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Climate Risk Management & Institutional Learning

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Abstract

Insurance is a prominent mechanism for risk transfers. Many initiatives are looking towards private-public partnerships and new risk management instruments to provide a cushion for climate change related impacts. In order for this aspiration to be fulfilled, the 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 from the USA 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 USA for the forseeable future.

Keywords: Insurance; Climate Change

1 Introduction

The management of risk involves identification, characterisation and quantification of risk occurrence probability and consequences as well as the development of strategies to reduce event probabilities, and/or ameliorate their adverse consequences once they have occurred. Concerns about global climate change date back to the 70s and represent the risk identification stage. The characterisation and quantification of the risk of climate change has involved many bodies, the most prominent being the IPCC. Taking measures to reduce its probability of occurrence, that is, to mitigate the risk of climate change, has been the realm of COP negotiations. Measures for risk management have been specified under article 4.8 of the UNFCCC and the subject of increasing international attention as

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the magnitude of climate change impacts and inadequacy of current mitigation efforts grow more evident.

Trends in extreme weather losses over the past three decades is unmistakable (Lott & 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; Pielke 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 continuing with Stern (2006), while others have tried to develop the risk context as it is being modified by climate change (e.g., Pielke & Sarewitz, 2002; Reiter et al., 2003; Casman & Dowlatabadi, 2002). The former have identified myriad pathways by which climate change can impact 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 risks [including climate change related risks], currently unaddressed, may be addressed effectively and with favourable results. Therefore, perhaps, the largest benefit of the new awareness of 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. However, the focus of this paper 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 has long been used in risk management and is now recognised 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 towards public-private partnerships and new risk management instruments to provide a cushion for climate change related impacts (Mills et al., 2005). In order 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.

The global insurance industry in 2004 had revenues in excess of US$3 trillion, approximately 60% of which is in life insurance (Lorenzo & Lauff, 2004)[1]. The remaining 40% includes property, crop, business interruption and liability insurances. Note that the unprecedented scale of insured losses due to hurricane Katrina (US$61 billion) is less than 5% of the premiums collected for the relevant insurance policies.

[1]The pattern of underwriting varies across Europe, Asia and North America.

2 The industry

To the surprise of many, an insurance company has two complimentary core businesses: asset management and insurance coverage[2]. 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 they can invest in profitable ventures. For example, even if insurance underwriting were to pay out as much as it collected, the insurer would have held its clients' money for the duration of the contract at an interest rate determined through competition among insurance companies. This is certainly a better deal than borrowing the capital directly. Extending this argument further, it becomes clear that the rate of interest on capital is a driver of insurance companies seeking clients. When interest rates are low, higher risk clients are not courted. The potential loss from a higher risk client may make the underwriting less profitable than borrowing the money from the capital markets. On the other hand, when interest rates are high, the insurance industry will likely 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, insurers have begun 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 risks from correlated, catastrophic and infrequent events successfully. We think the challenge lies in how to develop accurate estimates of hazard and vulnerability, when relying on sparse data stretching back into a distant past. In addition to there being few prior events, risk assessment and management is further compromised by evolving land use factors including: siting patterns, building technologies, occupancy patterns and interdependencies.

3 Event based learning

Historically, catastrophic events have been the main driver of insurance provision. For example, a fire service was formed in Rome in AD 6 (Carlson, 2005). Private risk management contracts were exemplified by private fire companies but these grew competitive and inefficient in coverage. Hence a public approach to risk management emerged, as fire services were municipalised (Carlson, 2005). Today, the public fire service is augmented with private fire insurance in a hybrid

[2]In the UK this is explicitly reflected in a unified regulatory structure where the Financial Services Authority (FSA) oversees all financial institutions from banks to insurance companies.

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) auto accident insurance (private insurance and public safety infrastructures and regulations) and so on.

In parallel with the emergence of public-private risk management regimes we also have to consider concentrations of risk in space, category, time, etc. Here, the insurance providers have to balance the benefits of being steeped in understanding a risk, against the challenge of being exposed to a concentration of loss events in that area.

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 have also highlighted that some risks may be uninsurable by private institutions[3].

Contrary to popular expectation, it is not the magnitude of loss from extreme events that determines the performance and stability of insurance companies, but rather the health of their assets. In August 1992, Hurricane Andrew had a dramatic impact on the insurance industry causing US$$_{2004}$22 billion of insured damage. This payout drove eleven insurance providers to file for receivership (Catovsky, 2005). By contrast, although the insured losses in the wake of the 2005 hurricane season were nearly thrice the losses from Andrew, exceeding US$$_{2005}$61 billion, only one insurance firm was forced into insolvency. This more fortunate 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, as the damage due to extreme weather events has grown, so has the share of insured losses, and the 2004 and 2005 hurricane seasons finally persuaded the industry to pay attention to geographically correlated risks. 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 New York City, Long Island and 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 US east coast. 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 Fire of London of 1666: Carlson, 2005), earthquake coverage (the 1906 San Francisco Earthquake and Fire: Guatteri et al., 2005), and flood damage insurance (Hurricane Betsy, 1965, precipitating the development of the National Flood Insurance Program in the US: Federal Emergency Management Agency, 2002).

[3]An uninsurable asset is one that faces such risk that the premiums needed to underwrite the risk are too costly for the owner of the assett.

4 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 modelling is more recent. Models that estimate the maximum storm on coastal areas and account for storm power decays after landfall (Kaplan & 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., deductible, cap, and premium) offered to potential clients.

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 in order to encourage clients to accept a high deductible and save the insurer 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: (a) whereas rates used to be based on claims from historic events, model-based rate calculations have sought much higher insurance rates—this is not well received by state regulators for whom affordability is a major concern; (b) the models have been successful in differentiating different risk groups—this too is not well received because it often identifies higher risk clients with lower incomes, and the regulator often imposes pooling between different risk groups to make insurance more affordable; and (c) the models are frequently proprietary in nature and their probabilistic property loss curves exhibit a wide range of values—compounding the issue of appropriate rate setting (Grossi et al., 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 insist homeowners within five miles of salt water invest in expensive impact mitigation measures before they renew policies. To some, MetLifes's requirements may seem callous. However, in the absence of government leadership to modify building codes and limit development in coastal areas that are known to be at risk for natural catastrophes, action by insurers is to be welcomed. Insurance companies can help their clients understand the risk inherent in where they have chosen to live and how to mitigate such risk. Internalisation of a building code that is cognisant of the added risks inherent in building homes on the coast

should be part of municipal building codes, but in its absence the insurer is enforcing a code.

Additionally, the industry is using models to promote greater awareness of the potential risks. In Europe, the EU 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 fourteen thousand lives in France. The prior experience from heat-wave events and loss of life in the 80s and 90s in the US led to a number of intervention programs that have been saving lives in large urban centres. The failure to adopt similar measures in Europe is precisely the challenge of institutional learning that the authors assert will lead to far greater losses from climate change than if we assume lessons from one disaster will lead to a much broader adoption of superior risk management practices.

Insurers are using the downscaled data (often extreme plausible data points) to elicit support from the EU, 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 refugia and higher social capital locally. These measures increase adaptive capacity and confer benefits far exceeding their proximate goal of avoiding loss of life in future heat waves.

5 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.

Extreme weather events may cause damages via a number of mechanisms (or perils), only a subset of which would be covered by the insurer. In some cases, it can be difficult to attribute causation of damage to a particular peril, and parties to an insurance contract often seek clarification from the courts. A case directly on this point arose out of damage caused by Hurricane Katrina on the Gulf Coast (Tuepker v. State Farm Fire & Cas. Co., 2006 WL 1442489 (S.D. Miss)). The lower court (United States District Court for the Southern District of Mississippi) held that coverage available under the plaintiff's State Farm policy is restricted to damage caused by wind, and that damage attributable to flooding is not covered by the policy. This is in accordance with "the general rules that have governed claims for property damage caused by a hurricane" (Maniloff, 2006). At appeal, the US Court of Appeals for the Fifth Circuit clarified the state of insurance law in Mississippi (Tuepker v. State farm Fire & Cas. Co., 2007 WL 3256829 (5th Cir Nov. 6, 2007)). The Fifth Circuit court's

decision included a review the law relating to excluded perils, anti-concurrent causation clauses, and the application of the efficient proximate cause doctrine. The Fifth Circuit court found that the lower court correctly held that damage attributable to flooding, an excluded peril, was not covered. The lower court had found that the anti-concurrent clause in the Tuepker's State Farm Policy (the ACC clause) was "ambiguous and ineffective to exclude damage proximately caused by wind or rain." As such, under the efficient proximate cause doctrine (which is the default causation rule in Mississippi regarding damages caused concurrently by a covered and an excluded peril under an insurance policy) the lower court held that any losses suffered as a result of flood damage, the excluded peril, would be covered if the Tuepkers could prove the flood damage was proximate. The lower court stated 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.* (emphasis added)(Tuepker v. State Farm Fire & Cas. Co., 2006 WL 1442489 (S.D. Miss.))

The Fifth Circuit court found that the ACC clause is not ambiguous and clearly states that"indivisible damage caused by both excluded perils and covered perils or other causes is not covered." In other words, flood damage was not covered by the Tuepker's State Farm Policy. The court found that proximity was irrelevant in the face of a valid and enforceable ACC clause, which under Mississippi law, operates to circumvent the efficient proximate cause doctrine. Additionally, the Fifth Circuit court held that the Hurricane Deductible Endorsement only applies to the deductible and does not affect the policy's scope of coverage. Since the Tuepkers and State Farm had contractually agreed to settle the case without returning to the lower court, the learning from this case is limited. Nonetheless, the problems of proximity and, more generally, causation, are areas of confusion and disagreement in the law and are likely to loom large in all litigation arising from damage realised by climate change related risks. Courts will be called upon to clarify both insurance law and insurance contracts.

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 (For academic discussion of climate change litigation, see Healy & Tapick, 2004; Grossman, 2003). Several legal actions in the US in respect of climate change have already 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, 2005 U.S. Dist. LEXIS 42335 (an action pursuant to the National Environmental Policy Act against the US export credit agencies for funding fossil fuel projects, where the Court

denied the defendant's motion for summary judgment) and Massachusetts v. EPA, 126 S. Ct. 2960 (an action by twelve US states, several cities and many ENGOs against the EPA for failure to regulate GHG emissions under the Clean Air Act, the US Supreme Court granted certiorari and heard oral argument on 29 November 2006) and handed down its judgment on 2 April 2007, finding that greenhouse gases are pollutants under the Clean Air Act, that the EPA has the right to regulate them and that the EPA has restricted grounds on which it can decide not to regulate. To date, civil law actions have included Conn. v. Am. Elec. Power Co., 406 F. Supp. 2d 265 (the first civil action brought by eight US states, New York City and NGOs against the five biggest US power companies, arguing that emissions from the defendants power plants are a public nuisance was dismissed for lack of jurisdiction and failure to state a claim upon which relief could be granted (September 2005)) and California v. General Motors, 06–05755, U.S. District Court, Northern District of California (an action brought by the Attorney General of California in September 2006 seeking compensation for environmental damage caused by increased GHG levels from vehicles produced by the named auto companies that are a public nuisance that cost California billons of dollars to fight pollution and erosion).

While the plaintiffs in climate change litigation have had limited success to date, observers would do well to recall the trajectory of tobacco litigation. There were three major waves of tobacco litigation in the US. Cases in the first (1954–1973) and second (1983–1993) waves floundered on the tobacco industry's vigorous defence strategies, specifically, its firm stance that cigarettes are not harmful and smokers had assumed risks and were thus contributorily negligent (Daynard, 2001). Success in the third (1994–) wave of tobacco litigation has been attributed to several factors including the taking up of the litigation by state attorneys-general 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 FDA, including the movement to regulate nicotine as a drug (Daynard, 2001).

In much of this paper we have focussed on underwriting homeowner risks due to climate change. Of course, the industry also offers many other types of insurance coverage including drought, crop, life, 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 NGO efforts to bring about a greater sense of urgency and action in large energy and utilities companies (Mills et al., 2005). At a recent workshop, the insurance industry was asked about their preparation for this eventuality and whether modelling would be a useful approach to inform them of their potential exposure and hence needed revision to the price of and terms of coverage. A prominent insurance association representative responded that the industry would only learn the true extent of their exposure for director and officer liability in a court case. While this may be true in part, the authors believe that the industry's reluctance to examine its exposure in the area of

director and officer insurance demonstrates a lack of preparedness.

Mass tort litigation has become a major means of policy-making 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 policy exclusions. At the point of claim, policyholders and courts are often 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 are often private and cannot be used to estimate the true pace and cost of "learning" from litigation.

6 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. Catastrophic events lead to institutional failures and opportunities to rewrite the rules of engagement affecting three aspects of risk management: (a) what is insurable in the private sector; (b) how much more risk mitigation will be carried out by public institutions; and (c) other provisions for covering privately uninsured/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.

Alas, 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:

1. The industry has restricted coverage in some markets (e.g. in the US, flood insurance, since 1968) and declined to renew policies it considers too risky (coastal areas that are at great risk for hurricane damage).
2. The industry has stipulated better building practices and investment in damage mitigation by the insured.
3. The re-insurance industry has made reinsurance more expensive.
4. The state has mandated industry participation—e.g., the Florida Property and Casualty Joint Underwriting Association (Gallagher, 1993).
5. The state has formed a publicly funded insurance company of last resort—e.g., the Citizens Property Insurance Corp in Florida.

6. The federal government has become the insurer of last resort in some markets—e.g., the National Flood Insurance Program.

7. The industry has developed financial instruments such as catastrophe bonds to share underwriting risks (Jeffee & Russell, 1997; Catovsky, 2005).

The current situation is far from ideal because the risks of continuing climate sensitive activities—e.g., farming where there is an ever increasing risk of drought, or building where there is high risk of storms or inundation—are not yet internalised.

Appealing to market-based mechanisms will not solve this issue, because markets will soon learn the extent of their exposure and will either seek assurances against catastrophic losses or refrain from supplying insurance.

It is often suggested that the government, as the insurer of last resort, is the best placed to experience internalised costs of risky activity. However, mitigation of risk through displacement of existing settlements is always unpopular (Priest, 2003). Before the disaster, such interventions are perceived as unnecessary and being heavy-handed while after the disaster they are insensitive and callous (e.g., the furore over not rebuilding the lower Ninth Ward in New Orleans). Unfortunately, such challenges reflect the reality of some higher risk settlements being the only possibility for the lowest income groups in some regions. Such development characteristics lead to a regressive distribution of risks from natural disasters: the lower income neighbourhoods are also most likely to be under-insured. So, while addressing such socio-political concerns is difficult, it is a matter than needs to be addressed head-on if we hope to improve disaster management.

The industry attitude of "wait and see" on corporate and, specifically, director and officer liability, may already 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 *per se*, this development, taken together with the 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. Over the last ten years, insurance-linked securities, primarily in the form of catastrophe bonds, have been developed to access capital markets and further spread risks. In 2005, USD 5.7 billion of new insurance-linked securities were issued. Mid-year numbers in 2006 suggested continued strong growth in such instruments, but the small size of these markets should indicate the market's willingness to explore their utility as opposed to having grown so comfortable as to adopt them broadly.

7 Conclusions

So far, extreme event losses have only dealt a small blow to insurance industry coffers (less than 5% of their revenues). The evidence from rising exposures and new probabilistic models estimating the risks quantitatively are growing in their influence over 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 will eventually lead to a renegotiation of risk management through a coordination of private and public entities—best achieved in an atmosphere of cooperation.

In countries where the insurance industry is well established, climate concerns are forcing a careful re-examination of underwriting and risk mitigation practices. The outcome will more clearly recognise the inadvisability of property developments 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 our own 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 afford insurance, and on the government which effectively acts as an insurer of last resort while fumbling to find the right mix of policies to mitigate risks.

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