdf](http://www.citizensfla.com/about/depoinfo.cfm?show=pdf&subject=faqs&link=/shared/depop/documents/DepopFAQ_Consumer022107.pdf) (accessed May 29, 2007), noting that: “The Florida Legislature created the state’s Depopulation program to reduce the number of property owners who have insurance coverage through Citizens Property Insurance Corporation, the insurer of last resort. Under the program, created by F.S. 627.351(6)(g)3.a, new or existing private insurance companies are encouraged to take on policies currently covered by Citizens. In this way, Citizens can transfer policies back to the private insurance market. This benefits all Floridians by preventing or reducing assessments charged to all property insurance consumers. Florida’s insurance market is made healthier by Depopulation as new or existing companies offer coverage for our state’s growing number of residents.”

- The industry has stipulated better building practices and investment in damage mitigation by the insured.
- The reinsurance industry has made reinsurance more expensive.
- State governments have mandated industry participation ( e.g., the Florida Property and Casualty Joint Underwriting Association [Gallagher 1993]).
- The federal government has become the insurer of last resort in some markets (e.g., the National Flood Insurance Program).
- The industry has developed financial instruments, such as catastrophe bonds, to share underwriting risks (Jeffee and Russell 1997; Catovsky 2005).

The current situation is far from ideal because the risks of continuing climate-sensitive activities, such as farming where there is an ever-increasing risk of drought or building where there is high risk of storms or inundation, are not internalized.

Appealing to market-based mechanisms will not solve this issue because markets will soon learn the extent of their exposure and either will seek assurances against catastrophic losses or refrain from supplying insurance. It often is suggested that the government as the insurer of last resort is the best placed to experience the internalized costs of risky activity. However, mitigation of risk through displacement of existing settlements frequently is unpopular (Priest 2003). Before the disaster, such interventions are perceived as unnecessary and heavy-handed, while after the disaster they are perceived as insensitive and callous (e.g., the furor over not rebuilding the lower Ninth Ward in New Orleans). Unfortunately, such challenges reflect the reality that some high-risk settlements are the only possibility for the lowest income groups in some regions where under-insurance is prevalent. This issue should not be solved through insurance subsidies but addressed head on if we hope to improve disaster management. This can be achieved through direct support for housing of lower-income groups in lower-risk settings. Otherwise, the status quo will lead to a regressive distribution of risks from natural disasters.

The industry attitude of “wait and see” on corporate, and specifically director and officer liability, may be changing. On September 21, 2006, Marsh Inc., Yale University, and Ceres announced a “collaborative effort to educate hundreds of independent corporate board members about the potential liabilities and strategic business opportunities global climate change can create for companies” (Modugno 2006). Although Marsh Inc. is an insurance broker rather than an insurer, this development, taken together with other recent actions by insurers noted above,

suggests that the insurance industry is no longer content to wait for government action on climate change.

In the aftermath of Hurricane Andrew in 1992, access to reinsurance was restricted, prompting insurers to develop further tools for risk transfer.<sup>15</sup> Over the last 10 years, insurance-linked securities, primarily in the form of catastrophe bonds, have been developed to access capital markets and further spread risks. In 2005, US\$5.7 billion of new insurance-linked securities were issued (Swiss Re 2007). Mid-year numbers in 2006 suggested continued strong growth in such instruments, but the small size of these markets indicates the market's willingness to explore their utility as opposed to having grown so comfortable with them as to adopt them broadly.

## Conclusion

So far, extreme event losses have dealt only a small blow to insurance industry coffers—less than 5 percent of their revenues. The evidence from rising exposures and new probabilistic models estimating risks quantitatively are growing in their influence on underwriting decisions. It is tempting to assume that this new knowledge is prompting the industry to offer better-informed terms for underwriting. It would be more accurate to say that the industry has learned that that some former underwritings are not insurable at rates that are acceptable to consumers. This eventually will lead to a renegotiation of risk management through coordination of private and public entities achieved in an atmosphere of cooperation.<sup>16</sup>

In countries where the insurance industry is well established,<sup>17</sup> climate concerns are forcing a careful reexamination of underwriting and risk-mitigation practices. The outcome will more clearly recognize the inadvisability of property development in hazardous areas, transfer some risks and burdens of mitigation to property owners, and engage the government and new instruments for provision of risk coverage. The recognition that many such risks are created by a lack of foresight will entail significant public benefits. In the interim, the costs of transition to a more enlightened pattern of land use is likely to fall on the shoulders of the poor, who cannot

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<sup>15</sup> See Lalonde 2005.

<sup>16</sup> Unattributable conversations with European and North American industry insiders suggest that the relationship in the United States is more contentious than in the European Union.

<sup>17</sup> Insurance is not available in most less developed countries, and the issue of how to reduce climate-change effects there is worthy of a separate discussion.

afford insurance, and the government, which effectively acts as an insurer of last resort while trying to find the right mix of policies to mitigate risks.



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